# **CITY OF AKRON**

# DEPARTMENT OF PUBLIC SERVICE

## **AKRON ENGINEERING BUREAU**

CONSTRUCTION AND MATERIAL SPECIFICATIONS



# **2008 EDITION**

## AN EQUAL OPPORTUNITY EMPLOYER

No.\_\_\_\_\_

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### Construction & Material Specifications 2008 Edition Index of Revisions

- 102.01 Revised first paragraph of section.
- 104.05 Revised  $2^{nd}$ . paragraph to clarify the salvaging of iron castings.
- 107.02 Revised Permits, Licenses and Taxes section.
- 107.17 Added a heading name to the section.
- 108.07 Revised Liquidated Damage amounts.
- 109.04 Revised the Extra and Force Account section.
- 201.05 Revised Tree Removal measurement procedure.
- 201.06 Added Trees Removed to Basis of Payment section.
- 203.13(c) Revised section regarding use of slag for Aggregate Type 2
- 203.16 Removed Linear Grading item.
- 251.03 Revised 1<sup>st</sup>. and 11<sup>th</sup>. Paragraphs of Excavation section.
- 251.10 Revised  $2^{nd}$ . paragraph of Anchorages section.
- 252.02 Revised 3<sup>rd</sup>. paragraph of Excavation section.
- Added sentence to end of first paragraph.
- 260.03 Revised 2<sup>nd</sup>. paragraph of Installation section.
- Added sentence in first paragraph.
- 404 Removed the Asphalt Concrete item.
- 448 Added pay item for Asphalt Driveway Reconstruction.
- 451.06 Added 5<sup>th</sup> paragraph to Placing Concrete section.
- 454 Revised Temporary Concrete Barrier to Portable Concrete Barrier.
- 455.06 Added 4" Rolled Curb and Gutter to Basis of Payment section.
- 460 Revised Brick Walk item.

- 461.02 Revised Materials section.
- 461.05 Revised Basis of Payment section.
- 499.03 Added ODOT Table 499.03-3
- 511.07 Revised the  $2^{nd}$  paragraph of the Slump section.
- 511.08 Replaced section with ODOT 511.10 for Placing Concrete.
- 511.18 Added section for ODOT Class HP Concrete Testing
- 511.20 Added new pay item for ODOT Class HP Concrete Testing
- 512 Replaced entire section with ODOT 512 Treating Concrete.
- 524.07 Revised Basis of Payment section.
- 551.07 Added reference to 602 for masonry bulkheads in the 7<sup>th</sup>. paragraph.
- 551.12 Revised specifications for low pressure air test.
- 553.02 Revised Materials section.
- 556.04 Added paragraph regarding lawn restoration for house drain work.
- 563.03 Added a 5<sup>th</sup> paragraph to include connection of underdrains.
- 564.03 Added sentence regarding the cost of underdrain connection to inlet.
- 602.05 Revised Basis of Payment section to include epoxy coated steel.
- 607.03 Revised Clearing and Grading section.
- 614.05 Added pay item for Portable Changeable Message Sign
- 621 Added specification for Plastic Parking Stops
- 621.15 Added standard colors for parking stall markings.
- 632 Removed sections 632.12 and 632.13.
- 633.06 Revised Testing and Prequalification section.
- 650.01 Revised certification.
- 651-669 Added Certification section to all landscaping items, other minor revisions.

- 653.08 Added Cubic Yards as a Basis of Payment.
- 671 Revised entire section for Play Equipment and Materials
- 672 Revised entire section for Park Equipment and Materials
- 673 Revised entire section for Sports Equipment and Materials
- 675 Removed Swing Seat item.
- 702 Replaced entire section with ODOT 702
- 707.20 Revised  $2^{nd}$ . paragraph of section.
- 711.12 Added AASHTO reference.
- 711.13 Added AASHTO reference.
- 711.22 Removed section.
- 715.03 Replaced 6<sup>th</sup> paragraph of section.
- 715.16 Inserted new paragraph after first paragraph of section.
- 715.22 Revised 4<sup>th</sup> sentence of section.
- 731.06 Removed reference to electromechanical sign flasher controllers.

### **100 GENERAL PROVISIONS**

### **101 DEFINITIONS AND TERMS**

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

**101.01 Abbreviations**. Whenever the following abbreviations are used in these specifications or other contract documents they are to be regarded as if fully written out as follows:

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and
	Transportation Officials
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
EEI	Edison Electrical Institute
FHWA	Federal Highway Administration, Department of Transportation
FSS	Federal Specifications and Standards, General
	Services Administration
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Association
ITE	Institute of Transportation Engineers
JMF	Job Mix Formula
NEMA	National Electric Manufacturers Association
NSPE	National Society of Professional Engineers
ODOT	Ohio Department of Transportation
ORC	Ohio Revised Code
OSHA	Occupational Safety Health Administration
PE	Professional Engineer (Licensed to practice in Ohio)
PS	Professional Surveyor (Licensed to practice in Ohio)
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratories, Inc.

**101.02** Advertisement (Legal Notice). The public announcement as required by law, inviting bids for Work to be performed or materials to be furnished.

**101.03 Bidder**. An individual, firm or corporation submitting a bid for the advertised Work or materials furnished, acting directly or through a duly authorized representative.

**101.04 Board of Control**. As established by the City Charter a board consisting of the Mayor, the Directors of Law, Finance and Public Service and the President of Council and the Chairman of the Finance Committee of Council with the Director of Public Service as the Chairman thereof.

101.05 Bureau. The Akron Engineering Bureau of the City of Akron.

101.06 Calendar Day or Day. Every day shown on the Calendar.

**101.07** City. The City of Akron, Ohio acting through its Director of Public Service and his authorized agents, such agents acting severally within the scope of the particular duties assigned them.

**101.08** Certified Test Data. A test report from a manufacturer's laboratory or independent laboratory listing test data covering the specified requirements for the samples tested and a statement by a person having legal authority to act for the manufacturer and/or supplier for the material that the test report furnished truly represents the material delivered for incorporation into, or use on, the project. The certifications shall include the Laboratory Report Number and the project name to which the material is delivered. Only laboratory Reports signed by a Registered Professional Engineer will be accepted for this purpose.

**101.09 Contract.** The written agreement between the City of Akron and the Contractor setting forth the obligations of the parties thereunder including, but not limited to, the performance of the Work, the furnishing of labor and materials, and the basis of payment. The contract includes, but is not limited to, the invitation for bids, proposal, contract form and required bonds, specifications, supplemental specifications, special provisions, general and detailed plans, notice to Contractor, and supplemental agreements that are required to complete the construction of the project in an acceptable manner including authorized extensions thereof, all of which constitute one instrument.

**101.10 Contract Performance Bond**. The approved forms of security, executed by the Contractor and/or his Sureties, guaranteeing complete execution of the contract as defined in 101.09 and the payment of all legal debts pertaining to the construction of the project.

**101.11 Contract Item (Pay Item)**. A specifically described unit of work for which a price is bid and paid for as provided in the contract.

**101.12** Contractor. The individual, firm or corporation (known as the party of the second part) contracting with the City of Akron for performance of prescribed Work acting directly or through a duly authorized representative.

**101.13 Engineer.** The City Engineer, Engineering Construction Manager, or other Engineers acting as authorized agents or assistants.

**101.14 Equipment**. All machines, tools and apparatus, together with the necessary supplies for upkeep and maintenance, required for the proper construction and acceptable completion of the Work.

**101.15 Extra Work**. An item of work not provided for in the contract as awarded, but found essential to the satisfactory completion of the contract within its intended scope.

**101.16 Laboratory**. The testing laboratory of the Akron Engineering Bureau, or other testing laboratories authorized by the City of Akron.

**101.17** Materials or Products. Any substance or substances, or the parts, goods, stock, or the like specified or contemplated for use in the construction of the project and its appurtenances.

**101.18 Plans**. The drawings, including but not limited to profiles, cross sections, working drawings and supplemental drawings, approved by the Service Director, or exact reproductions thereof, which show the location, character, dimensions, and details of the Work.

**101.19 Project**. The specific location together with all appurtenances and construction to be performed thereon under the contract.

**101.20 Proposal.** The offer of a bidder on the prescribed form, properly filled out, signed and guaranteed, to perform the Work and to furnish the labor and materials at the price quoted.

**101.21 Proposal Form.** The approved form on which the City of Akron requires bids to be prepared and submitted to do the Work.

**101.22 Proposal Guarantee**. The security furnished with a bid as a guarantee that the bidder will enter into the contract if his bid is accepted.

**101.23 Resident Project Representative**. The authorized representative of the Engineer assigned to make detailed inspections of contract performance.

**101.24 Right-of-Way**. A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a street, highway or utility.

**101.25** Service Director. The duly appointed Director of Public Service of the City of Akron, Ohio, or his properly authorized agents, to the extent of the powers vested in them.

**101.26 Special Provisions.** Additions and/or revisions to the standard and supplemental specifications covering conditions or procedures peculiar to an individual project.

**101.27 Specifications**. The directions, provisions and requirements contained herein as supplemented by the supplemental specifications and special provisions.

**101.28** Structures. Bridges, culverts, catch basins, inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other features which may be encountered in the Work and not otherwise classed herein.

**101.29 Subcontractor**. An individual, firm or corporation who assumes any part of the Contractor's undertaking to carry on and complete the Work under agreement with the Contractor, who prior to such an undertaking receives the written consent of the Service Director. This does not include those who merely furnish materials.

**101.30 Substructure**. All that part of the structure below the bearing seats of simple spans, truss, through girder and continuous spans, skewbacks of arches and tops of footings or rigid frames together with backwall, wing walls and slope protection.

**101.31** Superintendent. The Contractor's authorized representative present on the project and in responsible charge of the Work.

**101.32** Superstructure. The entire structure except the substructure.

**101.33** Supplemental Agreement. A written agreement executed by the Contractor and the Service Director and approved by the Board of Control and cabinet members as required, specifying necessary alterations in the contract.

**101.34 Supplemental Specifications**. Detailed specifications supplemental to or superseding these specifications.

**101.35** Surety. The corporation, firm or individual, other than the Contractor, executing a bond furnished by the Contractor.

**101.36** Titles (or Headings). The titles or headings of the sections or sub-sections herein are intended for convenience of reference only and shall not be considered as having any bearing on their interpretation.

**101.37** The Work. The Work consists of all elements of the project as described by the Contract and Supplemental Agreements thereto.

**101.38** Working Drawings. Stress sheets, shop drawings, erection plans, falsework plans, frame work plans, cofferdam plans, bending diagrams for reinforcing steel, traffic detour plans, or any other supplementary plans or similar data which the Contractor is required to submit for approval.

**101.39 Interpretations.** In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done if, as, or, when or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, sufficient, insufficient, rejected, or condemned," it shall be understood as if the expression were followed by the words "by the Engineer" or "to the Engineer."

#### **102 BIDDING REQUIREMENTS AND CONDITIONS**

**102.01 Contents of Proposal Form**. Upon request, and payment in the amount specified in the advertisement, copies of the Proposal Form, Contract Documents, Specifications and Plans may be obtained from the City of Akron at the location listed in the advertisement. The proposal will state the location and description of the contemplated construction and will contain the estimate of the various quantities and kinds of work to be performed and/or materials to be furnished, and will have a schedule of items for which unit price bids are invited. The proposal will state the time allowed for completion of the project, the amount of the proposal guarantee, and the date, time and place of the opening of proposals. The form will also include any special provisions or requirements that vary from or are not contained in the plans and specifications.

Other documents contained in the proposal include, but are not limited to, Wages and Payrolls, Notice to Contractors, Equal Employment Opportunity, Non-Collusion Affidavit and Resources and Experience of Bidders.

The plans and specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

**102.02 Issuance of Proposals**. The City of Akron reserves the right to disqualify or refuse to consider a proposal if a bidder is in default for any of the following reasons:

(a) Lack of competency and adequate machinery, plant and other equipment as revealed by the Resources and Experience forms.

- (b) Uncompleted work which, in the judgment of the Engineer, might hinder or prevent the prompt completion of additional work if awarded.
- (c) Failure to comply with any qualification regulation of the City.
- (d) Forfeiture of previous Bid Bond.
- (e) Default under previous contract.
- (f) Failure to comply with Equal Employment Opportunity, Minority Business Enterprise, Prevailing Wages Provisions or other such requirements in a previous contract or contracts.

**102.03** Interpretation of Quantities in Proposal. The quantities in the proposal are approximate only and are prepared for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished and accepted in accordance with the contract except for lump sum contracts, and except for lump sum items in unit price contracts. The scheduled quantities of work to be done and materials to be furnished may each be increased, decreased or deleted as hereinafter provided.

**102.04** Examination of Plans, Specifications, Special Provisions and Site of Work. The bidder is expected to examine carefully the site of the proposed Work, the proposal, plans and specifications, supplemental specifications, special provisions, and contract forms before submitting a proposal. The submission of a bid shall be considered evidence that the bidder has made such examinations and is satisfied as to the conditions to be encountered in performing the Work and as to the requirements of the plans, specifications, supplemental specifications, special provisions, contract and other related documents. When a prospective bidder is in doubt as to the true meaning of any item contained in the plans, specifications or other contract documents, he may submit to the Engineer a written request for interpretation of same. Any such interpretation will be made an Addendum and a copy shall be mailed or delivered to each person in receipt of a set of bid documents. The City will not be responsible for any other interpretation of the item in question.

**102.05 Preparation of Proposal**. The Bidder shall submit his proposal upon the forms furnished by the City. A unit price for each item shall be printed in the column provided. The products of the respective unit prices and quantities shall be written in figures in the column provided for that purpose and the total amount of the proposal obtained by adding the amounts of the several items. If there is a discrepancy between the unit bid prices and extensions thereof, see 103.01. All the figures shall be in ink or typed. Any erasures, corrections or alterations shall be initialed and dated by the Bidder.

When an item in the proposal contains a choice to be designated by the Bidder, the Bidder shall indicate his choice in accordance with the specifications for that particular item, and thereafter no further choice will be permitted.

The proposal shall include two copies of Bidder Employment Practices Reports properly filled out and signed.

The proposal shall include a properly executed Non-Collusion Affidavit.

The Bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation, or by an agent of the Bidder legally qualified to do so. If the proposal is made by an individual, his name and business address must be shown; by a partnership, the name and business address of each partnership member must be shown; as a joint venture, the name and business address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the state under the laws of which the corporation is chartered and the name and title of the officer or officers having authority under the bylaws to sign contracts, the name of the corporation and the business address of its corporate officials must be shown.

Anyone signing a proposal as an agent must file with it legal evidence of his authority to do so.

**102.06 Irregular Proposals**. Proposals will be considered irregular and may be rejected for the following reasons:

- (a) If the proposal is on a form other than that furnished by the City; or if the form is altered.
- (b) If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.
- (c) If the Bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award. This does not exclude a bid limiting the maximum gross amount of awards acceptable to any one Bidder at any one bid opening, provided that any selection of awards will be made by the City of Akron.
- (d) If the proposal does not contain a unit price for each pay item listed, except in the case of authorized alternate pay items or lump sum items.
- (e) If the proposal does not contain all information required of the bidder.
- (f) If the price proposal contains a bid price which is determined to be unbalanced and not in the best interest of the City.

**102.07 Proposal Guarantee**. No Proposal over \$25,000.00 will be considered unless accompanied by a guarantee of the type and in an amount not less than the amount indicated in the proposal form made payable to the City of Akron, Ohio. Proposals of \$25,000.00 or less need not be accompanied by a guarantee.

**102.08 Delivery of Proposals**. The proposals for each project shall be placed, together with the proposal guarantee, in a separate sealed envelope marked so as to indicate the identity of the project and the name and address of the bidder. Proposals will be received at the location specified in the proposal until the time and date set for the opening thereof and must be in the hands of the Engineer by such time. Proposals received after the time for opening of bids will be returned to the bidder unopened. If City offices are closed on the scheduled bid opening date due to unforeseen conditions, bids will be received and opened the next regular business day at the location and time noted on the Proposal.

**102.09** Withdrawal of Proposals. A bidder may withdraw his proposal, provided the request in writing is in the hands of the Engineer before the time set for opening of the proposals. When such proposal is reached, at the time of opening the bids, it will be returned to the bidder unopened.

**102.10** Combination or Conditional Proposals. If the Engineer so elects, proposals may be requested for projects in combination and/or separately, so that bids may be submitted either on the combination or on separate units of the combination. The City reserves the right to make awards on combination bids or separate bids to the best advantage of the City. No combination bids, other than those specifically set up on the proposals by the Engineer, will be considered. Separate contracts will be awarded for each individual project included in the combination.

**102.11 Combined or Separate Proposals**. If the Engineer so elects, bids for a project may be requested in a single proposal containing all of the items of work, or separate bids may be requested for each group of related items of work on a single project.

**102.12** Public Opening of Proposals. Proposals will be opened and read publicly at the time and place designated by the Engineer. Bidders, their authorized agents, and all other interested parties are invited to be present.

**102.13 Disqualification of Bidders**. Any of the following reasons may be considered as being sufficient for the disqualification of the bidder and the rejection of his proposal or proposals:

- (a) More than one proposal for the same Work from an individual, firm, or corporation under the same or different name.
- (b) Evidence of collusion among bidders. Participants in such collusion will receive no recognition as bidders for any future Work of the City of Akron for a period of three years or as determined by the Service Director.

**102.14 Material Guarantee**. Before any contract is awarded, the bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the Work

together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the Work.

#### **103 AWARD AND EXECUTION OF CONTRACT**

**103.01** Consideration of Proposals. The lowest bid will be determined by comparing the total amount of the proposal, excluding alternates, as specified in 102.05. Proposals will be compared on the basis of the summation of the products of the estimated quantities shown in the proposal and the unit bid prices. If there is a discrepancy between unit bid prices and extensions thereof, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if it is in the best interest of the City.

**103.02** Award of Contract. The award of contract, if it be awarded, will be made as soon as it is reasonably possible after the opening of proposals to the lowest and best bidder whose proposal complies with all the requirements prescribed. In no case will an award be made until all necessary investigations are made as to the responsibility of the bidder to whom it is proposed to award the contract. The successful bidder will be notified, by letter mailed to the address shown on the proposal, that his bid has been accepted and that he has been awarded the contract.

Where the bids exceed the Engineer's Estimate by more than 15 percent, a public hearing may be necessary, in which case the award of the contract, if it be awarded, will not be until after such a hearing.

If a contract is not awarded within 90 calendar days after the opening of bids, the Bidder may withdraw his bid without prejudice.

Where bids are taken in the form of separate proposals on portions of one project, the Work will ordinarily be awarded to the Contractor, otherwise qualified, whose combined bid is the lowest. No Contractor bidding on all such proposals shall be required to enter into a contract covering less than the entire project without his consent.

**103.03 Cancellation of Award**. The City reserves the right to rescind the award of any contract at any time before the execution of said contract by all parties without any liability against the City.

**103.04 Return of Proposal Guarantee.** All proposal guarantees in the form of certified checks and other negotiable securities, except those of the three lowest bidders, will be returned by mail to the bidders at the addresses shown on the

proposals, immediately following the opening and the checking of the proposals. The retained proposal guarantees of the three lowest bidders will be returned within 30 days following the execution of the contract by the successful bidder. Bid bonds will not be returned.

**103.05** Contract Performance Bond. The successful bidder shall be required to furnish a Contract Performance Bond in the amount of one hundred percent of the total contract price where such price exceeds \$25,000.00, executed by a Surety Guaranty or Trust Company authorized to do business in the State of Ohio, and having an Akron Agent with authority to execute said bond in the form contained in the Proposal. If through amendment the total contract price is increased from \$25,000.00 or less to an amount more than \$25,000.00, the Contractor shall be required to furnish a Contract Performance Bond or other security in the amount of one hundred percent of the uncompleted contract work. Uncompleted work for purposes of this section shall mean work which has not yet been inspected or which has been inspected and rejected.

**103.06 Execution of Contract**. The successful bidder shall within 10 calendar days after receipt of notice of the award and delivery of the contract form sign the contract and return it, together with the Contract Performance Bond, the Certificate of Compliance from the Industrial Commission, the Power of Attorney of the individual signing the Performance Bond and all other required contract documents. No proposal shall be considered binding upon the City of Akron until the execution of the contract by the duly authorized officials of the City of Akron.

**103.07** Failure to Execute Contract. Failure to execute the contract and file acceptable bond and required documents within 10 calendar days shall be just cause for the cancellation of the award and the forfeiture of the proposal guarantee which shall become the property of the City, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest and best bidder, or the Work may be readvertised and constructed under contract, or otherwise, as the City may decide.

**103.08 Workers' Compensation Insurance.** The Contractor shall take out and maintain during the life of the contract worker's compensation insurance for all of his employees employed at the site of the project and, in case any work is sublet, the Contractor shall require the subcontractor similarly to provide worker's compensation insurance for all of the latter's employees unless such employees are covered by the protection afforded by the Contractor. The Contractor and all subcontractors will be required to furnish certificates of compliance with worker's compensation requirements before proceeding with any work.

**103.09** Public Liability, Property Damage and Automobile Insurance. The Contractor shall take out and maintain during the life of this contract at his own expense, such public liability and property damage insurance, as shall protect himself, and the City of Akron, their agents, employees, representatives, and subcontractors, from claims for damages for bodily injury, including wrongful death, as well as from claims for property damage which may arise under this contract. All Contractors that desire to enter into contracts with the City shall provide a copy of all insurance policies properly executed by a duly authorized agent of the insurance company, to be placed on file with the director of law.

The amounts of such insurance shall be no less than the following:

- A. Combined Single Limit Public Liability Insurance: In an amount not less than \$2,000,000.
- B. Combined Single Limit Automobile Liability Insurance: In an amount not less than \$2,000,000.

This insurance shall be written with a company authorized and licensed to do business in the State of Ohio and acceptable to the City of Akron, director of law, shall be written in a form acceptable to the director of law of the City of Akron, shall be taken out before any operation of the Contractor is commenced, and shall be kept in effect until all operations have been satisfactorily completed. Copies, or the originals, as the case may be, of such policies shall be furnished to the City of Akron and shall be approved by the City before operations are commenced. The City of Akron shall be named as an additional insured on all such policies and such policies shall provide for thirty (30) days written notice of cancellation to the City. Further, the Contractor shall provide the City with the additional insured endorsement page from each policy, in a form acceptable to the City of Akron, director of law.

A worker's compensation insurance certificate and a facsimile or certified copy of all insurance certificates and additional insured endorsements properly executed by a duly authorized agent of the insurance company shall be attached to each copy of the contract.

### **104 SCOPE OF WORK**

**104.01 Intent of Contract**. The intent of the contract is to provide for the construction and completion of every detail of the work described. The Contractor shall perform all items of work covered and stipulated in the proposal and perform altered and extra work, furnish all labor, equipment, tools, transportation and supplies required to complete the Work in accordance with the plans, specifications and terms of the contract. Should any misunderstanding arise as to the intent or meaning of these plans, specifications, special provisions, or proposal, or any discrepancy appear, the decision of the Service Director shall be final and conclusive.

The Contractor shall supervise and direct the Work; shall be solely responsible for the means, methods, techniques and procedures of construction; and shall be solely responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance or operation.

**104.02** Alteration of Plans or Character of the Work. The City reserves the right to make, at any time during the bidding or the progress of work, such increases or decreases in quantities and such alterations of the details of construction, including alterations in the grade or alignment in the road or structure or both, as may be found to be necessary or desirable. Such increases or decreases and alterations shall not invalidate the contract nor release the surety and the Contractor agrees to perform the Work as altered, the same as if it had been a part of the original contract.

Unless such alterations and increases or decreases materially change the character of the Work to be performed or the cost thereof, the altered Work shall be paid for at the same unit prices as other parts of the Work. In this case, all expenses for increased alterations and increased cost shall be borne by the Contractor. If, however, the character of the Work or the unit cost thereof are materially changed, an allowance shall be made on such basis as has been agreed upon, either for or against the Contractor, in such amounts as the Service Director may determine to be fair and equitable.

Should the Contractor encounter or discover during the progress of the Work subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or unknown physical conditions at the site of an unusual nature, differing from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the contract, the Engineer shall be promptly notified in writing by the Contractor of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and if he finds they do so materially differ and cause an increase or decrease in the cost of, or the time required for performance of the contract, an equitable adjustment will be made because of changed conditions other than subsurface soil conditions or rock conditions.

Any adjustment in compensation because of a change or changes resulting from one or more of the conditions described in the foregoing paragraphs will be made in accordance with the provisions of 104.03. Any adjustment in contract time because of changes will be made in accordance with the provisions of 108.06.

**104.03 Extra Work.** The Contractor shall perform unforeseen work, for which there is no price included in the contract, whenever it is deemed necessary or desirable in order to complete fully the Work as contemplated. Such work shall be performed in accordance with the specifications and as directed, and will be paid for as provided under 109.04. In no event, however, shall a Contractor be required to perform additional work if the addition of such work would increase the total contract price from \$25,000.00 or less to more than \$25,000.00.

**104.04 Maintenance of Traffic**. When construction interferes with the normal use of the highway, temporary traffic facilities will be provided. For local traffic, facilities for pedestrian and vehicular egress and ingress shall be provided at all times for the property or properties adjacent to the Work. For through traffic the special provision or plans will designate whether the highway will be closed with detours, temporary roads and run-arounds provided, or whether traffic will be maintained through all or portions of the project.

Temporary traffic facilities shall be furnished, maintained, and paid for in accordance with the provisions of 614 Maintaining Traffic, and 615 Temporary Walks and Pavements. When the proposal does not contain Items 614 or 615 the work shall be performed and payment shall be included in the price bid for the various items which necessitate the work. The provisions of these items and this section shall not relieve in any way the Contractor of any of his legal responsibilities or liabilities for the safety of the public. The attention of the bidder is directed to the provisions of 107.07 of these specifications.

**104.05 Right In and Use of Materials Found on the Work**. The Contractor, with the approval of the Engineer, may use on the project such stone, gravel, sand or other material determined suitable by the Engineer as may be found in the proposed excavation. The Contractor shall not excavate or remove any material within the project limits which is not within the grading limits, as indicated by the slope and grade lines, without the written authorization from the Engineer. No charge for the materials so used will be made against the Contractor. The Contractor shall replace at his own expense with other acceptable material all of that portion of the excavation material so removed and so used, to the satisfaction of the Engineer.

Old paving material, curbing, manhole and inlet castings, etc., on the street or intersections, or so much of it as the Engineer may designate, shall remain the property of the City and shall be removed by the Contractor and neatly piled at such points as the Engineer may direct. These materials may be removed by the City, but in case the City shall have not removed such material before the final cleaning up of the street or streets, the Contractor shall remove and dispose of the same without additional compensation. Manhole, inlet or lamphole castings that are removed but not reused in the Work shall be piled on-site in an area designated by the Engineer. The Contractor shall contact the City of Akron Sewer Maintenance Division to have them inspect and select which castings will be salvaged by the City. The Contactor shall then coordinate and deliver the salvaged castings to Sewer Maintenance, and remove and dispose of any unselected castings.

**104.06** Final Cleaning Up. Before sub-final acceptance, the Project, including stream channels and banks within the right-of-way at drainage structures, and all borrow and waste areas, storage sites, temporary plant sites, all roads and other ground occupied by the Contractor in connection with the Work shall be cleaned of all rubbish, excess materials, temporary structures, and equipment. These areas shall have vegetative cover established by seeding and mulching in accordance

with 659 at no additional cost to the City, and all parts of the Work shall be left in an acceptable condition. Furthermore, the sewers, manholes, inlets, etc. shall be cleared of all scaffolding, centering, rubbish, dirt, dams or other obstructions.

Upon completion of the Work, the Contractor shall be responsible for a final cleaning of all Work areas. Cleaning shall include the removal of grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces as resulting from work on the project to the satisfaction of the Engineer. Cleaning materials and methods used shall not create hazards to health or property and shall not damage surfaces.

**104.07 Restoration of Disturbed Surfaces.** All areas affected by the Contractor's operations shall be completely restored at such time as may be designated by the Engineer.

On brick, block, or asphalt paved streets, the area over trenches shall be restored with materials of same kind as existing, over an 8 inch concrete, class "C" base. For further details see City of Akron Construction standard drawing and "Regulations for Construction and Special Activities in Street Right-of-Ways" (available from the Akron Plans and Permits Center). The concrete base shall extend at least 12 inches beyond the undisturbed soil. On brick and block surface streets all pieces of brick or blocks at the sides of the trench shall be removed and the repaving neatly toothed into the existing brick or block pavement.

On concrete paved streets, the area over trenches shall be restored with concrete, class "C"; same thickness as existing but no less than 8 inches, and extending a minimum of 12 inches beyond the undisturbed soil. Where an existing pavement joint is within 3 feet of the trench, the pavement restoration shall extend to the nearest existing joint. In no case shall the replacement consist of less than one half of an existing pavement block.

On unpaved, dust treated, chip and seal, cinder or gravel streets, the area over trenches shall be restored with a minimum of 4 inches of Item 301 - Bituminous Aggregate base extending at least 12 inches beyond the undisturbed soil.

Where the roadway surface cracks, settles, or gets damaged otherwise beyond the restoration limits stated above due to the Contractor s operations, such additional areas shall be restored in the same manner as areas over the trench. The Contractor will be required to remove all surplus excavation, open all gutters and existing drains, and shape or blade the existing roadways to the same condition as found prior to the start of construction, and in a manner satisfactory to the Engineer.

All curbs, sidewalks, and driveways affected by the Work of this contract shall be restored completely and in accordance with these specifications for constructing curbs, sidewalks and driveways. Restoration of curbs, sidewalks and driveways shall be done in full blocks. Patching or piecing of blocks will not be permitted. The cost of all restoration, unless otherwise provided on the plans or in the specifications, shall be included and paid for in the price bid for the Work, the construction of which made necessary the restoration.

Should any settlement in the street surface occur after the pavement restoration has been made which is the result of trench settlements, poor workmanship, defective materials, etc., the Contractor or his surety will be required within the guarantee period and in accordance with provisions thereof to remedy the defects in the trenches and to restore the street surface to its proper condition.

Failure of the Contractor to follow the order of the Engineer pursuant to this section, shall give the City the unqualified right to supply the materials and perform the labor or cause it to be performed and any and all expense chargeable thereto, directly or indirectly, shall be deducted from monies due the Contractor or billed to the Contractor.

**104.08 Record Documents**. The Contractor shall keep one record copy of all Specifications, Plans, addenda, change orders and shop drawings at the project site in an approved location. These record documents shall be annotated by the Contractor to show all changes made during the construction process and to note and accurately locate all existing 104.09 underground utilities encountered during construction, whether shown on the Plans or not. The record documents shall be kept current, and shall be available to the Engineer for inspection at all times. Record documents shall be properly labeled, shall be kept in a clean, dry and legible condition, with the Contractor to provide files and racks for storage, and shall not be used for construction purposes.

Prior to the sub-final estimate, the Contractor shall deliver the record documents to the Engineer with certification that each document as submitted is complete and accurate.

**104.09** Cutting and Patching, Protection. Cutting and patching in existing structures, as required to complete Work under this Contract, shall be completed in a manner acceptable to the Engineer. Patches shall not show in the finished Work. During cutting and patching and other operations, the Contractor shall be responsible for protecting all existing equipment and facilities from dust and debris created, and, immediately upon completing same, all dust and debris shall be cleaned up and disposed of by the Contractor. Protection of existing equipment and facilities shall be to the satisfaction of the Engineer, and may require isolation of the work area by providing temporary screens, etc. Particular attention shall be given to the protection of existing motors.

**104.10** Changes to Accommodate Materials and Equipment to be **Provided**. The Contractor shall provide materials and equipment to fit and be capable of use and/or operation within the structure dimensions shown. If materials and equipment provided by the Contractor require changes in his Work, the Contractor shall make the required changes at his expense and shall be responsible

for all additional expense of the Engineer, incurred by the City, to accommodate the changes.

### **105 CONTROL OF WORK**

**105.01** Authority of the Engineer. The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the Work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor, and as to compensation.

The Engineer will have the authority to suspend the work wholly or in part due to the failure of the Contractor to correct conditions deemed unsafe for the workers or the general public, for failure to carry out provisions of the contract and to carry out orders. The Engineer may suspend the work for such periods as deemed necessary due to adverse weather conditions, for conditions considered adverse to the prosecution of the work or for any other condition or reason deemed to be in the public interest.

**105.02 Plans and Working Drawings**. Plans will show location and design details of all structures, lines, grades and typical cross-sections of roadways, conduits and other items appearing on the proposal. The Contractor shall keep one set of plans available on the Work site at all times.

It is mutually agreed that all authorized alterations affecting the requirements and information given on the approved plans shall be in writing. No changes shall be made of any plan or drawing after the same has been approved by the Service Director except by the Engineer with the approval of the Service Director.

The Contractor shall be responsible for the furnishing of copies of plans, specifications and special provisions, or the necessary portions thereof, to Subcontractors and parties furnishing labor, materials and equipment for such a project.

The plans will be supplemented by such working drawings as are necessary to adequately control the Work. Working drawings for structures shall be furnished by the Contractor and shall consist of such detailed plans as may be required to adequately control the Work and which are not included in the plans furnished by the City. They shall include stress sheets, shop drawings, erection plans, falsework plans, cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans or similar data required of the Contractor. All drawings must be approved by the Engineer prior to commencement of work, and such approval shall not operate to relieve the Contractor of any of his responsibility under the contract for the successful completion of the Work. Where the Work consists of repairs or extension to or alteration of existing structures, the Contractor shall make such measurements of original construction as may be required to accurately joint old and new Work. Any measurements which may appear upon the plans to indicate the extent and nature of such repairs or extension shall not relieve the Contractor of this responsibility.

In order that the Engineer may be assured of complete compliance with the Plans and Specifications, the Contractor shall cause to be prepared and shall submit to the Engineer Working Drawings of piping; detail drawings or steel reinforcing, both bars and mesh, showing size and arrangement; details of machinery, apparatus and materials; outline drawings, connection diagrams and other data for all electrical, communication, instrumentation, control and related equipment, and proposed layout drawings of the complete electrical work; and installation/erection drawings. Drawings shall designate the complete installation and shall be suitable for coordinating work of the various trades.

Layout drawings for electrical work shall show locations and sizes of conduit runs, pull and junction boxes, outlets, lighting fixtures, panel boards, switches, motor controls, disconnects, etc. and will be used by the Engineer to verify the location and size of the conduit, wire and equipment. Shop drawings regarding pumps, blowers, etc. shall include all information on electrical components and characteristics, appropriate curve data at various operating and efficiency levels, manufacturer's motor data sheets, hardware and accessories. Shop drawings will not be reviewed and returned until all such information is received.

Sufficient shop drawings shall be submitted to provide for the retaining by the Engineer of four copies. Drawings will be reviewed and returned by the Engineer with appropriate comments. Neither fabrication, shipment nor installation shall begin until such drawings have been returned (with review stamp affixed) by the Engineer. If the Contractor installs any piping, reinforcing steel, electrical work, machinery, apparatus or material prior to the returning of the shop drawings (with review stamp affixed) by the Engineer, the Contractor will be required to remove all or any part of the items which are not satisfactory.

All shop drawings shall be checked, approved and certified by the Contractor as being in conformance with the requirements of the drawings and specifications before being forwarded to the Engineer. The Engineer's review of any shop drawing shall not release the Contractor from responsibility for deviations from the drawings and specifications.

The contract price will include the cost of furnishing all working drawings.

**105.03 Conformity with Plans and Specifications**. All work performed and all materials furnished shall be in conformity with the lines, grades, cross sections, dimensions and material requirements shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications but that reasonably acceptable Work has been produced, he shall then make a determination if the Work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for any appropriate adjustment in the contract price for such Work or materials as he deems necessary to conform to his determination based on engineering judgment.

Failure of the Contractor to follow the order of the Engineer, pursuant to this section, shall give the City the unqualified right to supply the materials for the finished product and perform the labor or cause it to be performed and any and all expense chargeable thereto, directly or indirectly, shall be deducted or billed to the Contractor at the option of the Engineer.

**105.04** Coordination of Plans, Specifications, Supplemental Specifications and Special Provisions. These specifications, the supplemental specifications, the plans, special provisions and all supplementary documents are essential parts of the contract, and a requirement appearing in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for complete Work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; plans will govern over specifications; supplemental specifications will govern over specifications and special provisions will govern over both specifications and plans.

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

**105.05** Cooperation by Contractor. The Contractor will be supplied five sets of approved plans, two unsigned proposal and contract books and two signed proposal and contract books; one complete set of which the Contractor shall keep available on the Job Site at all times. In addition, one set of approved plans will be supplied for each subcontractor listed in the proposal, and approved by the Akron Engineering Bureau, and any extra sets of plans or proposal and contract books, or any part thereof required by the Contractor must be purchased at the price set by the Administrative Division of the Akron Engineering Bureau.

The City shall have the right to enter the premises for the purpose of doing Work not covered by the contract documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except such as may be caused by agents or employees of the City.

The Contractor shall attend progress meetings when requested by the Engineer. These meetings will be held once every two weeks or as deemed necessary. The Contractor shall have on the Work Site at all times, as his agent, a competent Superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of Work being performed, who shall receive instructions from the Engineer or his authorized representatives. The superintendent shall have the full authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Such supervision shall be furnished irrespective of the amount of work sublet. The City will not permit any work to be performed unless there is a competent Superintendent on the Job Site.

The Contractor agrees to confine the work under this contract to the strict dimensions of easements, rights-of-way, or other Work area authorized in writing by the City or shown on the plans. Any failure of the Contractor, his agents, servants and employees to restrict the Work to the defined area shall be his sole liability and responsibility and the Contractor further agrees to save the City and its agents harmless from any activity of his agents, servants, employees and Subcontractors where such activity concerning work under this contract extends beyond the defined Work area.

**105.06** Night and Holiday Work. The Contractor agrees that all work on this contract which includes any and all Subcontractors shall be only during the period from 1/2 hour before sunrise to 1/2 hour after sunset as sunrise and sunset are determined by the US National Weather Service. Any special provisions shall be noted in the plans and specifications.

Authorization of work during any other time shall only be upon written permission by the Engineer.

In addition, no work will be permitted on Sundays and City Holidays except as authorized or directed by the Engineer.

**105.07** Cooperation with Utilities. The Contractor will notify all utility companies, all line owners or other parties affected and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe line and other appurtenances within or adjacent to the limits of construction made as soon as possible so as not to interfere with the progress of the Work.

Existing surface or overhead structures or utility lines are not necessarily shown on the drawings and those shown are only approximately correct. The Contractor shall make such investigations as are necessary to determine the extent to which existing surface or overhead structures may interfere with the prosecution of the Work contemplated under this contract.

Existing subsurface structures or utility lines (including sewer service connections but excluding all other subsurface connections) which may be encountered during the construction of the Work embraced under this contract or are

#### 105.07

located in such close proximity to the Work to be done under this contract so as to require special precautions and methods for their protection, such as sewers, drains, sewage force mains, water mains, gas mains, telephone and electric conduits, together with appurtenances, are shown in plan on the drawings, insofar as there is public record of their existence.

The sizes, locations and depths shown are, however, only approximately correct and the Contractor shall make such investigations or explorations as may be necessary to verify their accuracy. The Contractor shall, if so ordered, uncover and locate these structures in advance of the excavation for the work required by these specifications.

In order to avoid damages to private subsurface utility lines and services as a result of excavating operations, the Contractor shall give advance notice of each line or service crossing to the particular company concerned.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cable ways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense, except as otherwise provided for in the special provisions or as noted on the plans.

It is understood and agreed that the Contractor has considered in his bid all of the known permanent and temporary utility appurtenances in their present or relocated positions and that no additional compensation will be allowed for any delays, inconvenience or damage sustained by him due to any interference from the known said utility appurtenance or the operation of moving them.

If through no fault of the Contractor, the progress of his work is delayed for an unreasonable length of time from that proposed in his progress schedule as required in Section 108.02, because of failure of a Utility to relocate or adjust its lines, the Contractor shall immediately file with the City a detailed statement describing the nature of the delay and its effect upon his work progress. Compensation shall be considered by granting reasonable extension of time. No request for additional compensation, for added expense or loss of profit will be considered.

It is the complete responsibility of the Contractor to determine the exact location of each, every and all substructures and utility lines including but not limited to water, sewer, gas, electricity and pipes or conduits whether or not located on private property, public property, public or private rights-of-way, or public or private easements and of all surface or overhead structures, including but not limited to utility lines, telephone or electrical poles, sidewalks, driveways and growing things such as trees, shrubbery, etc.

If the Work of the Contractor is delayed because of any acts or omissions of any other Contractor of the Owner, the Contractor shall, on that account, have no claim against the owner other than for an equitable adjustment in the time required for performance of the Work.

**105.08** Cooperation Between Contractors. The City reserves the right at any time to contract for and perform other or additional work on or near the Work covered by the contract. When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the Work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the City from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall coordinate his work with that of the others in an acceptable manner and shall perform it in proper sequence with that of the others.

**105.09 Construction Stakes, Lines and Grades**. When the proposal does not contain a Lump Sum for 623 Construction Layout Stakes, the Engineer will set construction stakes establishing lines, slopes and continuous profile-grade in road work, and centerline and bench marks for bridge work, culvert work, protective and accessory structures and appurtenances as he may deem necessary, and will furnish the Contractor with all necessary information relating to lines, slopes and grades. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary control and perform the Work. The City will be responsible for the accuracy of lines, slopes, grades and other work which is performed by the Engineer as set forth under this section.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if any of the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost of replacing them will be charged against him and will be deducted from the payment for the Work.

When the proposal contains a Lump Sum for 623 Construction Layout Stakes, the Engineer will locate and reference the centerline of the project outside the construction limits and establish benchmarks, and the Contractor shall furnish and place all necessary construction layout stakes for the project, all in accordance with the provisions of 623.

**105.10** Authority and Duties of Engineering Projects Coordinator. The Engineering Projects Coordinator has immediate charge of the engineering details of each construction project. He is responsible for administration and satisfactory

completion of the project. The Engineering Projects Coordinator has the authority to reject defective material and to immediately suspend any work that is being improperly performed.

The Engineering Projects Coordinator will have the authority to suspend the Work wholly or in part due to the failure of the Contractor to correct conditions deemed unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; or for such periods as he may deem necessary due to unsuitable weather. The suspension of the Work for the above reasons does not relieve the Contractor of his responsibility according to 107.12.

In the event the Engineering Projects Coordinator orders the Work suspended for unsafe conditions, whether they be unsafe to workmen or the public, or unsuitable weather, use of defective material not in conformity with the specifications or because work is being improperly performed, the expense, whether direct or indirect for such suspension shall be borne solely by the Contractor.

**105.11** Authority and Duties of the Resident Project Representative. Resident Project Representatives are authorized to inspect all work done and material furnished. Such inspection may extend to all or any part of the Work and to the preparation, fabrication or manufacture of the materials to be used. The Resident Project Representative is not authorized to alter or waive the provisions of the contract. The Resident Project Representative shall have the authority to reject materials which do not meet specification requirements or suspend the portions of the Work involved until such question and issue can be referred to and decided by the Engineer. The Resident Project Representative is not authorized to issue instructions contrary to the plans and specifications, or to act for the Contractor.

**105.12 Inspection of Work**. All materials and each part or detail of the Work shall be subject to inspection by the Engineer. The Engineer or his representative shall be allowed access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor at any time before final acceptance of the Work shall remove or uncover such portions of the finished Work as may be directed. After examination, the Contractor shall restore said portions of the Work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work as provided for in 109.04; but should the work so exposed or examined prove unacceptable, the uncovering and replacing of the covering or making good of the parts removed, will be at the Contractor's expense.

Any work done, or materials used, without supervision or inspection by an authorized City representative may be ordered removed and replaced at the Contractor's expense. Failure to reject any defective work or materials shall not in any way prevent later rejections when such defects are discovered, nor shall it obligate the City to final acceptance.

When any other unit of government or political subdivision or any corporation has jurisdiction within limits of the project, or is to pay a portion of the cost of the Work covered by this contract, its respective representatives shall have the right to inspect the Work. Such inspection shall in no sense make any other unit of government or political subdivision or any companies a part of this contract, and shall in no way interfere with the rights of either party hereunder.

**105.13 Removal of Unacceptable and Unauthorized Work**. All work which does not conform to the requirements of the contract may be considered unacceptable work.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the Work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer except as specified in Section 105.09. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, except as herein specified, or any extra work done without written authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply with any order of the Engineer under the provisions of this section, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced, and unauthorized work to be removed, and to deduct the cost from any monies due or to become due the Contractor.

**105.14 Load Restrictions**. The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads. A special permit will not relieve the Contractor from his sole liability for damage which may result from the moving of equipment or materials, whether caused by his equipment or that of his Subcontractor.

The operation of equipment of such weight, or so loaded, as to cause damage to structures or the roadway or to any other type of construction will not be permitted. Hauling of materials over the subbase, base course or surface course of the roadway under construction shall be limited as directed by the Engineer. No loads will be permitted on a concrete pavement, sidewalk, driveway, base or structure before the expiration of the curing period. In no case shall legal load limits be exceeded unless permitted by the Engineer in writing. The Contractor shall be responsible for all damage done by his equipment.

Engineer may prohibit the use of certain public streets by construction equipment or delivery vehicles.

**105.15** Maintenance During Construction. The Contractor shall maintain the Work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway, conduits or structures are kept in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a roadway subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

Temporary restoration of street surfaces shall be made promptly on completion of underground lines and structures, surplus excavation shall be removed, and the street graded and put in a safe and passable condition. Settlements occurring in or adjacent to trenches shall be immediately refilled to a proper grade. Failure on the part of the Contractor to promptly restore the street surface to the satisfaction of the Engineer shall be considered a cause sufficient for stopping the construction work until such restoration shall be made and no extension of contract time will be granted for the resulting delay on account of stopping the construction work.

All cost of maintenance work and dust control, if the contract does not contain an Item 616, during construction and before the project is accepted shall be included in the unit prices bid on the various pay items, and the Contractor will not be paid an additional amount for such work.

Contractor shall repair, restore and clean streets and other public facilities outside the work limits that are affected by his operations, including hauling and delivery of materials.

**105.16 Failure to Maintain Roadway or Structures.** If the Contractor at any time fails to comply with the provisions of 105.15, the Engineer will immediately notify the Contractor in writing of such non-compliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project and the entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

**105.17 Borrow and Waste Areas**. The terms borrow area and waste area as used in this section refer to locations outside the right-of-way, the particular City property or the project work limits, from which natural materials are removed for use in the Work or upon which materials from the Work are to be deposited as waste.

Before any borrow or waste disposal operations are begun, the Contractor shall provide evidence of a current grading permit for the land to be used. The grading permit shall be from the City of Akron division of building inspection or if the area is outside of Akron from the authority having jurisdiction. Contractors requiring permits from the City of Akron shall make application to the City of Akron plan center in a timely manner. Applications shall be in conformance with subchapter 193.11 of the Akron building code.

In cases where the Contractor is not the permit holder and is not directly responsible for grading operations, sediment control, site restoration, etc., a letter signed by the land owner and/or permit holder shall be submitted to the Engineer. The letter shall identify the location, permit authority, permit number and state the permission granted to the Contractor.

The Contractor shall file a "Notice of Intent to Fill" with the local approval agency of the Ohio Environmental Protection Agency for any clean hard fill that is to be removed from the site and used as fill at a different site.

This subsection is not intended to apply to minor filling, topsoil, seeding or resurfacing of areas immediately outside of the project limits, that may have been inadvertently disturbed in the pursuit of the work.

The cost of work described herein necessary to secure these results shall be included in the contract price bid for the items to which they apply.

**105.18** Claims for Adjustment and Disputes. If in any case the Contractor deems that additional compensation is due him for work or material not clearly covered in the contract or not ordered by the Engineer as extra work, as defined herein, the Contractor shall notify the Engineer in writing of his intention to make claim for such additional compensation before he begins the work on which he bases his claim. If such notification is not given, or the Engineer is not afforded proper facilities by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor, and the fact that the Engineer has kept account of the cost as aforesaid, shall not in any way be construed as proving or substantiating the validity of the claim. If the claim after consideration by the Engineer is found to be just, it will be paid as extra work as provided herein for force account work. Nothing in this subsection shall be construed as establishing any claim contrary to the terms of 104.02.

### **106 CONTROL OF MATERIAL**

**106.01 Source of Supply and Quality Requirements.** The materials used on the Work shall meet all requirements of the contract. In order to expedite the

inspection and testing of materials, the Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. At the option of the Engineer, materials may be inspected at the source of supply before delivery. If it is determined by the Engineer, after trial, that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources which shall, in turn, be subject to the controls set forth herein.

**106.02** Samples, Tests, Cited Specifications. All materials may be inspected and/or tested, in compliance with the Specifications determined by the Engineer before incorporation into the Work. Unless otherwise designated, tests in accordance with AASHTO, ASTM or other methods on file in the office of the Engineer will be made by the City. Samples will be taken by a qualified representative of the City. References included in the specifications to AASHTO, ASTM, AWWA, ANSI or federal specifications shall be the test method, sampling method or specification, amended to bid date of the contract. All materials being used are subject to inspection, test or rejection at any time prior to incorporation into the Work. Copies of all tests will be furnished to the Contractor's representative if requested. The Contractor, in all cases, shall furnish the required samples and/or materials certifications as requested without charge.

Transports and distributors hauling bituminous material shall be equipped with an approved submerged bituminous material sampling device.

**106.03 Plant Inspection**. The Engineer may undertake the inspection of materials at the source. In the event plant inspection is undertaken, the following conditions shall be met:

- (a) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.
- (b) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.
- (c) If required by the Engineer, the Contractor shall arrange at no cost to the City for an approved building for the use of the inspectors; such building to be located conveniently near the plant, independent of any building used by the material producer.
- (d) Adequate safety measures shall be provided and maintained.

It is understood that the City reserves the right to retest all materials prior to incorporation into the Work which have been tested and accepted at the source of supply after the same have been delivered, and to reject all materials which when retested do not meet the requirements of these specifications, or those established for the specified project. **106.04** Storage of Materials. Materials shall be so stored as to assure the preservation of their quality and fitness for the Work. Stored materials, even though approved before storage, may again be inspected prior to their use in the Work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage purposes and for the placing of the Contractors plant and equipment, but any additional space required must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the owner or leasee, and if requested by the Engineer, copies of such written permission shall be furnished to him. Such permission shall not relieve the Contractor of his responsibilities under 107.01 and 107.11. All storage sites shall be restored to their original condition by the Contractor at his expense. This shall not apply to the stripping and storing of topsoil, or to other materials salvaged from the work.

**106.05 Handling Materials**. All materials shall be handled in such a manner as to preserve their quality and fitness for the Work. Aggregate shall be transported from the storage site to the Work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials intended for incorporation in the Work as loaded, and the quantities as actually received at the place of operation.

Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer

**106.06** Unacceptable Materials. All materials not conforming to the requirement of the specifications at the time they are to be used shall be considered unacceptable and shall be removed immediately from the site of the Work unless otherwise instructed by the Engineer. No materials, defects of which have been corrected, shall be used until approval has been given. Upon failure on the part of the Contractor to comply immediately with any order of the Engineer made under the provisions of this section, the Engineer shall have authority to remove and replace defective materials and to deduct the cost of removal and replacement from any monies due or to become due the Contractor.

**106.07** City-Furnished Material. The Contractor shall furnish all materials required to complete the Work, except when otherwise provided in the contract. If the contract documents specify that the City will furnish materials for the project, those materials shall be picked up by the Contractor at a location specified in the contract documents, with 24-hour advance notice. The cost of handling and placing all materials shall be considered as included in the contract price for the item in connection with which they are used. The Contractor will be held responsible for all materials, and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur, and for any demurrage charges.
**106.08** Protection of Materials. All concrete shall be placed during cold weather in accordance with 451.07, 511.12 or 515.06. No concrete shall be placed when the ambient temperature may be expected to drop below  $35^{\circ}F$  during the normal curing period, without the approval of the Engineer.

**106.09** Substitutions. A substitution is a change in product, material, equipment, and/or method of construction required by the contract documents proposed by the contractor after award of the project. Substitution requests are not required for items accepted by addendum prior to bidding, revisions to the contract documents requested by the Owner or Engineer, or specified options of products and construction methods included in the contract documents. Substitutions will not be considered prior to or during the bidding process.

The suitability of substitutions will be considered based on equality of substance and function, economy of maintenance and operation, availability of repair parts, and duration of life. In those instances in which a particular brand, make of material, device, or equipment is required to be used as a base bid, the Contractor will be required to provide the item so indicated.

A substitution request constitutes a representation that the requesting party has investigated the proposed substitution and determined that it meets or exceeds the quality level of the specified work. No submittals will be reviewed by the Engineer unless accompanied by a transmittal, first reviewed by the Contractor and bearing date, stamps, and signatures so stating. There shall be a limit of one proposed substitution per request. The request shall include the following items, as appropriate:

- 1. Identify the product, fabrication, or installation method to be replaced with each request. Also include related specification section and drawing numbers.
- 2. A minimum of five legible (5) copies, plus the original, with complete documentation showing compliance with the requirements for substitutions.
- 3. Coordination information, including changes or modifications needed to other parts of the work and to construction performed by the Owner and separate Contractors that will be necessary to accommodate the proposed substitution.
- 4. A statement indicating that if the substitution is approved, the Contractor must warrant that no major changes in the function of general design of the project will result.
- 5. A detailed comparison of all qualities of the proposed substitution with those of the work specified. Qualities may include elements such as performance, weight, size, durability, and visual effect.
- 6. Product data, including drawings and descriptions of products and fabrication and installation procedures.

- 7. Samples where applicable or requested.
- 8. A statement indicating the effect on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on the overall contract time.
- 9. Cost information, including a proposal of the net change, if any, in the contract sum. The City should receive a credit if an approved substitution represents a significant project savings. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without change in the contract price or contract time.
- 10. The same warranty for the proposed substitution as for the specified product.
- 11. The Contractor's certification that the proposed substitution conforms to the requirements in the contract documents in every respect and is appropriate for the applications indicated. Submit shop drawings and certified test results attesting to the proposed product equivalence.
- 12. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of the substitution to perform adequately.

The substitution request will be returned to the Contractor without consideration if any of the following conditions apply:

- 1. Extensive revisions to the contract documents are required.
- 2. Proposed changes are not in keeping with the general intent of the contract documents.
- 3. The request is not timely, fully documented, or properly submitted.
- 4. If the specified product or method of construction cannot be provided due to the Contractor's failure to pursue the work promptly or coordinate activities properly.
- 5. The substitution does not offer the Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to Consultant(s) for redesign and evaluation services, increase in cost of maintenance by the Owner, and similar considerations.
- 6. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals, without a separate written request.

The contractor will be notified in writing by the City as to the approval or denial of the substitution request.

# 107 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

**107.01 Laws to be Observed**. The Contractor shall keep fully informed of all federal, state and local laws, ordinances, and regulations and all orders and decrees of authorities having any jurisdiction or authority, which in any manner affect those engaged or employed on the Work or which in any way affects the conduct of the Work; and he shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the City and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself, his employees or his subcontractors.

Particular attention is called to the requirements of the State of Ohio relative to licensing of Corporations organized under the laws of any other State.

**107.02 Permits, Licenses and Taxes**. The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the Work, except for permit fees from City offices such as Plans and Permits and Building Department, which will be paid by the City of Akron. All Work shall be constructed in accordance with the City of Akron Building Code, the "Regulations for Construction and Special Activities in Street Right-of-Ways" (available from the City of Akron Plans and Permits Center), City of Akron Health Code, State of Ohio Codes, U.S. Army Corps. Of Engineers permits, and Ohio Environmental Protection Agency Notification requirements. The Contractor shall include in his bid the prices for each permit required to perform the Work, including but not limited to: General, Plumbing, HVAC, Electrical, water well abandonment, septic tank and vault abandonment, grading, asbestos abatement, dewatering, etc. Only Contractors licensed in the City of Akron may perform the Work.

The Contractor further agrees that all City income taxes due or payable under chapter 99 of the Akron code of ordinances shall be withheld by the Contractor pursuant to section 99.09 and further agrees that any of its subcontractors shall be required to withhold income taxes as set forth in chapter 99.

**107.03 Patented Devices, Materials and Processes.** If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the Surety shall indemnify and save harmless the City, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or

process, or any trademark or copyright, and shall indemnify the City for any costs, expenses, and damages which it may be obliged to pay by reason for any infringement, at any time during the prosecution or after the completion of the Work.

It is intended that the bidder, in addition thereto, bid on one or more patented or unpatented devices, materials and processes as alternates when provided in the proposal which may be bid upon and furnished by the bidder in lieu of the patented devices, materials and processes specified in the proposal.

**107.04 Restoration of Surfaces Opened By Permit**. The right to construct or reconstruct any utility service in the highway or street or to grant permits for same, at any time, is hereby expressly reserved by the City, and the Contractor shall not be entitled to any damages either for the digging up of the street or any delay occasioned thereby.

Any individual, firm, public agency or corporation wishing to make an opening in the street must obtain a permit. The Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When ordered by the Engineer, the Contractor shall make in an acceptable manner all necessary repairs due to such openings in accordance with the "Regulations for Construction and Special Activities in Street Right-of-Ways", and such necessary work will be paid for as extra work, or as provided for in the specifications, and will be subject to the same conditions as original work performed.

**107.05 Federal Aid Provisions.** When the United States Government or the State of Ohio pays all or any portion of the cost of a project, the Federal and State laws, and the rules and regulations made pursuant to such laws, must be observed by the Contractor and the Work shall be subject to the inspection of the appropriate Federal or State agency.

Such inspection shall in no sense make the Federal or State Governments a party to this contract, and will in no way interfere with the rights of either party hereunder.

**107.06 Sanitary Provisions**. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees and City representatives, and must comply with the requirements of the State and local boards of health, or of other authorities having jurisdiction.

**107.07 Public Convenience and Safety**. The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic. The safety and convenience of the general public and the residents along the street and the protection of persons and property shall be provided for by the Contractor as specified under 104.04 and 105.15.

The Contractor shall provide and maintain safeguards, safety devices and protective equipment, and take any other needed actions as may be necessary to protect the public and property in connection with the Work.

The presence of barricades or lights, provided and maintained by any party other than the Contractor, shall not relieve the Contractor of his responsibility.

It is a condition of this contract, and shall be made a condition of each sub-contract entered into pursuant to this contract, that the Contractor and any Subcontractor shall not require any laborer or mechanic employed in the performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health or safety and health standards (Title 29, Code of Federal Regulations, Part 1518 - published in the Federal Register on April 17, 1971) promulgated by the United States Secretary of Labor, in accordance with Section 107 of the contract Work Hours and Safety Standards Act (83 Sta. 96).

**107.08 Barricades and Warning Devices**. Temporary traffic control devices and facilities shall be furnished, erected, maintained and paid for in accordance with the provisions of Item 614, Maintaining Traffic. When the proposal does not include Item 614, payment for this work shall be included in the various items requiring the work. All traffic control devices shall conform to the Ohio Manual as required under Section 4511.09 ORC, and as supplemented by the City of Akron Barricade and Signing Manual for Construction and Maintenance. The provisions of this item and this section shall not in any way relieve the Contractor of any of his legal responsibilities or liabilities for the safety of the public.

**107.09 Use of Explosives**. When it is necessary to resort to blasting with explosives, and approved by the Engineer, the Contractor shall use the highest degree of care and adequate protective measures so as not to endanger life, completed portions of the project, and all other property, both public and private. Before conducting any blasting operations, the Contractor shall furnish the Engineer, in writing, a schedule of intended blasting operations and he shall give the Engineer prior written notification of any changes in such schedule. The Contractor shall secure a written permit from the Chief of the Fire Department of the City of Akron before any blasting work is begun.

The use, handling, storage and transportation of explosives shall conform and be in accordance with the applicable requirements and/or provisions:

- (a) of the latest "Bulletin 202, Specific Safety Requirements Relating to Building and Construction Work", issued by the Department of Industrial Relations and the Industrial Commission of the State of Ohio;
- (b) of the Ohio Explosive Laws common Section 3743.01 3743.26 of the Ohio Revised Code and amendments thereto;
- (c) of local regulations;
- (d) and as specified herein.

All blasting operations shall be covered by public liability and property damage insurance as elsewhere specified herein. Except in the case of continuous tunnel operations, all blasting shall be conducted in daylight hours only with the provision that, when required by the Engineer, blasting shall be limited to certain daylight hours.

All firing shall be done by electrical means only. The Contractor shall make suitable provisions to prevent the scattering of broken brick, earth, stones or other material during blasting operations.

**107.10** Protection and Restoration of Property. The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the Work resulting from any act, omission, neglect, or misconduct in his manner or method of executing the Work. Dust, mud, noise or other nuisance originating from any planned operations either inside or outside the right-of-way shall be controlled by the Contractor in accordance with local ordinances and regulations at the sole expense of the Contractor.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding or otherwise restoring as directed by the Engineer, or he shall make good such damage or injury in an acceptable manner.

The Contractor shall cooperate with the Engineer and shall exercise special care to protect and preserve all survey monuments such as stones, concrete monuments, iron pipe monuments, lot corners and benchmarks. Whenever the nature of the work necessitates the removal of any type of survey monument, the Contractor shall notify the Engineer before disturbing said monument. In the event that the Contractor damages, destroys or removes any monuments, stone, lot corner, iron pipe or other survey point without permission of the Engineer, the Contractor shall engage a registered surveyor to replace all such survey points or markers at no cost to the City.

The Contractor's attention is directed to the fact that a large number of monuments have been installed within the corporate limits of the City of Akron for both horizontal and vertical control of precise surveying operations. Before beginning the Work, the Contractor shall contact the Akron Engineering Bureau and determine whether or not any such monuments are in the vicinity of his work. Any monuments destroyed or damaged by the Contractor's operations will be replaced by the City at the Contractor's expense.

The cost to the City for repair, redetermination of location and replacement of any cornerstone, monument or landmarker within the project, damaged, destroyed or made inaccessible during the progress of the Work by the Contractor or his employees will be deducted from monies due or to become due the Contractor.

**107.11 Responsibility for Damage Claims**. The Contractor and his Surety shall save harmless the City of Akron and all of its representatives from all suits, actions, or claims of any character brought on account of any injuries or damages sustained by any person or property in consequence of any neglect in safeguarding the Work or through the use of unacceptable materials in the construction of the improvement or because of any act or omission by the Contractor or his agents, and he shall pay any judgment obtained or growing out of any claims or suits.

**107.12** Contractor's Responsibility. Until sub-final acceptance of the Work by the Engineer, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements, from vandalism or from any other cause, whether arising from the execution or from the nonexecution of the Work. The Contractor shall rebuild, repair, restore and make good all injuries or damages to any portion of the Work occasioned by any of the above causes before sub-final acceptance and shall bear the expense thereof except damage to the Work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, of the public enemy or governmental authorities.

The Contractor shall not suspend the Work unless approved by the Engineer and in such case or under the provisions of 105.10, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project, provide for adequate drainage and shall erect any necessary temporary signs, structures, or other facilities at his expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings and soddings furnished under this contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

**107.13** Contractor's Responsibility for Utility Property and Services. At points where the Contractor's operations are adjacent to properties of railway, telegraph, telephone, and power companies, or are adjacent to other utilities or property, damage to which might result in considerable expense, loss, or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made. The Contractor shall, within forty-eight hours after execution of the contract, notify all owners of public utilities known to be in the area or which may be affected by the Work of the name and address of the Contractor.

The Contractor shall, at least two but not more than ten days prior to commencing construction operations, cause notice to be given to the owners of the underground utility facilities, their designated representatives, or notification centers subscribed to by the owners of the underground utilities, in writing, by telephone, or in person. Where notice is given in writing by certified mail, the signed return receipt shall be conclusive proof of notice.

The Contractor shall cooperate with the owners of any underground or overhead utility lines in their protection, and in removal and rearrangement operations, in order that these operations may progress in a reasonable manner, the duplication of rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

The Contractor shall be responsible for the identification, location and protection of all underground utilities. Any damage to or interruption of service of any utilities due to the Contractor's operations shall be the sole responsibility of the Contractor and shall be remedied as directed by the Engineer at no cost to the City. In the event of interruption to water or utility services as a result of accidental breakage, or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. If water, steam or sewer service is interrupted, repair work shall be continuous until the service is restored.

The Contractor's responsibilities under this section are to be part of the initial contract price, and the Contractor is not entitled to any increase in the contract price for any additional cost.

**107.14** Furnishing Right-of-Way. The City will be responsible for the securing of all necessary rights-of-entry in advance of construction. Any exceptions will be indicated in the contract.

**107.15 Personal Liability of Public Officials**. In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Service Director or his authorized representatives, either personally or as officials of the City, it being understood that in all such matters they act solely as agents and representatives of the City.

**107.16** No Waiver of Legal Rights. Neither the inspection by the Engineer, nor by any of his duly authorized representatives, nor any order, measurement, or certificate by the Service Director, or said representatives, nor any order by the Engineer for the payments of money, nor any payment for, nor acceptance of any work by the Engineer, nor any extension of time, nor any possession taken by the City or its duly authorized representatives, shall operate as a waiver of any provision of this contract, or any power herein reserved to the City, or any right to damages herein provided; nor shall any waiver of any breach of this contract be held to be a waiver of any other subsequent breach.

**107.17** Negligence of the City. Nothing stated in Sections 107.01 through 107.16 shall be construed as making the Contractor responsible for the negligence of the City.

**107.18 Environmental Protection.** The Contractor shall comply with all Federal, State and local laws and regulations controlling pollution of the

environment. Pollution of streams, lakes, ponds and reservoirs with fuels, oils, bitumens, chemicals or other harmful materials and pollution of the atmosphere from particulate and gaseous matter shall be avoided.

When work areas or pits are located in or adjacent to streams, such areas shall be separated from the main stream by a dike or barrier to keep sediment from entering the stream. Care shall be taken during the construction and removal of such barriers to minimize siltation of the stream.

Control of ground water and water in excavations shall be accomplished in a manner that will prevent the degradation of the water quality of any surface water. Wells and well points shall be installed with suitable screens and filters where necessary to prevent the continuous pumping of fines. The discharge of sediment-laden water from pumping shall be performed in a manner to prevent degradation of streams, lakes, ponds, or other areas of water impoundment. Such prevention may involve but is not limited to the use of ditch checks, sediment traps, sediment basins, sediment pits, or other control devices and methods necessary to prevent adverse effects to surface waters. The cost of constructing and maintaining these measures shall be included in the price bid for the contract items requiring de-watering.

Water from aggregate washing or other operations containing sediment shall be treated by filtration, settling basins, or other means sufficient to reduce the sediment concentration to not more than that of the stream or lake into which it is discharged.

**107.19 Civil Rights.** The Contractor shall comply with Federal, State, and local laws, rules and regulations which set forth unlawful employment practices including that of discrimination because of race, religion, color, sex or national origin and which define actions required for Affirmative Action and Minority or Disadvantaged Business programs.

## **108 PROSECUTION AND PROGRESS**

**108.01** Subletting of Contract. The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts or any portion thereof, or of his right, title, or interest therein, without written consent of the Service Director. A copy of any such subcontracts must be furnished to the City. In case such consent is given, the Contractor will be permitted to sublet a portion thereof, but shall perform with his own organization, work amounting to not less than 50 percent of the total contract cost, except as set forth in paragraphs (3) and (4) hereof. The term "his own organization" shall be construed to include only workers employed and paid directly by the Contractor and equipment owned or rented by him with or without operators. Such term does not include employees or equipment of a subcontractor, assignee, or agent of the prime Contractor. An assignment of contract work is considered synonymous with a subcontract to perform work. To determine whether the Contractor is in compliance with the requirement that he

perform with his own organization contract work amounting to not less than 50 percent of the total contract price, the following criteria shall apply:

(1) The contract amount upon which the 50 percent requirement is computed shall include the cost of materials and manufactured products which are to be purchased or procured under the contract provisions.

(2) The percentage of subcontracted work, for purposes of this section, shall always be based on original contract prices rather than actual subcontract prices. Actual subcontract prices will be used for the purpose of calculating compliance with any Minority Business Enterprise (MBE) or Disadvantaged Business Enterprise (DBE) percentage subcontracting obligations. If only a part of a contract item is to be sublet, its proportional value shall be determined administratively on the same basis. This procedure should be followed even when the part not sublet consists only of procuring the materials. However, when a firm both sells materials to a Contractor and performs the work of incorporating the materials in the project, these two phases must be considered in combination and as constituting a single subcontract.

(3) The cost of any specialty items performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the Contractor with his own organization. However, in no event shall the Contractor perform less than 35 percent of the total contract cost. No subcontract, or transfer of contract, shall release the Contractor of his liability under the contract and bonds, unless release is granted by the Service Director.

(4) When bidding on a particular project has been restricted to Disadvantaged Business Enterprises or Minority Business Enterprises, the Disadvantaged Business Enterprise or Minority Business Enterprise contractor shall perform with his/her own organization, work amounting to not less than 51 percent of the remainder obtained by subtracting from the total original contract amount the sum of any "specialty items."

Section 34.10 of the Codified Ordinance of the City of Akron, Ohio, 1985, requires that where a Contractor intends to subcontract 10 percent or more of the total value of the contract, 15 percent of the subcontracted demolition, construction, erection, alteration or repair of City buildings or other improvements and services shall be subcontracted to Minority Business Enterprises; 7 percent of the subcontracted equipment, supplies, materials and services other than professional services procurements shall be subcontracted to Minority Business Enterprises; and 5 percent of the subcontracted professional services shall be subcontracted to Minority Business Enterprises; and 5 percent of the subcontracted professional services shall be subcontracted to Minority Business Enterprises unless the Contractor obtains a waiver from the Contract Compliance Officer. The Contractor shall show to the satisfaction of the Contracts which, when added to all previously approved and all other currently proposed subcontracts, exceed 10 percent of the value of the contract.

**108.02 Prosecution and Progress**. The Contractor shall meet with the Engineer for a pre-construction conference prior to commencing work. Prior to the conference or at a time agreed to by the Engineer, the Contractor shall submit a CPM progress schedule. The schedule shall show the Contractor's plan to carry out the work, the dates on which the Contractor and subcontractors will start the critical features of the work, including procurement of materials and equipment, ordering special manufactured articles, trees, shrubs, sod, working drawing submittals required under Subsection 105.02 for review and approval, and the planned completion dates of the critical features.

The Contractor shall furnish a list of the Contractor's proposed subcontractors and major material suppliers not included in the list submitted prior to the signing of the contract. If the Contractor fails to provide the required submissions, the Engineer may order the conference suspended until such time as they are furnished and work shall not begin until the conference has been reconvened and concluded or the Engineer has given specific written permission to proceed.

If the Contractor's operations are materially affected by changes in the plan or in the amount of the work or if he has failed to comply with the approved schedule, the Contractor shall submit a revised progress schedule, if requested by the Engineer, which schedule shall show how he proposes to prosecute the balance of the Work. The Contractor shall begin the Work on such date as the Engineer shall notify him to begin, provided the Contractor shall have at least five days notice. The Contractor shall use all practical means to make the progress of the Work conform to that shown on the progress schedule which is in effect. No payment will be made to the Contractor while he is delinquent in the submission of a progress schedule. Should the prosecution of the Work, for any reason, be discontinued, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations. All time limits stated in the Proposal are of the essence of the Contract.

**108.03** Suspension of Work or Termination of Contract. The Engineer may instruct the Contractor to delay the start of his operation or suspend the Contractor's operations in whole or in part for the length of time the Engineer may deem necessary for the convenience of the City or due to inclement weather conditions. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional section if the opening of such section is deemed essential to public convenience.

In preparation for winter conditions, all concrete work shall stop on October 31 unless otherwise approved in writing by the Engineer. All other work shall stop when the Engineer so directs, but not later than November 15, and shall resume on April 15. The Engineer may allow or order work to continue beyond November 15, and to resume before April 15, if deemed necessary for public convenience and safety.

When ordered by the Engineer to suspend the work in whole or in part, or to delay starting his operation due to no fault of the Contractor, the Contractor shall be compensated by granting an extension of the completion time by the number of days that the Engineer's order delays the completion of the work. No request for additional compensation, for added expense or loss of profit will be considered, except for idle machinery or equipment. Payment will be allowed only for machinery or equipment on the project site actually required for those phases of the construction work to which such order applies and such payment shall be made at the following rates: For idled machinery or equipment owned by the Contractor, 50 percent of the Rental Rate Blue Book (current edition) rental price; and for idled machinery or equipment rented by the Contractor, the actual rental invoice cost plus 15 percent thereof.

The Service Director may, at any time upon written notice to the Contractor, terminate the contract in whole or in part when it is determined to be in the best interest of the City.

Upon receipt of the notice of termination, the Contractor shall immediately proceed with the performance of the following:

- A. Stop work as specified in the notice;
- B. Place no further orders and enter into no further subcontracts for materials, labor, services, etc., except as necessary to complete work not affected by the notice of termination;
- C. Terminate all subcontracts and orders for materials or services to the extent they relate to the work terminated;
- D. Remove from site all equipment to the extent they relate to the performance of terminated work;
- E. Proceed to complete the portion of work not affected by the notice of termination;
- F. Take actions that may be necessary, or that the Engineer may direct, for the protection and preservation of the terminated work.

Upon such termination, the Contractor shall be compensated for the portions of work completed and accepted, at the contract unit prices, or as mutually agreed upon for items of work partially completed, and all other costs incurred by the Contractor attributable to the termination of contract. No claim for loss of anticipated profit will be considered.

Acceptable materials or equipment already procured by the Contractor for the work, that have been inspected, tested, and approved by the Engineer, and that are not incorporated in the work, may be purchased from the Contractor at actual cost, as evidenced by receipted bills and actual cost records, at such points of delivery as may be designated by the Engineer.

Within 90 calendar days from the effective date of termination notice, unless extended by the Service Director in writing, the Contractor shall submit a settlement proposal to the Engineer for review and approval. The settlement proposal shall include detailed cost breakdowns supported by cost data employed in submitting his

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bid, and actual costs incurred in performance of the contract from the date of award through the date of termination.

If the Contractor fails to submit the termination settlement proposal within the time allowed, the Service Director may determine, on the basis of information available, a fair

and equitable amount due the Contractor because of the termination and shall pay the amount so determined.

In no event shall be Contractor's total compensation exceed the total contract amount.

Termination of a contract or a portion thereof, under the provisions of this clause, shall not relieve the Contractor of his responsibilities for the completed portion, nor shall it relieve his surety of its obligation for and concerning any just claims arising out of the work performed.

**108.04 Limitation of Operations**. The Contractor shall conduct the Work at all times in such a manner and in such sequence as will assure the least interference with traffic and other operations of the public. He shall have due regard to the location of detours and to the provisions for handling traffic. He shall not open up work to the prejudice or detriment of work already started. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

The Contractor shall take all necessary precautions and actions to prevent pollution of streams, lakes and reservoirs and private water systems with fuels, oils, bitumens, calcium chloride or other harmful materials, and to prevent pollution of the atmosphere from particulate and gaseous matter. The Contractor, if requested by the Engineer, shall also, as an attachment to the progress schedule required by 108.02, submit: his schedules and methods for accomplishment of temporary and permanent erosion control work as are applicable for clearing and grubbing, grading operations, borrow pits and haul roads; his plan for disposal of waste materials; and a schedule of his operation at locations of high siltation potential in sufficient detail to clearly indicate how siltation of streams, lakes and reservoirs and the interruption of normal stream flows will be held to a practical and feasible minimum. Proposed erosion control items provided in the contract, exclusive of seeding, shall be constructed concurrently with or immediately following earthwork or structure work of which they are a part. Seeding, mulching and protecting of major exposed slopes shall not be delayed until such time as they can be performed on a project wide basis. This work shall be performed in stages and shall be accomplished as soon as finished grade for seeding can be established in any significant portion of the project. The Contractor shall finish and seed, consistent with the general requirements of the specifications, significant portions of the project where, as determined by the Engineer, the grading has reached a stage that finishing thereof is incidental. Temporary control of water pollution, soil erosion, siltation and additional limitations of areas of erodible earth material exposed by clearing, grubbing and earthwork operations shall be in accordance with 207. The Contractor shall at all times conduct his operations in accordance with the approved schedule. Whenever any excavation, embankment or earth cofferdam work is to be performed in or immediately adjacent to a live stream, the Contractor shall submit details of such operations so that the Engineer may obtain any necessary approvals from the appropriate State or Federal agencies.

**108.05** Character of Workers, Methods and Equipment. The Contractor shall at all times employ sufficient competent labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily. Any person employed by the Contractor or by any Subcontractor who, in the opinion of the Engineer, does not perform the work in a proper and skillful manner or is intemperate or disorderly, shall at the written request of the Engineer, be removed forthwith by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the Work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the Work, the Engineer will withhold all estimates, which are or may become due, or may suspend the Work by written notice at no cost to the City until the Contractor complies with such orders. No extension of the contract completion date will be considered for such a suspension of the Work.

All equipment which is proposed to be used on the Work shall be of sufficient size and in such mechanical condition as to meet requirements of the Work and produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property, or other streets or highways will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the Work are not prescribed in the contract, the Contractor is free to use any methods or equipment that, demonstrated to the satisfaction of the Engineer, will accomplish the Work in conformity with the requirements of the contract.

When the contract specifies that the construction be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified in the contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of

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the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with contract requirements. If, after trial use of the substituted methods of equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute methods or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as directed. No change will be made in basis of payment for the construction items involved nor, in contract time as a result of authorizing a change in methods or equipment under these provisions.

**108.06 Time for Completion.** The Contractor shall have completed the Work on or before the time specified in the proposal, or on or before a later date determined as specified herein, otherwise the Service Director shall proceed as provided in 108.07 or 108.08. Time is of the essence of the Contract.

If the Contractor finds it impossible for reasons beyond his control to complete the Work by the date as specified, or as extended in accordance with the provisions of this subsection, he may, at any time prior to the expiration of the contract time as extended, make a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the Work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

Delays caused by weather or seasonal conditions should be anticipated and will be considered as the basis for an extension of time only when the actual workdays lost exceeds the number of work days lost each month due to inclement weather as determined by the following schedule:

	Number of Work Days
<u>Month</u>	Lost Due to Weather
May	5
June	5
July	4
August	4
September	5
October	6
November	6

The time between December 1 and April 30 is considered winter months and no extensions will be granted for this time. A workday will be counted as lost if the Contractor's efficiency is reduced more than 50 percent on the critical item under

construction at that time. Weekends and holidays will not be counted as lost workdays.

If the Contractor is delayed at any time in the progress of the Work by changes ordered in the Work by the Engineer, or for any reason deemed necessary by the City, then the time for completion shall be extended for such reasonable time as the Engineer may determine. The Contractor agrees to complete the Work within the Contract time as thus extended. Such delays or extensions shall not be grounds for claims by the Contractor for damages for additional cost, expenses, overhead or loss of profit, or any other compensation, except for idle machinery or equipment as provided under 108.03 herein.

**108.07** Failure to Complete on Time. For each calendar day that any Work shall remain uncompleted after the contract completion date, the sum specified herein will be deducted from any money due the Contractor, not as a penalty but as liquidated damages provided, however, that due account shall be taken of any adjustment of the completion date granted under the provisions of 108.03 and 108.06. The liquidated damages shall cease when the project is substantially completed as determined by the Engineer.

Permitting the Contractor to continue and finish the Work or any part of it after the date fixed for its completion, or after the date to which completion may have been extended, will in no way operate as a waiver on the part of the City of any of its rights under the contract.

The project shall be considered substantially complete when all work required by the contract documents has been satisfactorily completed except those items that are seasonally restricted, such as tree planting or sodding, and minor punch list items not affecting operational integrity and functional use of the project as determined by the Engineer.

Original Contract Amount		Amount of Liquidated
(Total Amount of the Bid)		Damages to be Deducted for
		Each Calendar Day of
		Overrun in Time
From More Than	To and Including	
\$0	\$50,000	\$200.00
\$50,000	\$100,000	\$400.00
\$100,000	\$500,000	\$600.00
\$500,000	\$1,000,000	\$800.00
\$1,000,000	\$2,000,000	\$1,000.00
\$2,000,000	\$5,000,000	\$1,200.00
\$5,000,000	\$10,000,000	\$1,600.00
Over	\$10,000,000	\$2,000.00

SCHEDULE OF LIQUIDATED DAMAGES

108.08 Cancellation of Contract. If the Work to be done under contract shall be abandoned by the Contractor, or if the contract shall be assigned or the Work under contract sublet by the Contractor, otherwise than herein specified, or if before the completion of the work under this contract, the Contractor shall become financially unable to meet his current obligations or shall become bankrupt or shall make a general assignment for the benefit of the creditors or shall have a receiver appointed to take charge of his affairs or shall have his property levied upon or taken in execution or under attachment, or if at any time the Service Director shall be of the opinion that the performance of the contract is unnecessarily or unreasonably delayed, or that the Contractor is violating any of the conditions or agreements of the contract, or is executing the same in bad faith or is not fulfilling the terms thereof, or is not making such progress in the execution of the Work as to indicate its completion within the time specified in the contract, or within the time to which the completion of the contract may have been extended by the Engineer, then the Service Director, at his discretion, acting for the City, may at any time declare the contract or any portion thereof terminated, by a written notice served upon the Contractor, a copy of which shall be given to the Surety or the authorized agent of the Surety.

Upon the service of such notice, the Contractor shall discontinue the Work or such part thereof as the Service Director shall designate, whereupon the Surety may, with the written permission of the Service Director and at its option, assume the contract or that portion thereof on which the Service Director has ordered the Contractor to discontinue work and to proceed to perform the same and may, with the written consent of the Service Director, sublet the Work, or portion of same taken over, provided, however, that the Surety shall exercise its option, if at all, within two weeks after written notice to discontinue work has been served upon the Contractor and upon the Surety or its authorized agent.

The Surety, in such event, shall take the Contractor's place in all respects and shall be paid by the City for all work performed by it in accordance with the terms of the contract and if the Surety, under the provisions hereof, shall assume said entire contract, all monies remaining due the Contractor at the time of his default, shall thereupon become due and payable to the Surety as the work progresses, subject to all of the terms of the contract.

In the event the Service Director has ordered the Contractor to discontinue work on the project, the City shall have the absolute right, without liability on the part of the City to the Contractor or his Surety, to continue and complete the project. The Surety and the Contractor shall then be jointly and severally liable for all expenditures made by the City to complete the said project excepting and providing that the Surety shall not be liable for any amount over the obligation of its bond.

Any and all balances of payments due the Contractor by the City shall be forfeited to the City and the Contractor agrees that he shall lose all right, title and interest to said balances, excepting and providing that said balances shall be used, after forfeiture, for a set-off to the benefit of the Contractor and his Surety on the expenditures of the City to complete the project.

**108.09** Payroll Records. Payroll records shall be open to inspection of authorized representatives of the Service Director. Upon completion of the Work and prior to the payment of the sub-final estimate, the Contractor and all subcontractors shall submit an affidavit stating that wages have been paid in conformance with the minimum rates set forth in the contract for construction of the project.

A certified copy of the Contractor's and Subcontractor's payrolls including wages, Employee's name, current address, social security number, number of hours worked each day during the pay period and the total for each week, his hourly rate of pay, his job classification, fringe payments, and deductions from his wages shall be submitted monthly during the period in which construction is performed to the Akron Engineering Bureau, Administrative Services Division - Attention: Wage Rate Coordinator. No monthly payments will be processed until payrolls have been received.

When Subcontractors have not worked on the project, the Contractor shall submit a certified statement along with his payroll stating no Subcontractors worked during the previous pay period.

## **109 ACCEPTANCE, MEASUREMENT AND PAYMENT**

**109.01** Measurement of Quantities. For all contracts, except lump sum contracts, after an item of the work is completed and before final payment is made therefor, the Engineer will determine the quantities of various items of work performed as the basis for final settlement. The Contractor, in case of unit price items, will be paid for the actual amount of work performed in accordance with these specifications as provided under the various items. The Engineer's measurements and determination of quantities shall be final.

The term "gage" when used in connection with the measurement of plates, will mean the U.S. Standard Gage (ounces per square foot), except that when the reference is made to the measurement of galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, then the term "gage" will mean that specified in AASHTO M 36, M 167 or M 197. When the term "gage" refers to the measurement of wire, it will mean the wire gage specified in AASHTO M 32.

The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois. All materials which are measured or proportioned by weight shall be weighed on accurate, approved scales by competent, qualified personnel at locations approved by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material be paid for. However, car weights will not be

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acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty at least once daily, at such time as the Engineer directs, and each truck shall bear a plainly legible identification mark.

All materials which are specified for measurement by the cubic yard "loose measurement" or "measured in the vehicle" shall be hauled in approved vehicles and measured therein at the point of delivery on the project. Approved vehicles for this purpose may be of any type or size satisfactory to the Engineer, provided that the body is of such type that the actual contents may be readily and accurately determined. Unless all approved vehicles on a job are of uniform capacity, each approved vehicle must bear a plainly legible identification mark indicating the specific approved capacity. The Inspector may reject all loads not hauled in such approved vehicles.

For work on a tonnage basis, the Contractor shall file with the Engineer receipted freight bills where railroad shipments are made, and certified weight-bills when materials are received by any other method, showing the actual tonnage used. For work on a yardage basis, the Contractor shall furnish itemized evidence of the yardage used. Freight bills, weigh-bills, and yardage certificates shall be furnished as requested.

The following materials will be paid for by the gallon at the following temperatures:

At 60°F; Creosote for Priming Coat, Creosote Oil and Creosote Solutions for Timber Preservatives, Asphalt Primer for Waterproofing, and Liquifier.

At 100°F; RC, MC, Asphalt Emulsions, RT-1, 2, 3, 4, 5, 6 and CBAE, Primer 20 and 100.

Tank car outage of bituminous material shall be measured at destination before any material has been removed from the tank car.

For shipments for bituminous materials the net weight shall be converted to gallons at the specified pay temperature.

Companies or Contractors furnishing bituminous material in calibrated distributors or tank trucks shall provide the Engineer a certified list of the capacities of this equipment.

Timber will be measured according to 504.04 actually incorporated in the structure.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the item. When a complete structure or structural unit is specified as a unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions.

**109.02** Scope of Payment. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all labor, materials and equipment for performing all work under the contract in a complete and acceptable manner, and for all risks, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof, except as otherwise provided in 104.02, 105.18, and 107.12.

If the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the specifications.

**109.03** Compensation for Altered Quantities. When the accepted quantities of work vary from the quantities in the bid schedule, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the accepted quantities of work done. No allowance except as provided in 104.02 will be made for any increased expense, loss of the expected reimbursement, or loss of anticipated profit suffered or claimed by the Contractor, resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursements therefor or from any other cause.

Work involving supplemental agreements shall be paid for as stipulated in such agreements. The Contractor shall furnish substantiating data required in the preparation of these agreements.

**109.04 Extra and Force Account Work.** Extra Work performed in accordance with the requirements and provisions of 104.03 and 105.12 will be paid for at the unit prices or lump sum stipulated in the order authorizing the work or the City may require the Contractor to do such work on a force account basis to be compensated in the following manner:

(a) Labor - for all labor and foremen in direct charge of the specific operations, the Contractor shall receive the rate of wage and fringe benefits currently in effect at the time the work is performed for each and every hour that said labor and foreman are actually engaged in such work, to which may be added an amount equal to 38 percent of the sum thereof. The term fringe benefits shall be defined as the actual cost paid to or in behalf of workmen by reason of health and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the class of labor employed on the Work. In addition to the above, the Contractor shall receive the actual cost of Social Security Tax, Worker's Compensation and State and Federal Unemployment Insurance. In lieu of itemizing these four items, 21 percent of the base wages may be added.

The wages of any foreman who is employed partly on force account work and partly in other work, shall be prorated between two classes of work according to the number of men employed on each class of work as shown by the payrolls.

The estimated rate of wage and labor cost is to be agreed upon in writing before beginning work.

The Contractor shall receive the actual cost paid for subsistence and travel allowance when such payments are required by collective bargaining agreements or other employment contract generally applicable to the classes of labor employed on the Work. No percentage may be added to these costs.

- (b) Materials For materials provided by the Contractor for the extra work, accepted by the Engineer and used, the Contractor shall receive the actual cost of such materials delivered on the Work, including transportation charges paid by him (exclusive of machinery rentals as hereinafter set forth), to which cost 15 percent may be added.
- (c) Equipment For any machinery or special equipment other than small tools, which the Engineer considers necessary for the performance of the work, the Contractor shall be allowed a reasonable rental price to be agreed upon in writing before such work is begun, for the time that such equipment is in use on the Work. No profit or overhead shall be added to any charges in connection with the use of owned equipment, however, 15 percent of the base amount payable for rented equipment may be added for overhead and profit. Proper invoices will be required for rental equipment.

Equipment that is in operational condition and is standing by with the Engineer's approval for participation in force account work will be paid for at 50 percent of the appropriate hourly rate. Payment for such "stand-by" will be limited to not more than eight hours in a 24 hour day or 40 hours in a normal work week.

No compensation will be allowed for equipment that is inoperable due to breakdown.

No payment will be allowed for equipment that is not operating because the work has been suspended in accordance with the specifications unless the suspension is for the convenience of the City. No payment will be allowed for equipment that is not operating because the work has been suspended by the Contractor for the Contractor's own reasons.

The time for which such compensation will be paid will be the actual normal working time during which such delay condition exists, but will in no case exceed eight hours in any one day.

The days for which compensation will be paid will be the number of working days charged during the existence of such delay. No compensation will be made for days that are considered lost due to weather as determined by the Engineer.

Compensation will only be made for equipment physically located at the work site that would be used to prosecute the delayed work during the existence of such delay.

- (d) Operating Costs For all equipment, the Contractor shall be allowed a reasonable operating rate to be agreed upon in writing before such work is begun, for the time that such equipment is in use on the Work.
- (e) Subcontract Work For work performed by an approved Subcontractor the prime Contractor will be allowed to cover administrative cost equal to 5 percent of the compensation provided in (a), (b), (c) and (d) but not exceeding \$5,000. No additional markup is allowed for work performed by a subcontractor.
- (f) Compensation The compensation to the Contractor as above provided in (a), (b), (c), (d) and (e) shall constitute payment in full for extra work done on a force account basis including administration, superintendence, overhead, use of hand tools and equipment for which no rental is allowed, profit, taxes other than sales tax, premium on insurance, demurrage charges and/or any other expense incidental to performing the force account work. Sales tax will not be allowed on any item for which tax exemption may be obtained.
- (g) Statements No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with itemized statements and/or invoices of the cost of such force account work detailed as follows:
  - (1) Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman.
  - (2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment, except for hand tools and equipment for which no compensation is allowed.
  - (3) Quantities of materials, prices and extensions.

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(4) Transportation of materials, excepting demurrage charge for which no compensation will be allowed.

The Contractor's representative and the Engineer shall compare records daily of the extra work done as ordered on a force account basis, and they shall certify that these records are correct, and no subsequent additions, deletions or alterations of these records shall be permitted.

Statements shall be accompanied and supported by receipted invoices for all materials used and transportation charges, and rented equipment performing work on force account operations. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then, in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor. Statements shall be filed not later than the 20th day of the month following that in which the work was actually performed.

The above-described force account provisions will also apply to work performed at agreed unit prices and agreed lump sum when the agreed prices are based on analysis of cost of labor, material and equipment.

**109.05** Eliminated Items. Should any items contained in the proposal be found unnecessary for the proper completion of the Work, the Engineer may, upon written order to the Contractor, eliminate such items from the contract, and such action shall in no way invalidate the contract. When a Contractor is notified of the elimination of items, he will be reimbursed for actual work done and all costs incurred in connection with such items including mobilization of materials prior to said notification. Any claim for loss of profit shall not be considered.

**109.06 Partial Payments**. If satisfactory progress is being made, the Contractor will receive monthly payments amounting to ninety percent of the value of work and materials in place, less any previous payments made. The monthly payment is approximate only, and all partial estimates and payments shall be subject to correction in the sub-final estimate and payment.

Should any defective work or material or acceptable work that has been damaged by the Contractor's operations be discovered previous to sub-final estimate, or should a reasonable doubt arise previous to the sub-final estimate as to the integrity of any part of the completed Work, the estimate and payment for such defective or questioned work shall not be allowed until the defect has been remedied and cause for doubt removed.

**109.07** Payment for Material on Hand. Partial payments may be made to the extent of the delivered cost of approved materials to be incorporated in the Work, when delivered to the project or stored in acceptable storage places in the vicinity of the project.

Partial payments may be made to the extent of the cost of approved materials to be incorporated in the Work when assigned to the Contractor, if the Engineer determines that it is not practical to deliver the material to the project site. This provision shall be applicable only to bulky materials that are durable in nature and represent a significant portion of the project cost, such as steel and pre-cast concrete. Small warehouse items shall not be included.

No partial payment will be made on living or perishable plant material until planted.

**109.08** Sub-Final Estimate. As soon as practicable after the Contractor completes all Work and is found to be acceptable to the Engineer, there shall be issued a letter of sub-final acceptance and the sub-final estimate for payment based on the actual quantities of completed and accepted work performed under this contract. Such sub-final estimate shall be approved by the Engineer, after which the City shall pay the entire sum found to be due, after deducting all previous payments made under 109.06, and 109.07, and deducting the retainer as provided for in 109.09. All prior estimates are subject to correction in the sub-final estimate payment.

Before payment of the sub-final estimate, sworn affidavits attesting that all work has been completed and that all labor, materials, services and equipment have been paid for and that all subcontractors, suppliers, etc. have been paid in full, will be required from the Contractor and all subcontractors.

**109.09 Retainer**. The City will retain three percent of the entire cost of the work done by the Contractor under this contract for the specified guarantee period of one year from the date of the sub-final acceptance of the project by the Engineer. At the end of the specified guarantee period the Contractor shall fill all joints in rigid pavement and seal all cracks in flexible pavement with approved materials as directed by the Engineer, and repair all other defects as determined by the Engineer to the Engineer's satisfaction.

If the Contractor shall have complied with all the requirements of his contract in keeping said Work in good and proper repair, then at the end of his guarantee period, upon order of the Director of Public Service, the Contractor shall receive his retainer; but if the Contractor shall fail to make all necessary repairs, as indicated by the Engineer, at any time during the above period, then the Director of Public Service shall have power to expend all or such part of the amount so retained as the said Director of Public Service may see fit, and apply the same to making the necessary repairs. Should the amount retained not be sufficient to make the required repairs, the Contractor shall at once make good the deficiency. At the expiration of the guarantee period, whatever remains to the credit of the Contractor, provided all repairs shall have been made satisfactory to the Engineer, shall be paid to the Contractor as final estimate and full settlement of any balance due on said contract,

as herein provided, whereupon and not until then, shall the Contractor be released from the obligation assumed in this contract and his Surety discharged.

**109.10 Guarantee**. The Contractor hereby agrees that all defects in the work done under this contract arising, in the opinion of the Engineer, out of the use of defective material, settlement of foundation, or improper workmanship in the construction thereof, and from which said causes may be in need of repair during the period of one year from the date of the sub-final acceptance of the project shall be repaired by the Contractor without expense to the City, and the Contractor agrees to make such repairs when and as directed by the Engineer, by a written notice, and if after having received such notice, the Contractor fails to make such repairs within the specified time from the receipt of such written notice, the City may thereupon cause said repairs to be made and charge the expense thereof to the Contractor or his Surety.

# **200 EARTHWORK**

# **ITEM 201 CLEARING AND GRUBBING**

201.01 Description
201.02 General
201.03 Clearing and Grubbing
201.04 Scalping
201.05 Method of Measurement
201.06 Basis of Payment

**201.01 Description.** This work shall consist of clearing, grubbing, scalping, removal of trees and stumps, and removing and disposing of all vegetation and debris within the limits of the right-of-way and easement areas, except such objects that are to remain or are to be removed in accordance with other sections of these specifications. When the bid schedule contains a lump sum for 201 Clearing and Grubbing, the lump sum price bid will be paid and shall be full compensation for all the work described in this section, including removal of all trees and stumps marked for removal. When the bid schedule contains 201 Removal of Trees and Stumps on an individual basis, the balance of the work described in this section shall be performed but will not be paid for directly, but shall be considered as a subsidiary obligation of the Contractor under other contract items.

**201.02** General. The Engineer shall exercise control over clearing and grubbing and shall designate all trees, shrubs, plants, and other objects to be removed. This work shall also include the preservation from injury or defacement of all vegetation and objects to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be a suitable asphaltum base paint.

Before the Contractor removes any tree or stump which the plans state is to be removed, the Engineer shall review the plan requirements and appropriately mark each tree or stump which is to be removed. Only such trees and stumps which have been marked for removal by the Engineer shall be removed.

Limitations of areas of clearing and grubbing and earthwork operations shall be in accordance with 108.04 and 207.

**201.03 Clearing and Grubbing**. All surface objects, brush, roots and other protruding obstructions not designated to remain and all trees and stumps marked for removal shall be cleared and/or grubbed, including mowing, as required. In locations which will be a minimum of 3 feet below the slope of embankment, the Contractor

may leave undisturbed stumps and roots and nonperishable solid objects, provided they do not extend more than 6 inches above the existing ground surface.

In all other areas, trees and/or stumps up to and including 24" diameter shall be removed to a minimum of 12 inches below the proposed finish grade. Trees and/or stumps greater than 24" diameter and any roots within 12 inches of the tree or stump's periphery shall be removed to a minimum of 24 inches below the proposed ground surface.

All roots beyond 12 inches of the tree trunk or stump's periphery, regardless of the distance away, shall be removed to a depth of 6 inches below the proposed ground surface.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted in accordance with 203.10.

Materials and debris removed from the right-of-way may be disposed of at locations off the project with the written permission of the property owner on whose property the materials and debris are placed. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid. The Contractor shall comply with all applicable laws, regulations, permit requirements, etc. Of the authority having jurisdiction over the dump site.

Low hanging branches and unsound or unsightly branches on trees or shrubs within the right-of-way which are designated to remain shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the pavement surface or as directed by the Engineer.

**201.04** Scalping. The Contractor shall scalp areas where excavation or embankment is to be made, except that areas need not be scalped where the embankment to be constructed is 4 feet or more in height to subgrade elevation. Scalping shall include the removal of material such as roots, sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter from the surface of the ground.

Areas on resurfacing and widening projects which do not support new pavement and do not involve new ditch or sidewalk construction shall be cleared of weeds and brush, but need not be scalped prior to placement of embankment required to build up the shoulder.

Sod and incidental topsoil removed in the scalping operation shall be salvaged and stockpiled for use as specified in 203.04(e). The stockpiles of scalping shall be made in such a manner and at such locations that they will be well drained and will not impound water. The depth of scalping performed under this section is not intended to include topsoil. Additional depth of material which is required to be removed over and above scalping operations as described in this section shall be measured and paid for at the contract unit price bid per cubic yard for 203.

**201.05 Method of Measurement**. Measurement will be by one of the following alternate methods:

(a) Lump Sum Basis. When the bid schedule contains a Clearing and grubbing "lump sum" item, no measurement of area will be made.

(b) Individual Unit Basis. The diameter of trees will be measured at a height of 54 inches above the ground for a single stem tree. Multiple stem trees will be measured at a height of 54 inches above the ground using the following formula: The largest trunk diameter plus 70 percent of the sum of the remaining trunk diameters. Trees with a single stem but are multiple branching at less than 54 inches above the ground will be measured at the narrowest point between the root flare and the branch flare. See Figure 201-1.



Figure 201-1

Removal of trees or stumps less than 12 inches in diameter will not be paid. Stumps will be measured by taking the average diameter at the cutoff. When the bid schedule indicates measurement by individual unit basis, trees or stumps will be designated and measured in accordance with the following schedule of sizes:

Diameter	Pay Item Designation
12 inches to 24 inches	18 inch
Over 24 inches to 36 inches	30 inch
Over 36 inches to 60 inches	48 inch
Over 60 inches	60 inch

Tree removal shall include removal of the stump to a depth of 12 inches.

**201.06 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>	
201	Lump Sum	Clearing and grubbing	g
201	Each	Stumps removed,	_ inch
201	Each	Trees Removed,	inch

## **ITEM 202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

- 202.01 Description
- 202.02 Construction Requirements
- 202.03 Bridges, Culverts and Other Drainage Structures Removed
- 202.04 Pipe Removed
- 202.05 Pavement, Walks, Curbs, etc. Removed
- 202.06 Buildings Removed
- 202.07 Underground Storage Tanks, Septic Tanks and Vaults Removed or Abandoned
- 202.08 Guardrail and Fence Removed
- 202.09 Manhole, Catch Basin and Inlet Removed
- 202.10 Manhole, Catch Basin and Inlet Abandoned
- 202.11 Pipe Abandoned
- 202.12 Method of Measurement
- 202.13 Basis of Payment

**202.01 Description**. This work shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, fences, guardrails, structures, old pavements, abandoned pipe lines, storage tanks, septic tanks, vaults, and any other obstructions which are not designated or permitted to remain, except for the

obstructions to be removed and disposed of under other items in the contract. It shall also include the salvaging and storage within the project limits of designated materials and backfilling the resulting trenches, holes, and pits. Removal of structures and obstructions as set forth in this section shall be performed under Item 203 Grading or under the item of work which necessitates such removal, unless specific pay items are noted on the plans and listed in the Proposal.

Any and all material being removed in conjunction with an improvement, renovation, remodeling and addition to City-owned property is subject to the following provisions:

- a. The Contractor and Subcontractor shall inform the Engineer when salvageable material is removed and available for inspection to determine if the respective item(s) shall be retained by the City.
- b. If the material(s) are determined to be salvageable, the City has three days, unless additional time for removal is requested, in which to claim and remove any such items, during which time the Contractor shall store the materials at locations determined by the Engineer. If the material is not claimed within this period of time, it shall be the Contractor's responsibility to dispose of the material at no cost to the City.
- c. The term salvage shall include, but is not limited to such items as: castings, piping, brick, steel, iron, copper, brass, aluminum and other metals, wiring, conduit, lighting, lamps, panels, boxes, fixtures, motors, electrical incidentals, machines, plumbing, plumbing fixtures, water heaters, HVAC equipment and incidental appurtenances, miscellaneous building materials, doors, door frames, windows, frames, granites, marbles, stone panels, trees, shrubbery and plant material.
- d. The Contractor shall file a "Notice of Intent to Fill" with a local approved agency of the Ohio Environmental Protection Agency for any clean hard fill that is to be removed from the site and used as fill at a different site.

**202.02** Construction Requirements. The Contractor shall raze, remove and dispose of all buildings and foundations, structures, fences, guardrails, old pavements, abandoned pipe lines, storage tanks, septic tanks, vaults and other obstructions any portions of which are within the limits of the project, except utilities and those items for which other provisions have been made for removal. All designated salvageable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported, and shall be stored by the Contractor at specified places within the project limits. Unusable material shall be destroyed or disposed of outside the limits of the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners shall be furnished the Engineer upon request. Basements or cavities left by structure removal shall be filled to the level of the

surrounding ground, and if within the area of construction, shall be compacted in accordance with 203.

When existing conduits are encountered in removal operations and are determined by the Engineer to be inactive or are to be abandoned, they shall be abandoned as per 202.11 or as directed by the Engineer before backfilling operations proceed.

**202.03** Bridges, Culverts and Other Drainage Structures Removed. Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic. The substructures of existing structures, including piling, shall be removed down to the proposed stream bottom and those parts outside the stream shall be removed to a minimum of three feet below proposed ground surface or as shown on the plans. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

When specified, all structural steel, timber, and other reusable materials shall be carefully dismantled: and when specified, steel members shall be match marked as directed by the Engineer. Specified salvaged materials shall be considered as the property of the City and such materials shall be stored as specified in 202.02. Where alteration of an existing structure requires removal of portions of the structure, such removal shall be performed with sufficient care as to leave the remaining portion of the structure undamaged. In case of damage to the existing structure, repair or replacement shall be made at the Contractor's expense and to the approval of the Engineer.

**202.04 Pipe Removed**. This section provides for Pipe removed for reuse or storage and Pipe removed. For both types of removal, the work under this section shall include excavating all material necessary to permit removing the pipe; disposing of excavated material, including broken pipe; sealing openings left in walls of manholes, catch basins or other structures that are to remain in place; removing and disposing of pipe headwalls.

(a) For Pipe removed for reuse or storage, the work shall include removing, cleaning when reused, transporting and storing the pipe. All pipe shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe. Pipe to be relaid shall be removed and stored when necessary, so that there will be no loss or damage before relaying. The Contractor will be required to replace sections lost from storage or damaged by negligence or by use of improper methods at no additional cost to the City.

(b) For Pipe removed, the pipe becomes the property of the Contractor and shall be disposed of in accordance with 202.02.

(c) Excavating. Where the plans call for pipe to be removed for reuse or storage, a section of pipe shall be removed sufficient in length to permit determining the quality of pipe and the possibility of removing it without damage. If the Engineer determines that the pipe is worth salvaging and can be salvaged, the Contractor shall perform the remainder of the excavation in a manner that will not damage the pipe. If the Engineer determines otherwise, the pipe shall be removed and disposed of and the original item shall be non-performed.

Where caving occurs, the caved materials shall be excavated before the trench is backfilled. All excavated material shall be used or disposed of in accordance with the provisions of 203.

(d) Backfill. The trench resulting from the removal of pipe shall be backfilled in accordance with the provisions of 203 except when the trench lies within the limits of subsequent excavation.

**202.05** Pavement, Walks, Curbs, Etc. Removed. When designated for removal, an existing wearing course, concrete base course, concrete or full depth (6" thick) asphalt pavement, bituminous wearing course on brick and/or concrete base, concrete walks, concrete gutters, stone or concrete curbs, concrete traffic dividers, etc., shall be removed and disposed of as follows:

(a) Materials to be salvaged shall be carefully removed and stored within the project limits at locations determined by the Engineer. A portion of all asphalt grindings generated from the removal of a wearing course shall be salvaged and delivered to the City Public Works Bureau on Triplett Boulevard. The Contractor shall salvage and deliver not less than 50% of the total amount of asphalt grindings generated unless otherwise specified in the contract documents. If the City refuses the salvage material, the material becomes the responsibility of the Contractor to properly dispose.

(b) Materials that are not to be salvaged or that are not suitable for reuse shall be disposed of in the same manner as excavation, 203.05.

(c) Where only a portion of an existing walk, pavement, etc. is to be removed, full depth sawing with a diamond saw blade shall be used at the limits of the designated repair/removal areas. All repair/removal areas will be located by the Engineer prior to start of the work. Aerosol spray paint for outlining shall be provided by the Contractor. Payment for the work associated with sawing shall be included in the 202 item which necessitates the sawing.

**202.06 Buildings Removed.** Buildings and appurtenances designated for removal shall not be disturbed by the Contractor until being furnished with a written notice of possession and approval to proceed by the Engineer. As soon as such approval has been given, the Contractor shall schedule and perform the removals in a manner that will accommodate utility rearrangements and clearance of structures. If the Contractor desires to use buildings located within the project limits for storage,

office, living quarters or other purposes, a copy of a written agreement between the Contractor and the property owner shall be furnished to the Engineer allowing such use during the period of the contract and saving the City harmless from any claims whatsoever by reason of such use. Buildings and appurtenances designated for removal are not the property of the Contractor until they have been severed and removed from the real estate and the Contractor has no right to rent, sell or otherwise transfer title to such buildings or appurtenances prior to such severance and removal.

Foundations, floors, tanks, and basement, pit, well and cistern walls shall be removed to a minimum of 3 feet below the grade of the surrounding area.

Tanks shall be completely removed and basements shall be cleared of all debris, appliances, wood or metal partitions, wood floors, etc., so that only masonry walls and concrete basement floors remain. All floor slabs, under which a pit, well, cistern or tank exists shall be broken and removed.

Basement floors which are left in place shall be broken up into pieces not to exceed one square foot and all drains that are not removed shall be sealed with masonry or with precast clay or concrete stoppers.

All materials except that belonging to a public or private utility company shall become the property of the Contractor. The Contractor shall notify the owners of water, electric or gas meters when the meters are ready for removal and shall be responsible for disconnection of all utilities in compliance with local requirements.

As soon as removal work has been otherwise completed and approved by the Engineer, backfilling shall be performed as described in 202.02. The final grade of backfill in areas outside the prism of construction shall be such as to present a neat, well-drained appearance and to prevent water from draining unnecessarily onto adjacent properties.

**202.07 Underground Storage Tanks, Septic Tanks and Vaults Removed or Abandoned**. Underground storage tanks, septic tanks and vaults located within the proposed project limits shall be emptied and the removed contents disposed of in accordance with 202.02 in a manner that will comply with requirements of the State and Local Boards of Health or other authorities having jurisdiction.

Underground storage tanks shall be removed in their entirety and shall become the property of the Contractor and disposed of by him. Septic tanks and vaults located above the subgrade or finished ground lines shall be removed and disposed of. When septic tanks and vaults are located below the subgrade or finished ground lines, tops and walls shall be removed to a minimum depth of three feet below these lines, floors shall be broken up into pieces not to exceed one square foot and drains that are not removed shall be sealed with masonry or with precast clay or concrete stoppers. Backfilling shall be in accordance with 202.02. **202.08 Guardrail and Fence Removed**. Where so required by the plans and proposal, existing guardrail (including any attached posts, signs and delineators) and fence shall be carefully dismantled and stored for reuse as specified or for salvage by the City. Wood posts, drums and other material not considered salvageable shall be disposed of as directed. Temporary beam rail or drums shall not be removed without the approval of the Engineer.

**202.09 Manhole, Catch Basin and Inlet Removed**. Existing drainage structures of these types designated for removal shall be removed under this item. Casting shall become the property of the City unless otherwise directed by the Engineer.

**202.10** Manhole, Catch Basin and Inlet Abandoned. Existing drainage structures of these types which are designated to be abandoned shall be removed to a minimum of three feet below the finished subgrade or ground surface in a manner that will not damage pipes that are to remain.

When directed, existing pipes shall be connected through the structure with new pipe of a type and in a manner acceptable to the Engineer, without additional cost to the City. After connecting across or sealing the existing pipes and removing walls to the required depth, remaining cavities shall be backfilled as required. When connecting pipes are used, suitable backfill shall be carefully tamped solidly under and around the pipe.

When directed, existing inlet and outlet pipes shall be sealed with precast vitrified or concrete stoppers or with masonry of a type and thickness acceptable to the Engineer.

Castings shall become the property of the City unless otherwise directed by the Engineer.

**202.11 Pipe Abandoned**. Existing pipe designated on the plans or as directed by the Engineer, to be abandoned shall be plugged and filled under this item. The ends shall be sealed as detailed on the plans or as directed by the Engineer. Starting at the lowest end the pipe shall be pumped full of cement grout filler. The filler shall be composed of 10 parts of fine aggregate 703.03 and 1 part of portland cement 701.01 by volume. The aggregate and the sand shall be thoroughly mixed dry in an approved mechanical mixer and only enough water shall be added to obtain a grout capable of being pumped.

**202.12 Method of Measurement**. When the contract stipulates that payment will be made for removal of obstructions on a Lump Sum basis, the pay item will include all structures or obstructions encountered at locations or within areas designated on the plans or in the proposal, in accordance with the provisions of this section. When the proposal stipulates that payment will be made for the removal or abandonment of specific items on a Linear foot, Square yard, Pound or Each basis, measurement will be made by the unit stipulated in the contract.

Pipe removal for reuse or storage, pipe removed, or pipe abandoned may be paid based upon the diameter size of the pipe. When the bid schedule indicates measurement based upon the diameter of the pipe, these items will be designated and measured in accordance with the following schedule of sizes:

Pipe Diameter	Pay Item
	Designation
Up to 12 inches	12 inch
Over 12 inches to 36 inches	24 inch
Over 36 inches to 57 inches	48 inch
Over 57 inches	60 inch

If no diameter measurement is given in the bid schedule, all pipe to be removed or abandoned shall be paid for at the contract price for that item.

**202.13 Basis of Payment**. The accepted quantities of structures and obstructions removed and stored or disposed of, as directed, will be paid for at the contract lump sum price bid or at the price bid per unit specified in the proposal, which prices shall be full compensation for removal and storage or disposal of such items, including excavation and backfill incidental to their removal, and the custody, preservation, storage on the project limits and disposal as provided herein.

Payment will be made at the contract price for:

Item	<u>Unit</u>	Description
202	Lump Sum	Structures removed
202	Lump Sum, Cubic Yard	Portions of structures
	Or Pound	removed
202	Linear Foot	Pipe removed for reuse or storageinch
202	Linear Foot, Lump Sum	Pipe removedinch
202	Linear Foot	Pipe abandoned inch
202	Square Yard	Pavement removed
202	Square Yard	Wearing course removed
202	Square Yard	Base removed
202	Linear Foot	Curb removed for storage
202	Each	Precast traffic dividers removed for reuse or storage
202	Lump Sum	Buildings removed
202	Each	Underground storage tank removed
202	Each	Septic tank removed
202	Each	Vault removed or abandoned
202	Linear Foot	Guardrail removed
202	Linear Foot	Guardrail removed for reuse or storage
202	Linear Foot	Fence removed for reuse or storage
202	Each	Manhole removed
202	Each	Manhole abandoned
#### 203.01

202	Each	Catch basin or inlet removed
202	Each	Catch basin or inlet abandoned
202	Each	Temporary drums removed
202	Linear Foot	Water Mains removed

# **ITEM 203 GRADING**

- 203.01 Description
- 203.02 Definitions
- 203.03 Borrow
- 203.04 General
- 203.05 Disposal of Excavated Materials
- 203.06 Tolerances
- 203.07 Embankment Construction
- 203.08 Requirements for Suitable Material
- 203.09 Construction Methods
- 203.10 Construction of Embankment and Subgrade with Moisture Density Control and Treatment of Subgrade in Cut
- 203.11 Moisture Control
- 203.12 Embankment Compaction
- 203.13 Subgrade
- 203.14 Proof Rolling
- 203.15 Method of Measurement
- 203.16 Basis of Payment

**203.01 Description**. This work shall consist of preparation of areas upon which embankments are to be placed; excavation for the roadway and channel, including the removal of all material encountered not being removed under some other item; constructing embankments with the excavated material and material from other sources necessary to complete the planned embankments; furnishing and incorporating all water required for compacting embankment and subgrade; disposing of unsuitable and surplus material; preparing the subgrade; testing the stability and uniformity of compaction of the subgrade for areas specifically called for on the plans; finishing shoulders, slopes and ditches; all in accordance with these specifications and in reasonably close conformity with the lines, grade, thicknesses and cross sections shown on the plans. All excavation shall be considered as unclassified excavation.

The Contractor shall file a "Notice of Intent to Fill" with the local approved agency of the Ohio Environmental Protection Agency for any clean hard fill that is to be removed from the site and used as fill at a different site.

Where embankment is a separate pay item, payment for roadway excavation shall be made under 203 Excavation Not Including Embankment Construction. Payment for roadway embankment shall be made under 203 Embankment, which shall include payment for furnishing suitable material from sources other than excavation if needed to complete embankments, with no separate payment for borrow for planned embankments. The Contractor shall control disposition of excavated material, using it in embankment, if suitable, or disposing of it as he desires.

Where embankment is not a separate pay item, payment for roadway excavation shall be made under 203 Excavation Including Embankment Construction, which shall include payment for placing suitable excavated material in embankment. If borrow is needed to complete planned embankments, it shall be measured and paid for separately under 203 Borrow. No excavated material shall be disposed of without permission, and all suitable material from excavation, or an equivalent volume from other sources, shall be used for planned embankments to the extent of project requirements.

When the proposal does not contain a lump sum for 201 Clearing and Grubbing or an estimated quantity for 201 Trees or Stumps Removed, or an estimated quantity for 202 Removal of Structures and Obstructions, this work shall be performed but will not be paid for directly, and shall be considered as a subsidiary obligation of the Contractor under 203.

**203.02 Definitions**. Embankment. A structure consisting of suitable material as per 203.08 constructed in layers to a predetermined elevation and cross section.

Subbase. Selected material of planned thickness placed on the subgrade as a foundation for a base or surface course. Subbase is a part of the pavement structure.

Soil. All earth materials, organic or inorganic, which have resulted from natural processes such as weathering, decay, and chemical action in which more than 35 percent by weight of the grains or particles will pass a No. 200 sieve.

Granular Materials. Natural or synthetic mineral aggregate such as broken or crushed rock, gravel, slag or sand which can be readily incorporated in an 8 inch layer, and in which at least 65 percent by weight of the grains or particles are retained on a No. 200 sieve. Open hearth and basic oxygen steel slags shall be subject to approval by the Laboratory.

Shale. Laminated material, formed by the consolidation in nature of soil, having a finely stratified structure. For the purpose of these specifications, the following bedrock types shall also be considered as shale: mudstone, claystone, siltstone and clay bedrock.

Rock. Sandstone, limestone, dolomite, glacial boulders, brick and old concrete which cannot readily be incorporated in an 8-inch layer.

Random Material. A mixture of previously defined materials suitable for use in embankment which can be readily incorporated in an 8 inch layer. Optimum Moisture. The water content at which the maximum density is produced in a soil by a given compactive effort using AASHTO Designation: T 99.

Field Testing. Testing of embankment and subgrade compaction shall be in accordance with the City of Akron Testing Laboratory procedures.

Laboratory Dry Weight. The maximum laboratory dry weight shall be the weight provided by the Laboratory when the sample is tested in accordance with AASHTO T 99.

Excavation. The excavation and disposal of all materials of whatever character encountered in the work.

Borrow. Material obtained from approved sources, outside the project limits, and used for the construction of embankments or for other portions of the work.

Engineering Fabric. Synthetic fabrics meeting the requirements of 712.09, used for subgrade reinforcement or drainage filter.

**203.03 Borrow**. Borrow shall meet the requirements for suitable embankment material set forth in this section. Borrow shall be resorted to only when sufficient quantities of suitable materials are not available from other items of the contract. Unless otherwise designated in the contract, the Contractor shall make his own arrangements for obtaining borrow and shall pay all costs involved including, but not limited to, material, delivery and placement in accordance with all of the requirements for constructing embankment. Borrow used in embankment shall be placed in accordance with all of the requirements for constructing embankment.

Borrow will not be paid for as a separate item:

- (a) Where embankment is a pay item in the contract, or
- (b) Where the Contractor elects to use borrow in place of excavation.

If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume as measured in the borrow area. All borrow areas shall be bladed and left in such shape as to permit accurate measurements after excavating has been completed. The Contractor shall notify the Engineer sufficiently in advance of opening any borrow areas so that cross section elevations and measurements of the ground surface after stripping may be taken.

Borrow areas shall meet the requirements of 105.17 and cleaning up of all borrow areas shall meet the requirements of 104.06.

**203.04** General. Excavation and embankments for the pavement, walks, roadway, and intersections shall be finished to conform to the plan cross sections

within the tolerances set forth in 203.06. The Contractor shall satisfy himself as to the nature and distribution of the materials to be excavated. The unit price bid for excavation shall apply to all materials, of whatever nature, to be excavated.

Prior to beginning excavation, grading, and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed. Limitations of areas of clearing and grubbing and of earthwork operations shall be in accordance with 108.04 and 207.

Removal of full depth asphalt pavement, portland cement concrete pavement and portland cement concrete base course will be paid for as a contract item as specified in 202.

When the Contractor's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Engineer will contact archaeological authorities to determine the disposition thereof. When directed by the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state authorities. Such excavation will be considered and paid for as extra work.

Where excavation to the finished graded section results in a subgrade of unstable soil, the Engineer may require the Contractor to remove some or all of the unstable materials, place synthetic fabric and cover material, or place aggregate refill, to the finish graded section using approved material and compacted in accordance with 203.12. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary cross sectional measurements before the backfill is placed.

(a) Drainage. During the process of excavation, the pavement area shall be maintained in such condition that it will be well drained at all times. When trenching is done for narrow base widening, ditches of an adequate depth shall be constructed to provide positive drainage to the nearest outlet. Side ditches shall be constructed, if necessary to provide a free outlet for water to insure the thorough drainage of the subgrade at all times.

The ends of all abandoned pipe lines encountered in earthwork operations shall be effectively plugged and filled, as per 202.11.

(b) Rock and Shale Excavation. Where granular subbase is not a part of the pavement design, and where rock, shale or coal is encountered in subgrade, it shall be excavated to a depth of 6 inches below the surface of the subgrade for the full cross section width of the roadway including walks, and the additional excavation so made shall be paid for at the contract unit price bid for excavation. The portion so excavated shall be filled with suitable embankment material. Where granular subbase is a part of the pavement design, excavation of rock, shale or coal below plan subgrade elevation is not required. The Contractor shall be paid for thickness of granular subbase material shown on the typical section in rock excavation areas. Rock or shale may be undercut to a uniform depth below the plan subgrade for the full cross section width of the pavement and walks. The area thus excavated shall be backfilled with embankment material suitable for use as subgrade. No payment will be allowed for this extra excavation or for the material and placement costs of the new subgrade material.

(c) Drilling and Blasting in Rock Cuts. Drilling and blasting shall meet the requirements as set forth in this section and also in 107.09. Where rock encountered in cuts requires drilling and blasting, all necessary precautions shall be exercised to preserve the rock in the finished slope in a natural undamaged condition, with the surfaces remaining reasonably straight and clean. The Contractor shall presplit rock and shale along the proposed backslopes which are designed in inclinations steeper than one to one and where depths of cut in rock or shale exceed 5 feet.

The Contractor shall first completely remove all overburden soil along the line(s) of presplitting to expose the rock surface prior to drilling the presplitting holes. The Contractor shall then drill 2-1/2 to 3 inch nominal diameter holes, spaced not more than 3 feet center to center along the required slope line and at the required slope inclination to the full depth of the cut or to a predetermined stage elevation. If any cut is presplit by vertical stages (lifts), the presplit drill holes for the next stage may be offset a distance of not more than 1 foot inside the previously presplit face, but in no case shall any of the presplit holes be started inside of the payment line. No payment will be made for additional excavation quantities caused by these offsets.

No hole shall deviate more than one-half foot at any place from the plane of specified presplit slope, or an approved offset plan as herein above provided. Also, no hole shall deviate more than 1 foot at any place from a vertical plane through the top of the hole, normal to the plane of slope.

Before placing the charge, each hole shall be tested for its entire length to ascertain the possible presence of any obstruction. No loading will be permitted until the hole is free of all obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charge will not cause caving of material from the walls of the hole. The charge for each hole shall consist of not less than one-fourth pound nor more than one pound of 40 percent dynamite per foot of hole and spaced not more than 20 inches center to center of charge, except that one-half to two and one-half pounds of dynamite shall be placed in the bottom of the hole, and except near the top of the hole the charges shall be reduced sufficiently to eliminate overbreak and heaving. The top charge shall not be less than 2-1/2 nor more than 3 feet below the top of rock.

The spacing of the dynamite charges in each hole shall be accomplished by means of securely taping (or attaching by other approved means) each piece of dynamite to the detonating fuse at the required intervals, or by deck loading. If the latter is used, the dynamite must be in intimate contact with the detonating fuse to assure detonation of all charges.

Either of the following charges may be used as an alternate, provided the results are satisfactory and with the written permission of the Engineer:

(1) Continuous column commercial explosives manufactured especially for presplitting.

(2) Multiple strands of high strength (175-200 grains of explosive per foot) detonating fuse taped together at 4 to 6 foot intervals.

All space in each hole not occupied by the explosive charge shall be filled with No. 8 size coarse aggregate meeting the requirements of 703.01. No other material or type of stemming will be permitted.

Firing shall be by means of detonating fuse extending the full depth of each hole and attached to a trunk line of detonating fuse at the surface, which shall be fired by dynamite cap(s). Permission to use any other method of detonating must be approved by the Engineer in writing.

The detonation of presplitting charges shall precede the detonation of adjacent fragmentation charges within the section by a minimum of 25 millisecond.

The cost of all material, all labor and equipment necessary for presplitting and other work included herein shall be included in the unit price bid for the pertinent 203 excavation item.

Changes may be made in details of procedure outlined in the above requirements for presplitting, including hole spacing and size, provided that written permission is secured from the Engineer and satisfactory results can be obtained.

In rock cuts, portions of rock which would be hazardous if allowed to remain, shall be removed when and as directed.

(d) Slide and Breakages. All slides and breakages beyond the finished work as planned, if caused by improper methods of excavation, shall be removed by the Contractor at his own expense. Slides and breakages beyond the finished work as planned which occur due to no fault or neglect of the Contractor shall be paid for at the contract unit price for excavation.

(e) Shoulders, Slopes and Ditches. Sod and topsoil salvaged in the scalping operations shall be placed upon areas to be seeded or sodded. With 2 inches of the surface in a loose condition, the shoulders shall be built at an elevation that

will allow subsequent operation of seeding and sodding to conform to the lines shown on the plans within the tolerances set forth in 203.06. Shoulders, slopes and ditches which have been damaged by erosion during construction shall be reshaped by the Contractor at no additional expense to the City.

(f) Pavement Widening Construction. For work performed under this item the Contractor shall, under the direction of the Engineer, locate the edges of sound pavement, and shall cut and trim the pavement to a neat line as established by the Engineer. Damage done to those areas designated for salvaging, by the Contractor's equipment or methods, shall be repaired and restored at the Contractor's expense. The old pavement materials resulting from this cutting and trimming operation shall be used or disposed of in accordance with the provisions of 203. The cost of cutting, trimming, and disposal of excavated material shall be included in the unit price bid for 203 Excavation.

**203.05 Disposal of Excavated Material**. All surplus or unsuitable excavated material, including rock or large boulders, that cannot be used in embankments shall be disposed of by one of the following methods as determined by the Engineer:

(1) Wasted adjacent to or incorporated in the regular construction where and as directed by the Engineer.

(2) Disposed of by the Contractor at his own responsibility and expense outside the limits of the project.

Material wasted outside the limits of the project shall be in accordance with the provisions of 105.17.

**203.06 Tolerances**. The Contractor shall check the work under this item with templates, slope boards or other devices satisfactory to the Engineer. The completed work shall conform to the plans within the following tolerances:

For cut and for fill slopes beyond the sidewalk or shoulder, deviations of one foot measured in a horizontal plane will be permitted. For shoulders and ditches, the horizontal measurements from the centerline shall not be less than the plan dimensions, and the elevations thereof shall not be higher than specified, but may vary not more than 1/2 inch at the sidewalk or pavement edge and 2 inches elsewhere, below the established grades. For subgrade, the surface shall at no place vary more than 1/2 inch from a ten-foot straight edge applied to the surface parallel to the centerline of the pavement, nor more than 1/2 inch from subgrade elevation established by construction layout stakes.

For excavation and embankment beyond plan lines, measurement for payment will be made only to plan lines.

**203.07 Embankment Construction**. Embankment construction shall consist of preparation of the areas upon which embankments are to be placed, and the

placing and compacting of embankment material in holes, pits and other depressions within the roadway area. Only approved materials shall be used in the construction of embankments and backfills. Frozen material shall not be placed in the embankment nor shall embankment be placed on frozen material.

**203.08 Requirements for Suitable Material**. Granular materials and shale as defined in 203.02 are suitable for use in embankment. Rock and random material will not be permitted, unless authorized by the Engineer in writing.

Soil is suitable for use in embankment outside R/W's provided it has the following characteristics:

Maximum laboratory dry weight shall be not less than 90 pounds per cubic foot, except that soils having maximum dry weights of less than 100 pounds per cubic foot shall not be used in the top 12 inches of embankment subgrade.

Silt from excavation or borrow identified as Ohio classification A-4b shall be considered suitable for use in embankment only when placed at least 3 feet below the surface of the subgrade.

Soil, in addition to the above requirements, shall have a liquid limit of not to exceed 65, and the minimum plasticity index number of soil with liquid limits between 40 and 65 shall be not less than that determined by the formula liquid limit minus 30.

**203.09** Construction Methods. When embankment is to be placed and compacted on hillsides or where new embankment is to be compacted against existing embankments, or where embankment is built half-width at a time, slopes that are steeper than 8:1 when measured at right angles to the roadway shall be continuously benched over those areas where it is required as the work is brought up in layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense.

Soil, granular material and shale shall be spread in successive loose layers, not to exceed 8 inches in thickness. The layers thus placed shall be compacted as specified in this section. Compaction of the outer 5 feet of each layer measured horizontally from the face of the slope shall be obtained with a roller capable of covering the layer to the outer edge.

If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted in a manner such that it will cause overturning of or excessive pressure against the structure. When embankment is to be placed on both sides of a concrete wall or a pipe or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

(a) Soil. All soil used in embankment shall be placed in accordance with provisions of 203.12.

(b) Granular Material. Granular material shall be compacted to the density established as satisfactory by the Engineer based on field density test. The moisture content shall be as determined by the Engineer to obtain the desired compaction.

(c) Shale. Shale which consists predominantly of fine particles which can be readily tested for compaction shall be placed and compacted in accordance with requirements for soil. Shale containing sufficient amounts of large particles to make checking of the compaction impracticable shall be broken down in placing until the voids between the shale particles are filled insofar as is practicable. When so directed by the Engineer, water shall be used to aid in breaking down the shale. Watering of the shale shall be performed in accordance with the provisions of 203.11. The moisture content and compaction shall be as directed by the Engineer.

Shale embankment, within a length of 6 times the height of the fill at an abutment, shall be sprinkled as directed by the Engineer to bring the moisture content to within a range of optimum minus 3 percent and optimum plus 2 percent. Each layer shall be rolled with at least 6 coverages of a fully ballasted tamping roller, or with other rollers satisfactory to the Engineer.

Mixtures of shale and rock shall be placed in accordance with the above noted provisions for shale. Rock in such mixtures shall be reduced in size not to exceed 8 inches or separated from the mixture and placed as rock fill.

(d) Rock. Rock fill shall be placed in not to exceed 3 foot lifts except that within a length of 6 times the height of the fill at an abutment, thickness of rock layers shall not be greater than 18 inches. Rock which cannot be incorporated into lifts of the above specified thicknesses shall be reduced in size until it can be so incorporated. Lifts made up principally of small rock shall be rolled as directed by the Engineer. Care shall be exercised in placing rock so that the side slopes will conform with the requirements of the plan.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankment as rock fill and the other material shall be incorporated into the inner portion as rolled embankment. Rolled embankment adjacent to rock fill shall be held at substantially the same elevation as the rock, but always above the rock and of sufficient width to permit the proper compaction of this portion.

The top 2 feet of all embankments shall be constructed of material other than rock according to the specifications for placing that material. Material for this upper 2 feet shall be reserved by the Contractor from the suitable excavation to the extent that it is available. Should this material be available and not be reserved, it shall be furnished and placed by the Contractor at his expense. In all cases where embankment material other than rock is superimposed upon rock, the top of the rock fill shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth.

(e) Areas Inaccessible to Rollers. Embankment in areas inaccessible to rollers shall be composed of embankment material which can readily be incorporated into a 4 inch layer, loose depth, placed and compacted in accordance with the following provisions: Embankment material, other than granular material, shall be deposited in level layers not exceeding 4 inches in thickness, loose depth, and compacted by mechanical devices to the density required in 203.12. Granular material shall be compacted as required in this section except that it may be deposited in water without compaction to a height not exceeding normal water level.

Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density.

(f) Engineering Geogrid. Where geogrid is to be placed for subgrade reinforcement, the subgrade shall be excavated to a depth shown on the plan, or as directed by the Engineer. Isolated soft areas shall be removed and refilled if directed, to result in a plane parallel to the finished subgrade surface. The prepared surface shall be free of ruts, plant material and standing water.

The geogrid shall be placed with adjacent edges overlapped at least three feet. Cover material, conforming to 203.13 (c), shall be placed in lifts between six inches and eight inches deep, and compacted according to 203.12 to the final subgrade cross section. Care shall be exercised to ensure that the geogrid is not torn or displaced, nor the underlying soil rutted or displaced, while laying geogrid and placing cover material.

203.10 Construction of Embankment and Subgrade with Moisture and Density Control and Treatment of Subgrade in Cut. All embankments, except rock embankments, shall be constructed using moisture and density control. All subgrade, except rock and shale in cut sections, shall be constructed using moisture and density control.

**203.11 Moisture Control**. Embankment and subgrade material which does not contain sufficient moisture to be compacted, in accordance with the requirements of this subsection, shall be sprinkled with water as directed by the Engineer to bring the moisture content to within the range of optimum, plus or minus 3 percent. Water shall be applied by means of tank trucks equipped with suitable sprinkling devices

and shall be thoroughly incorporated into the material which is to be compacted by means of discs or other approved equipment.

Embankment and subgrade material containing excess moisture shall be required to dry prior to or during compaction to a moisture content not greater than 3 percentage points above optimum, except that for material which displays pronounced elasticity or deformation under the action of loaded rubber tired construction equipment, the moisture content shall be reduced to optimum if necessary to secure stability. For subgrade material, these requirements for maximum moisture shall apply at the time of compaction of the subgrade, and also at the time of placing pavement or subbase. Drying of wet soil shall be expedited by the use of plows, discs, or by other approved methods when so directed by the Engineer.

**203.12 Embankment Compaction**. Embankment shall be placed and compacted in layers until the density is not less than the percentage of maximum dry density indicated in the following table determined by AASHTO T-99 or other approved method.

Max Lab Dry Wt.	Min Comp. requirements
lbs/cu.ft.	<u>% Lab. Max.</u>
90 to 104.9	102%
105 to 119.9	100%
120 and more	98%

EMBANKMENT SOIL COMPACTION REQUIREMENTS

**203.13** Subgrade. When Item 203 Subgrade Compaction is not a separate pay item, all work shall be done in accordance with this specification, but payment shall be considered to be included in the price bid for the various items requiring this work. All soil subgrade shall be prepared in accordance with this subsection. Soils with a maximum laboratory dry weight of less than 100 pounds per cubic foot are considered unsuitable for use where subgrade compaction for a depth of 12 inches is required, and when encountered in the upper 12 inches of the subgrade shall be replaced with granular material.

(a) Compaction Requirements. Soil subgrade with maximum laboratory dry weight of 100-105 pounds per cubic foot shall be compacted to not less than 102 percent of maximum dry density. All other soil subgrade shall be compacted to not less than 100 percent of maximum dry density. The maximum dry density shall be as determined by AASHTO T 99 or other approved method.

Subgrade under new pavement shall be compacted to a depth of 12 inches below the surface of the subgrade and for the entire width of the pavement or base, including curb and gutter plus 18 inches.

(b) Drainage. The surface of the subgrade shall be maintained in a smooth condition to prevent ponding of water after rains, and ditches shall be constructed and maintained in accordance with 203.04(a), to insure the thorough drainage of the subgrade surfaces at all times.

(c) Soft Subgrade. Where soft subgrade is encountered in cuts, due to no fault or neglect of the Contractor, in which satisfactory stability cannot be obtained by moisture control and compaction as provided for under 203.11 and 203.13 (a), the unstable material shall be excavated to the depth required by the Engineer. Material thus excavated shall be disposed of in accordance with 203.05.

The excavation thus made shall be filled using Aggregate Refill, Type 1 or Type 2, as directed by the Engineer as follows:

- 1. Aggregate Refill Type 1 Material shall be crushed limestone meeting the requirements of 304.02 and be placed and compacted in accordance with 304.03 and 304.04.
- Aggregate Refill Type 2 Material shall be crushed limestone or air-cooled blast furnace slag, #1 and #2 size aggregate meeting requirements of 703.02 and be placed and compacted in accordance with 304.03 and 304.04. If slag is used, it shall conform to the requirements of 703.01. The slag supplier shall be on ODOT's list of approved suppliers.

In addition to the above, the Engineer may direct the Contractor to furnish and install one of the following:

- 1. Engineering geogrid such as Tensar BX1200 in accordance with 609.
- 2. Engineering geogrid such as Tensar BX1300 in accordance with 609.

Where soft subgrade in cuts is due to the failure of the Contractor to maintain adequate surface drainage as required in 203.04(a), or is due to any other fault or neglect of the Contractor, the unstable conditions shall be corrected as outlined above at no expense to the City.

(d) Full Width New Pavement Construction. After the surface of the subgrade has been shaped to approximate cross section grade, and before any pavement, base or subbase material is placed thereon, the subgrade for a distance of at least 18 inches outside the limits of the surface of the planned pavement shall be compacted. When the rolling is completed, the surface of the subgrade shall be shaped as necessary to conform to the grade and cross section shown on the plans within the tolerance set forth in 203.06, and shall be so maintained until the overlying course is in place.

**203.14 Proof Rolling**. Proof rolling shall be performed on areas described on the plans or as directed by the Engineer.

(a) Equipment. The equipment shall consist of four heavy rubber tired wheels mounted on a rigid steel frame. The wheels shall be evenly spaced in one line across the width of the roller and shall be arranged so that all wheels will carry approximately equal loads when operated over an uneven surface. The maximum center-to-center spacing between adjacent wheels shall not exceed 32 inches. The compacting equipment shall have a suitable body for ballast loading with such capacity that the gross load may be varied from 10 to 50 tons.

The tires shall be capable of operating at inflation pressures ranging from 90 to 150 pounds per square inch. From 90 to 95 percent of the volume of the tire shall be filled with liquid. The Contractor shall furnish the Engineer charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loading for the particular tires furnished.

Ballast to obtain the weight directed by the Engineer shall consist of ingots of known weight, or sand bags with a unit weight of 100 pounds, or bags of other material of known unit weight, or other suitable material such that the total weight of the ballast used can be readily determined at all times. There shall be a sufficient amount of ballast available to load the equipment to a maximum gross weight of 50 tons.

(b) Construction. The designated areas of subgrade, prior to the placing of the overlying course, shall be compacted to requirements of 203.13. The subgrade shall then be rolled with one or more coverages, as directed, of the heavy pneumatic tired roller. One coverage shall be considered to represent two trips of the roller, each trip offset from the other by the width of one tire, to obtain complete area coverage. The roller shall be operated in a systematic manner so that the number of coverages over all areas can be readily determined and recorded.

Moisture content of the subgrade at the time of proof rolling shall conform to the requirements of 203.11.

Within the ranges set forth above, the load and tire inflation pressure shall be adjusted as directed. It is the intent to use a contact pressure as nearly as practical to the maximum supporting value of the subgrade. The equipment shall be operated at the speed directed, but in no case shall the speed exceed five miles per hour, and the normal operating speed shall not be less than 2-1/2 miles per hour.

Where the operation of the heavy pneumatic tired roller shows the subgrade to be unstable or to have non-uniform stability, the Contractor shall correct the unstable areas in accordance with the provisions 203.13 so that the stability of the subgrade will be uniform and satisfactory. The subgrade shall then be checked for conformance to the plan lines and any irregularities to the surface caused by operation of the heavy pneumatic tired roller shall be corrected, and the subgrade shall be shaped to the plan lines within the tolerance specified in 203.06.

Proof rolling will not be required where rock or shale occurs in subgrade, or in areas where subbase has been thickened to replace frost susceptible silts or other unsuitable subgrade material.

**203.15** Method of Measurement. The quantities of excavation to be paid for shall be the number of cubic yards of material in the original position, acceptably excavated, measured by the method of average end areas. Excavation outside plan lines shall not be included in measurement for payment.

(a) Contract Quantity Payment. The quantities of excavation and embankment, when embankment is specified as a separate bid item, for which payment will be made will be those shown in the contract, provided the project is constructed to the lines and grades shown on the plans, within allowable tolerances, and provided the plan quantities are adjusted to correct errors and to take into account authorized changes. Check measurements or final cross sections shall be used to establish the quantity for payment.

When the plans have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall have the right to request and cause the quantities involved to be measured in accordance with "measured quantities." When the quantities are measured for payment, the original plan cross-sections plotted on the plans, corrected for errors, if any, shall be used as original field cross sections. Additional original cross sections may be interpolated at points where necessary to more accurately determine quantities.

(b) Measured Quantities. When payment is specified on a volume basis, all accepted excavation shall be measured in its original position by cross-sectioning the area excavated, which measurements will include overbreakage or slides not attributable to carelessness of the Contractor. Volumes will be computed from the cross-section measurements by the average end area method.

Measurements will be made for unsuitable materials actually excavated and removed at the direction of the Engineer, to obtain proper stability in cut sections and in foundations for fill sections.

Where it is impracticable to measure material by the cross section method due to erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

(c) Measurement of Embankments. Where the contract does not specifically provide for payment for embankment or borrow, the work of embankment construction will not be paid for as such, but will be considered incidental to the various items of excavation.

When payment for embankment constructed with moisture and density control is specified as a separate bid item, the quantities to be paid for shall be the number of cubic yards of embankment in the completed position, acceptably placed as herein described, measured by the method of average end areas. Embankment outside plan lines shall not be included in measurement for payment.

(d) Measurement of Borrow. Borrow will be measured and paid for by the cubic yard or ton in accordance with 109.

Borrow material in a natural formation shall be measured by the method of average end areas or by weight. Where measurement by the method of average end areas is used, the borrow area shall be cross-sectioned after the surface has been cleared and scalped and again after excavating in the borrow area has been completed. The cubic yards to be paid for shall be determined from these cross sections. Where measurement by weight is used, the density of the material in its original position shall be determined by a series of representative field measurements made after clearing and scalping have been performed, and as the material in the borrow area becomes exposed by excavating operations. Acceptable material excavated from the borrow area for incorporation into the embankment shall be weighed and load slips furnished. The cubic yards to be paid for shall be determined by dividing the average weight per cubic yard of the undisturbed material as determined by the density tests into the total weight of borrow material as determined by the load weight slips.

Borrow material from sources other than natural formations, such as cinders, slag, processed stone or gravel, and quarry strippings shall be measured as follows: The weight per cubic yard of any such material in its compacted condition in the embankment shall be determined. Ninety-five percent of the density, thus determined, divided into the weight of the material furnished shall be the cubic yards of such material.

Where measurements show that completed embankment exists outside allowable tolerances, the quantity outside plan lines shall be multiplied by a shrinkage factor determined by the Engineer, and the resulting quantity shall be deducted from the measured borrow to determine the pay quantity for this item. Volume of roadway excavation outside plan lines will not be considered in the determination of deductions from measured borrow.

(e) Measurement of Subgrade Compaction. The quantity to be paid for shall be the number of square yards of subgrade acceptably compacted to a depth of 12 inches as herein described, measured by the number of square yards of pavement surface, paved median, and curb and gutter supported by the compacted subgrade. Rock and shale subgrade in cuts shall not be included in quantities measured for payment. (f) Measurement of Aggregate Refill. The quantity of aggregate refill to be paid for shall be the number of cubic yards of authorized material in place and satisfactorily compacted. The number of cubic yards shall be the calculated volume of the excavation refilled as per 203.15(b).

The accepted quantities shall be paid for at the Contract unit prices bid for Item 203 - Aggregate Refill, which prices shall constitute full compensation for furnishing all labor, material equipment, tools and incidentals including the excavation and disposal of all materials required to be replaced, and any necessary sheeting, bracing, pumping and draining required to complete the work as directed.

(g) Measurement of Proof Rolling. The quantity shall be the actual number of hours of accepted proof-rolling time. No measurement of time will be made for idle equipment due to repairs, servicing, loading or unloading ballast, increasing or decreasing tire pressure, bad weather, wet subgrade, standing by so as to be available when next needed, or for any other reason, or for the use of the equipment at times or locations other than as directed by the Engineer. The actual rolling time shall be recorded to the nearest 0.1 hour by the Contractor and will be checked by the Engineer.

**203.16 Basis of Payment**. The accepted quantities will be paid for at the contract price per unit of measurement for each of the pay items listed below that is included in the bid schedule.

Payment will be made at the contract price for:

Item	<u>Unit</u>	Description
203	Cubic Yard	Excavation including embankment construction
203	Cubic Yard	Excavation not including embankment construction
203	Cubic Yard or Ton	Borrow
203	Cubic Yard	Embankment
203	Square Yard	Subgrade compaction
203	Hour	Proof rolling
203	Cubic Yard	Aggregate Refill Type 1
203	Cubic Yard	Aggregate Refill Type 2

# **ITEM 207 TEMPORARY SOIL EROSION AND SEDIMENT CONTROL**

207.01 Description
207.02 General
207.03 Construction Requirements
207.04 Performance
207.05 Method of Measurement

#### 207.06 Basis of Payment

**207.01 Description**. This work shall consist of temporary control measures as detailed in the plans or ordered by the Engineer during the life of the contract to control soil erosion and sedimentation through use of straw or hay bales, dikes, slope protection, sediment pits including basins and dams, slope drains, coarse aggregate, mulches, grasses, filter fabric fences and other erosion control devices or methods.

The permanent control provisions contained in the contract shall be coordinated with the temporary erosion control features to the extent practicable to assure economical, effective and continuous erosion control throughout the construction and post-construction period.

Temporary control may be required for construction work outside the right-of-way such as borrow pit operations, haul roads, equipment and material storage sites, waste areas, and temporary plant sites.

#### 207.02 General.

(a) Commercial fertilizer shall be (12-12-12) and shall conform to 659.

Temporary ditch checks shall consist of straw or hay bales or coarse aggregate.

Temporary inlet filters and filter dikes shall consist of straw or hay bales or filter fabric adequately supported on fence.

Temporary dikes shall consist of suitable 203 material.

(b) Temporary seeding and mulching shall consist of annual ryegrass (Lolium multiflorum). Seed and mulching material shall be applied in accordance with 659. Sediment pits may be included as part of the slope drain protection.

Temporary sediment basins and dams shall be constructed by methods described in 203 Excavation and Embankment or 601 Rock Channel Protection, Type C. Sand or fabric filters may be required.

(c) Temporary slope drains shall consist of pipe, coarse aggregate, riprap, rock channel protection, mats, plastic sheets, or other materials. Such materials shall be approved by the Engineer before being incorporated into the work.

**207.03** Construction Requirements. Contractor shall limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and provide immediate permanent or temporary control measures to prevent contamination of adjacent streams or other water courses, and lakes, ponds, or other areas of water impoundment. Such work shall involve construction of temporary ditch checks, filters, benches, dikes, dams, sediment basins, slope drains

and use of temporary mulches, matting, seeding or other control devices or methods necessary to control erosion and sedimentation.

The Contractor shall incorporate all permanent erosion control features into the project at the earliest practicable time. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes are made available. This will require the establishing of final grades and application, if specified in the contract, of Items 659 Liming, Commercial Fertilizer, and Seeding and Mulching. When directed by the Engineer, the temporary items of fertilizer, seeding and mulching materials shall be used. Temporary control measures will be used when and as directed by the Engineer to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures will be required between successive construction stages.

The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Mulching, seeding, and other such permanent control measures shall be applied after completion of 8 feet (vertical) of embankment or cut, unless otherwise directed by the Engineer. Should seasonal limitations or embankment construction make such coordination unrealistic, temporary erosion control measures shall be taken immediately.

The amount of surface area of erodible earth material exposed at one time by clearing and grubbing, excavation, borrow or fill within the project limits shall not exceed 50,000 square feet.

The Engineer may increase or decrease the allowable amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions. Factors such as soil erodibility, slope, cut or fill height, exposed area contributing to a watercourse and weather will be considered in this determination.

In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal or State or local agencies, the more restrictive laws, rules or regulations shall apply.

Temporary seeding areas shall be fertilized at 1/2 the normal plan or specification rate of application in accordance with 659.

All areas of temporary seeding shall be seeded with lawn seed sown at the rate of 6 pounds per 1000 square feet and mulched in accordance with 659.

When, in the judgment of the Engineer, project conditions are such that incorporation of fertilizer into the soil and preparation of the seed bed cannot be performed in accordance with 659, these requirements may be waived except that temporary seed shall not be placed on frozen ground.

When directed by the Engineer, the seed bed shall be thoroughly watered in accordance with the requirements of Item 659.

When directed by the Engineer, temporary seeded areas shall be mowed in accordance with Item 659.

Temporary erosion control features shall be acceptably maintained and shall subsequently be removed or replaced when directed by the Engineer. Removed materials shall become the property of the Contractor and shall be disposed of in accordance with 203.05.

**207.04 Performance**. If, in the opinion of the Engineer, proper control of soil erosion and sedimentation is not being provided by the Contractor, the Engineer may take the necessary steps to provide corrective measures, and the cost of such services will be deducted from any monies which may be due or become due the Contractor.

**207.05** Method of Measurement. Temporary erosion and sediment control work, completed and accepted, will be measured as follows:

(a) Temporary seeding and mulching will be measured by the square yard of seeded and mulched area completed in accordance with these specifications.

(b) Temporary slope drains will be measured by the linear foot complete in place.

(c) Straw and hay bales installed will be counted and paid for by each bale staked in place.

(d) Rock required will be paid for under Item 601 Rock Channel Protection, Type C.

(e) Temporary benches, dikes, dams, and sediment basins will be measured by the cubic yard of excavation performed, including necessary cleaning of sediment basins, and the cubic yard of embankment placed at the direction of the Engineer, in excess of plan lines and elevations. (f) Filter fabric fence will be measured by the linear foot complete in place.

Control work performed for protection of construction areas outside the project limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly, but shall be considered as a subsidiary obligation of the Contractor, with costs included in the contract prices bid for the items to which they apply.

In the event that temporary erosion and sediment control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, and are ordered by the Engineer, such temporary work shall be performed by the Contractor at his expense.

**207.06 Basis of Payment**. Accepted quantities of temporary soil erosion and sedimentation control work ordered by the Engineer and measured as provided above, will be paid for at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
207	Square Yard	Temporary seeding and mulching
207	Linear Foot	Temporary slope drains
207	Cubic Yard	Temporary benches, dikes, dams, and sediment basins
207	Each	Straw or hay bales
207	Linear Foot	Filter fabric fence

## **ITEM 251 WATER MAINS - GENERAL**

- 251.01 Description
- 251.02 Responsibilities of Work
- 251.03 Excavation
- 251.04 Boring for Water Services
- 251.05 Surface Restoration
- 251.06 Materials
- 251.07 Handling of Materials
- 251.08 Cleanliness of Pipe
- 251.09 Cutting Pipes
- 251.10 Anchorages
- 251.11 Manholes
- 251.12 Valves
- 251.13 Special Castings
- 251.14 Air Release Assemblies
- 251.15 Polyethylene Encasement
- 251.16 Fire Hydrants
- 251.17 Tie-ins
- 251.18 Abandoning Mains
- 251.19 Sterilization
- 251.20 Testing
- 251.21 Piling and Cradling
- 251.22 Steel Casing Pipe
- 251.23 Access Hatches
- 251.24 Field Location of Existing Mains and Utilities

**251.01 Description**. Water mains and appurtenant structures shall be constructed as shown on the plans, in accordance with the specifications for the various items which constitute the completed water main, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

**251.02 Responsibilities of Work**. The Contractor shall furnish labor and approved materials required to install water mains and appurtenances, install new copper water services from the new mains to the property line, to excavate and assist City forces transferring existing water services from the mains to be abandoned to the new mains and, if needed, replace substandard service material, and to adjust existing mains where such mains interfere with construction of the new mains. If so noted on the plans, the Contractor shall furnish labor to set in existing mains all valves and special castings required for connection with the new mains, with materials furnished by the City. The Contractor shall furnish labor for such tie-ins, as specified in 251.17. When a tie-in is to be made with a tapping sleeve and valve,

the tap will be made by the City. All excavation, backfilling, and surface restoration required for the above work shall be performed by the Contractor and shall be considered included in the various bid items which necessitate the work.

The City will perform all necessary opening and closing of valves for all purposes related to the construction of water mains.

All survey work required for the layout and installation of the water mains shall be performed by the Contractor, unless noted otherwise on the plans.

**251.03 Excavation**. When the bid schedule contains Item 503 Excavation, the bid price shall be full compensation for excavating and backfilling the trenches in which the new mains, valves, special castings, hydrants and hydrant runs will be installed. The price shall also be full compensation for excavating and backfilling trenches required for tying into existing mains and adjusting existing mains. Granular backfill shall conform to the specifications of either 604.02 Bank Run Gravel, 304.02 Aggregate, or 310.02 (Grading A) material. When limestone or crushed concrete is required for bedding the pipe as hereinafter determined, the cost of furnishing this material shall be paid for at the price bid for 603 Limestone. Backfill or bedding containing slag or cinders will not be permitted. The cost of placing granular backfill or limestone shall be considered included in the price bid for the item which necessitated the work.

When the bid schedule does not include Item 503 Excavation, the cost of this work shall be considered included in the price bid for the item which necessitated the work.

The cost of excavating and backfilling for the construction of structures, such as manholes, anchorages, and piling and cradling, shall be included in the price bid for 503 Excavation For Structures, when such item is included in the bid schedule. When this item is not included in the bid schedule, the cost of the excavating and backfilling shall be considered included in the price bid for the various items covering such construction. Excavation and backfilling of trenches for new copper water services, and excavations and backfilling of holes for water service transfers will be as directed by the Engineer and shall be performed in accordance with the provisions and included for payment under Item 252 Trenches for Copper Water Services or Item 253 Boring for Water Services.

Removal of pavement, curb, gutter, sidewalk and other structures encountered within the excavation limits shall be included for payment under the appropriate Items of 202 Removal of Structures and Obstructions, if such items are included in the bid schedule. Structures not covered by 202 items in the bid schedule shall be removed in accordance with the provisions of 202, and payment for the work shall be considered included in the various bid items which necessitate the work.

When the bid schedule does not contain Item 201 Clearing and Grubbing, this work shall be performed in accordance with the provisions of 201, and payment for this work shall be considered included in the various bid items which necessitate the work.

All excavation and backfilling shall be performed in accordance with the provisions of 503 and/or 551 as applicable, and as hereinafter specified.

Trenches for water mains shall be excavated to a width of two feet greater than the internal diameter of the pipe to be laid, and to the depth required to lay the pipe at the grade shown on the plans or established by the Engineer. Pipes shall be laid directly on the trench bottom after it has been graded and tamped to support the pipe along its entire length, with holes for pipe bells recessed into the trench bottom, unless otherwise shown on the plans.

When excavating trenches for water mains in rock, as defined in 203.02, the Contractor shall excavate the trench to an additional depth of six inches below the proposed grade of the bottom of the pipe, and shall bring the trench depth to the grade of the bottom of the pipe with limestone bedding material meeting the requirements for Class B Bedding specified in 551.05, with holes recessed in the bedding material for the pipe bell. Slag will not be permitted for use as bedding material. The bedding material shall be compacted as specified in 203.09(e) and 203.12.

Unstable or unsuitable material encountered at the water main trench bottom, as determined by the Engineer, shall be removed to a depth specified by the Engineer, and the trench refilled to the proposed grade of the bottom of the pipe with limestone bedding material and compacted as specified above. Should it be necessary to excavate more than 3 feet below the original trench bottom, the Contractor shall receive additional compensation for the excavation below the 3-foot depth as specified in 503.08.

Excavation for appurtenant structures, such as manholes and anchorages, shall be excavated to a width sufficient to properly construct and inspect the structures, and to allow thorough compaction of backfill adjacent to the structures. Unsuitable materials at the bottom of the excavations shall be removed as specified above.

The backfill material shall be placed under and around the pipes and structures and to the top of the excavations in layers not to exceed 24 inches in thickness with mechanical tampers. Compaction of backfill shall be as specified in 551.09.

Special care shall be taken in placing and tamping backfill material under, around, and to a depth of twelve inches over top of the pipe. No boulders or rock shall be used for backfill below this level. No boulder or rock having six inches for its greatest dimension shall be used for backfilling the trench above this level. Earth shall be mixed with rock backfill to eliminate voids which could result in settlement.

All surplus or unsuitable excavated material shall be disposed of in accordance with 203.05 and the cost of such disposal shall be considered included in the price bid for the item which necessitated the work.

When excavation is to be paid for under Item 503, the cubic yards will be measured by the Engineer within the limits specified in the preceding paragraphs, after the requirements of 201 (if applicable) and 202 have been met. No allowance will be made for holes required to accommodate pipe bells or for tees or crosses set in the line for future uses. Whenever payment lines for Item 503 overlap for parallel

or intersecting trenches, the excavation within the overlapping portion will be measured once to cover the excavation for both trenches.

**251.04 Boring for Water Services**. The Contractor shall perform boring operations for copper water services when directed to do so by the Engineer. Borings shall be performed in accordance with the provisions of, and paid for under, Item 253 - Boring for Water Services.

**251.05** Surface Restoration. All street pavement or surfaces, curb and gutter, sidewalks, and driveways necessarily removed during excavation operations shall be replaced in kind by the Contractor. The surfaces shall be replaced as specified in 104.07, and in accordance with the applicable provisions of Sections 300 Bases, 400 Flexible Pavement, 450 Rigid Pavements, 456 Sidewalks, Driveways and Steps, 455 Curbing, 453 Approach Slabs, and Standard Construction Drawings, unless otherwise shown on the plans. Restoration of the surfaces shall be paid for under the applicable items of the above sections, if such items are included in the bid schedule. Restoration of surfaces not covered by separate bid items shall be restored as specified above, and payment for the work shall be considered included in the various bid items which necessitate the work.

The Contractor shall repair or replace all house drains that were damaged during the excavation operations in the manner shown on the plans or directed by the Engineer, and in accordance with the provisions of 556. When the bid schedule does not contain an item for 556 House Drain Pipe, payment for the restoration of drains shall be considered included in the bid items which necessitate the work.

The Contractor shall restore all grassy areas and replace and replant all shrubs and trees damaged during the construction of water mains and appurtenant structures, and all incidental work thereto. These surfaces shall be restored in the manner shown on the plans, or as directed by the Engineer, in accordance with the applicable provisions of 653 Topsoil Furnished and Placed, 659 Seeding and Mulching, 660 Sodding, 662 Planting Shrubs, and 663 Planting Trees. When the bid schedule does not contain the above items, the cost of the work shall be considered included in the prices bid for the various items which necessitated the work.

Unless specified otherwise, the Engineer shall determine the limits of all surface restoration.

**251.06** Materials. Unless otherwise noted in the Contract or in these specifications, the Contractor shall furnish all materials required for the complete installation of the water mains, appurtenant structures, and incidentals as shown on the plans. All materials furnished by the Contractor shall be approved by the Engineer prior to construction.

All materials required for the installation of water mains and appurtenant structures shall meet the requirements of the appropriate sections of 715.

**251.07 Handling of Materials**. The Contractor shall carefully handle and lay all pipe, special castings, valves, and hydrants to prevent damage, and special care

#### 251.08

shall be taken to prevent the pipe coating from being damaged, particularly on the inside of the pipe.

All pieces shall be carefully examined for defects, and no piece shall be laid which is known to be defective. If any defective piece is discovered after being laid, it shall be removed and replaced in a satisfactory manner by the Contractor at his own expense.

The Contractor shall protect all material from loss or damage from any cause at all times. He shall be responsible for any hydrant, valve, or other material found broken on the work site, and all parts lost or damaged shall be repaired or replaced at his expense.

**251.08** Cleanliness of Pipe. The pipe shall be thoroughly cleaned before lowered into the trench, and shall be kept clean until accepted in the completed work. The exposed ends of all uncompleted lines shall be closed with wooden or other acceptable bulkheads such as caps or plugs at all times when pipe laying is not actually in progress.

**251.09 Cutting Pipes.** Whenever ductile iron or steel pipes require cutting to fit in the line, the work shall be done at the Contractor's expense. Cuts shall be made at right angles to the pipe axis. When cutting pipe ends that will be inserted in push on joints, the circumference of the pipe shall be beveled in the manner directed by the Engineer to prevent cutting of the rubber gasket.

**251.10** Anchorages. The pipes shall be anchored against movement at all locations where unbalanced pressures occur, such as at elbows, tees, and bulkheads.

For all ductile iron or steel pipes 12 inches in diameter and larger, and for all diameters of ductile iron or steel pipes in which the internal pressure equals or exceeds 100 psi, all horizontal thrust blocks shall be constructed of concrete and shall be of the design shown on the plans. Horizontal thrust blocks and thrust blocks for bottom vertical bends for ductile iron or steel pipes less than 12 inches in diameter and with less than 100 psi internal pressure shall be hard wood blocking. Anchors for top vertical bends for ductile iron or steel pipes shall be constructed of concrete and reinforcing steel and shall be of the design shown on the plans. Top and bottom vertical bends may be restrained using ductile iron lugs and threaded bar stock in lieu of concrete thrust blocking. When the plans do not specify dimensions and/or reinforcing steel sizes for thrust block and anchorages, the dimensions and/or bar sizes shall be as determined by the Engineer.

All thrust blocks and anchorages for prestressed concrete cylinder pipe shall conform to the design and size shown on the plans.

Wood blocking shall be included for payment under the item governing the installation of the pipe being anchored. Concrete anchorages shall be constructed in accordance with the provisions of 509 Reinforcing Steel and 511 Concrete for Structures.

**251.11 Manholes**. Access manholes, air release manholes, and blowoff manholes shall be of the size, type, and design as shown on the plans. Manholes shall be constructed and paid for in accordance with the provisions of Item 562.

**251.12** Valves. Gate valves, butterfly valves, check valves, and accompanying valve boxes, Victaulic couplings, and valve stem extensions shall be installed as specified in 258. For purposes of payment, the prices bid for items listed under 258 shall include the cost of furnishing materials only. The cost of installing valves, valve boxes, Victaulic couplings, and valve stem extensions shall be included in the price bid for the item governing the installation of the pipe in which the valve will be installed.

**251.13 Special Castings**. The cost of furnishing cast or ductile iron special castings for ductile iron water mains shall be paid for at the prices bid for Item 259. The cost of installing special castings shall be included in the price bid for the item governing the installation of the pipe in which the special casting will be installed.

**251.14** Air Release Assemblies. Air release assemblies shall be of the size and type shown on the plans, and shall be installed at the locations shown. Air release assemblies shall be installed and paid for in accordance with the provisions of Item 262.

**251.15** Polyethylene Encasement. The Contractor shall furnish and install polyethylene encasement for all ductile iron, prestressed concrete cylinder and steel pipe, special castings, valves, and couplings unless determined otherwise by the Engineer. When the bid schedule does not contain an item for 261 Polyethylene Encasement, the cost of this work shall be included for payment in the item governing the installation of the material to be encased.

**251.16 Fire Hydrants**. Hydrants, hydrant valves, and hydrant run piping shall be furnished and installed as specified in Item 260. The installation of the hydrant and the laying of the hydrant run pipe and valve shall be paid for under the appropriate items governing the installation of the pipe and valve.

**251.17 Tie-Ins**. When the Contractor is responsible for tying a new main into an existing main, the tie-in shall be made at the location and in the manner shown on the plans. Cutting of an existing main for a tie-in shall be performed and paid for in accordance with 263 Tying Into Existing Mains. Furnishing and installing pipe, special castings, and sleeves required for constructing the branch to the existing main shall be performed and paid for in accordance with 254 and 259. When the plans call for tie-in to be made using a tapping sleeve and valve, the City will install the sleeve and valve as specified in 251.02.

**251.18** Abandoning Mains. The Contractor shall bulkhead exposed ends of existing mains to be abandoned at locations and in the manner specified on the plans or determined by the Engineer. The cost of the work shall be considered included in the various laying pipe items which necessitate the work.

**251.19 Sterilization**. During the laying of the main the Contractor, at his own expense, shall place a sterilizing powder meeting the requirement of 715.19 into the main at intervals so that the quantity per 100 feet of main shall be not less than the following amount:

Pipe Diameter (in.)	Ounces/100 Ft.
4	2
6	4
8	6
10	10
12	14
16	24
20	38
24	54
30	84
36	120
42	162
48	200
54	254

If an alternate type of sterilizing material is furnished, as provided for in 715.19, the material shall be introduced in the main in such a quantity that will produce a chlorine concentration of 50 ppm. All sterilizing shall be performed in accordance with the latest revision of AWWA C 651.

When pipe laying is completed, the City will fill the line for sterilizing the pipe and appurtenances, and will obtain and test a sample for bacteria. Should additional sterilization be required due to poor test results, the Contractor shall furnish additional labor to assist in the additional sterilization work but the sterilizing equipment and material will be furnished by the City. The cost of materials and labor required for the Contractor's work in sterilizing the mains shall be included in the corresponding item governing the main being sterilized.

**251.20** Testing. After the mains have been laid, and backfilled, the mains will be filled with water by the City for a leakage test.

The leakage test shall be in accordance with the latest revision of section 4, pressure and leakage test, in ANSI/AWWA C600, standard for installation of ductile-iron water mains. The mains shall be tested in lengths of less than 2,000 feet when possible. The duration of the test at full pressure shall be a minimum of two (2) hours, unless otherwise directed by the Engineer. The leakage during the test shall not exceed 11.65 gallons per day per inch diameter per mile of pipe. When testing against a closed metal-seated valve, an additional leakage allowance of 0.19 gallons per day per inch diameter per valve will be allowed.

The test shall be made by connection of a pump to a fire hydrant or a corporation stop in the main, pumping the main to the test pressure, and measuring the quantity of water required to pump the main back up to the test pressure at the end of the test period.

The mains shall be tested under a minimum pressure that is 1.5 times the static pressure at the point of testing or 50 psi higher than the maximum static pressure that the mains will experience in service, as determined by the Engineer. The minimum pressure at the highest point along the test section shall be 1.25 times the working

static pressure at that point. The duration of the test shall be two hours unless directed otherwise by the Engineer.

The Contractor shall furnish the necessary pumps, pipe, and connections for making the test, install all taps in the pipe, and shall install and remove the temporary bulkheads furnished by the City. The City will furnish gauges and measuring devices for the test, but the Contractor shall furnish all assistance necessary for conducting the test.

In the event that the main fails to meet the test requirements, the Engineer may order the Contractor to expose the joints or any section in question, repair the defective joint or replace the defective pipe, repeat the test, backfill, and restore the surface. Such additional work shall be at the Contractor's expense.

The Contractor shall be responsible for any damage to the trench, piping or appurtenances which may arise from, or in connection with, the tests and all damaged pipe or appurtenances shall be replaced by the Contractor immediately.

The cost of all material and labor performed by the Contractor in conjunction with the pressure testing shall be included for payment under the item governing the installation of the main being tested.

**251.21 Piling and Cradling**. Piling required for supporting the water main shall be of a size and type shown on the plans, and shall be driven at the locations and to the evaluations shown, or as directed by the Engineer. Piling shall be driven and paid for in accordance with the provisions of Item 507.

Reinforced concrete pile caps and cradling for the water main shall be constructed in accordance with the details shown on the plans, and paid for under Items 509 and 511. Excavation for the pile caps and cradling shall be included for payment under Item 503 Excavation For Structures.

**251.22 Steel Casing Pipe**. The Contractor shall furnish and install steel casing pipe for water mains at the locations shown on the plans, or as determined by the Engineer. Steel casing pipe shall be installed and paid for in accordance with the provisions of under Item 264.

**251.23** Access Hatches. Access hatches shall be provided in all water mains that are 30 inches and larger in diameter. The locations and number of access hatches shall be as shown on the plans. The cost of furnishing special pipe sections with access hatches shall be included in the price bid for the item governing the installation of the pipe for the main in which the special pipe section will be installed.

**251.24 Field Location of Existing Mains and Utilities**. The Contractor shall be responsible for determining the elevations and alignment of existing water mains, especially at points of connection and of all other utilities in the vicinity of the work. The Contractor will receive no extra payment for additional work required if the alignment and/or elevations of existing mains or other utilities are not as shown on the plans.

## **ITEM 252 TRENCHES FOR COPPER WATER SERVICES**

- 252.01 Description
- 252.02 Requirements
- 252.03 Classification
- 252.04 Method of Measurement
- 252.05 Basis of Payment

**252.01 Description**. This work shall consist of the excavating and backfilling of trenches for copper water services.

**252.02 Requirements.** Trenches for copper water services shall be excavated and backfilled in accordance with the provisions of 503 and as hereinafter specified.

The trenches shall have a width of thirty inches, and shall be excavated to the depth required for the installation of the service as determined by the Engineer.

Granular material shall be used for backfilling all copper water service trenches. The granular material shall meet the requirements of 604.02, Bank Run Gravel, 304.02 Aggregate, or 310.02 (Grading A) material. Backfill containing slag or cinders will not be permitted. The backfill shall be placed under and around the copper service and to the top of the trench in layers not to exceed 24 inches in thickness with mechanical tampers. Compaction shall be as specified in 551.09. Special care shall be taken in placing and tamping backfill material under, around, and to a depth of twelve inches over top of the pipe.

The cost of placing and compacting granular backfill material shall be included in the price bid for 252.

Removal of pavement, curb and gutter, sidewalks, and other structures encountered within the excavation limits, and the restoration of surfaces necessitated by the excavation of the trenches shall be included in the various bid items covering such work, as specified in 251.03 and 251.05. Work not covered by specific bid items shall be considered included in the prices bid for Item 252.

**252.03 Classification**. For purposes of payment, excavation for water service trenches shall be classified as (a) earth, or (b) rock. Earth excavation shall include all excavation not classified as rock. Rock excavation shall include excavation defined as rock in 203.02.

**252.04 Method of Measurement**. After the requirements of 201 (if applicable) and 202 have been met, the linear feet of excavated trench will be measured in place by the Engineer within the limits specified above.

252.05 Basis of Payment. Payment will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
252	Linear Foot	Trenches For Water Services In Earth
252	Linear Foot	Trenches For Water Services In Rock

The above prices shall include the cost of furnishing all labor and equipment necessary for the excavating and backfilling of trenches for copper water services, except for work designated to be included for payment under other Contract items, as specified herein.

## **ITEM 253 BORING FOR WATER SERVICES**

- 253.01 Description
- 253.02 Requirements
- 253.03 Method of Measurement
- 253.04 Basis for Payment

**253.01 Description**. This work shall consist of boring holes through earth for the purpose of installing or transferring copper water services. Boring will not be done in rock as defined in 203.02.

**253.02 Requirements**. Holes will be bored underneath the roadway for water services at locations specified by the Engineer.

The bore holes shall be left in such condition that the City may readily install the service in the bore hole or pull the service through by means of rods.

Boring length will be determined by the Engineer. Additional excavation required for the installation of a new service beyond the boring limits will be paid for at the price bid for 252 Trenches For Water Services.

The bore hole shall be at a depth specified by the Engineer.

**253.03** Method of Measurement. Boring for water services will be paid for by the actual number of linear feet bored as measured by the Engineer.

**253.04 Basis for Payment**. Payment for boring for water services will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
253	Linear Foot	Boring for water services

The above price shall include the cost of furnishing all labor, materials, and equipment necessary for boring for water services as specified herein.

254.01 Description
254.02 Materials
254.03 Installation
254.04 Joints
254.05 Method of Measurement
254.06 Basis of Payment

**254.01 Description**. This work shall consist of the furnishing, hauling, handling, and laying of ductile iron pipe for water main construction. Included in this Item are: Connecting the new pipes with the branches set in the existing mains, cutting the pipes to fit in the line where required, installing restrained hydrant runs, making all restrained joints for special castings and valves, placing wood and concrete thrust blocks, bulkheading water mains to be abandoned, sterilization of the new mains, pressure testing the new mains, and all incidental work not specifically covered by another Contract Item.

**254.02** Materials. Materials to be furnished for this work shall meet the requirements of the following sections:

Materials - General	1
Ductile Iron Pipe715.0	2
Polyethylene Encasement715.1	5
Restrained joints715.1	6
Wood Blocking	7
Gasket Lubricant	8
Sterilizing Powder	9
Anchoring Pipe	7

**254.03** Installation. The mains shall be installed in accordance with 251 Water Mains-General, and as hereinafter specified. Hydrant runs shall be constructed using ductile iron pipe meeting 715.02 or anchoring pipe meeting 715.27.

**254.04 Joints**. Push on joints with rubber gaskets for ductile iron pipe shall be made with gasket lubricant, in accordance with the pipe manufacturer's instructions. The spigot end of the pipe to be inserted in the bell shall be beveled as specified in 251.09. Ductile iron pipe used as a carrier pipe within a casing pipe shall have restrained joints as specified in 715.16.

All pipe joints at special castings, valves, sleeves, and anchoring pipe shall be made with a restraining gland as specified in 715.16. Straight pipe joints adjacent to special castings, valves, and sleeves will be made with a restraining gasket at the discretion of the Engineer.

The spigots shall be adjusted in the bells to no more than one-half of the manufacturer's maximum allowable joint deflection. The inside of the bell and the outside of the spigot must be thoroughly cleaned and all dirt, mud or grease, and all lumps, blisters or bubbles of coating removed before making the joints.

In areas where pressure is 100 psi or less, restrained joints for pipe diameters 12 inches and smaller shall be installed for a length of 15 feet on each side of the valve, bend, or offset using restraining gaskets or mechanical joint restraining glands. In areas where pressure exceeds 100 psi, restrained joints for diameters 12 inches and smaller shall be installed for a length of 30 feet on each side of the valve, bend, or offset using restraining gaskets or mechanical joint restraining glands. Restrained joints for diameters 16 inches and larger shall be installed for a length of 30 feet on each side of a valve, bend, or offset using restraining gaskets or mechanical joint restraining glands.

Butterfly valves shall be connected to ductile iron mains using either mechanical joint restraining glands or mechanical joint to Victaulic adapters and Victaulic couplings. Mechanical joint restraining glands shall be furnished under Item 254.04. Mechanical joint to Victaulic adapters shall be furnished under Item 259.

**254.05** Method of Measurement. The length of pipe to be paid for shall be the length of pipe line in place and accepted, measured along the axis of the pipe, with no deductions made for valves or special castings. In case of branch pipes, the length shall be measured from the axis of the main line to the end of the branch. Lengths of branch runs for tees and crosses set in the pipe for future use shall not be considered as length of pipe for measurements and payment.

**254.06 Basis of Payment**. Payment for laying Ductile Iron Water Pipe will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
254	Linear Foot	inch Ductile Iron Pipe

The above price shall include the cost of furnishing labor, materials, and equipment necessary to complete the work specified in 254.01 for the installation of ductile iron water mains, in the manner specified herein and in accordance with 251 - Water Mains, General. The price shall also include the cost of other related work not specifically itemized in the bid schedule, as provided for in 251 - Water Mains, General.

## **ITEM 255 PRESTRESSED CONCRETE CYLINDER PIPE**

255.01 Description 255.02 Materials 255.01

255.03 Laying Schedule
255.04 Installation
255.05 Joints
255.06 Extra Bends
255.07 Method of Measurement
255.08 Basis of Payment

**255.01 Description**. This work shall consist of the laying of prestressed concrete cylinder pipe, and the setting of valves and valve boxes, for water main construction. Included in this item are: Installation of all special pipe sections and fittings, closure pieces, adapters, couplings, and other appurtenances as may be required for completion of the concrete water main. Also included are connecting the new pipes with the branches set in the present mains, making all restrained joints at special pipe sections designed for thrust restraint, sterilization of the new mains, pressure testing the new mains, and all incidental work not specifically covered by another Contract Item. The Contractor shall furnish the material required for the above work, with the exception of valves, valve boxes, and Victaulic couplings paid for under other Contract items as specified in 251.

The furnishing and laying of ductile iron hydrant runs, the furnishing and setting fire hydrants, the construction of anchorages and manholes, the furnishing and installing of air release assemblies, and tying into existing mains shall be paid for under other Contract items as specified in 251. Excavation, backfilling, and surface restoration shall be paid for as specified in 251.03.

**255.02** Materials. Materials to be furnished for this work shall meet the requirements of the following sections:

Materials - General	715.01
Prestressed Concrete Cylinder Pipe	715.04
Gasket Lubricant	715.18
Sterilizing Powder	715.19
Polyethylene Encasement	715.15

Prestressed concrete cylinder pipe and fittings shall be prefabricated so that, when installed according to the laying schedule, the pipe will conform to the lines and grades shown on the plans.

**255.03 Laying Schedule**. The Contractor shall submit a laying schedule for approval by the Engineer prior to any construction. The schedule shall show all pertinent information required for the laying of the prefabricated concrete pipe and fittings, including but not necessarily limited to stationing, elevations, grades, laying lengths, locations of all special pipe sections and fittings, deflections, and rotations of pipe sections.

**255.04 Installation**. The pipe, fittings adapters, closure pieces, and couplings shall be installed in accordance with the manufacturer's instructions, and in accordance with 251 Water Mains-General.

**255.05** Joints. Non-restrained push-on joints shall be made with gasket lubricant. The joints shall be sealed with grout in accordance with the pipe manufacturer's specifications and instructions.

After pushing the pipes together using gasket lubricant, restrained joints shall be made with the harness clamp assembly furnished with the pipe, and shall be sealed with grout. All materials used, and the methods employed in making the joints, shall be in strict conformity with the manufacturer's specifications and instructions.

The inside of the bell and the outside of the spigot of the pipes must be thoroughly cleaned of all dirt, mud or grease and all lumps, excess metal, blisters or bubbles of coating removed before making the joint.

As soon as the joints are grouted and inspected, the pipe shall be covered with at least six inches of earth, unless ordered completely backfilled by the Engineer.

**255.06 Extra Bends.** The Contractor shall have at least two  $2^{\circ}$  and two  $4^{\circ}$  bevel adapters for use as required for unforeseen field adjustments. Such materials shall be furnished by the Contractor at his expense.

**255.07** Method of Measurement. The length of pipe to be paid for shall be the length of pipe in place and accepted, measured along the axis of the pipe, with no deduction made for valves, special pipe sections, fittings, and closure pieces. In case of branch pipes, the length shall be measured from the axis of the main line to the end of the branch. Lengths for tees, Y-branches, or crosses set in the line for future use shall not be considered as length of pipe for measurement and payment.

**255.08 Basis of Payment**. Payment for laying prestressed concrete cylinder pipe will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
255	Linear Foot	inch Prestressed concrete cylinder pipe

The above price shall include the cost of furnishing all labor, materials and equipment necessary to complete the work specified in 255.01 for the installation of prestressed concrete cylinder pipe, in the manner specified herein and in accordance with 251. The price shall also include the cost of other related work not specifically itemized in the bid schedule, as provided for in 251.

256.01 Description
256.02 Materials
256.03 Laying Schedule
256.04 Installation
256.05 Method of Measurement
256.06 Basis of Payment

**256.01 Description**. This work shall consist of laying buried steel pipe and fittings, and the setting of valves and valve boxes, for water main construction. Included in this Item are: Installation of all special pipe sections and fittings, closure pieces, adapters, couplings, and other appurtenances as may be required for the completion of the steel water main, connecting the steel pipes with branches set in the present mains, making all types of joints required for the completion of the steel work, sterilization of the steel mains, pressure testing the steel mains, and all incidental work not specifically covered by another Contract Item. The Contractor shall furnish the material required for the above work, with the exception of valves, valve boxes, and Victaulic couplings, which shall be paid for under other Contract Items as specified in 251.

The construction of anchorages and manholes, the furnishing and installing of air release assemblies, and tying into existing mains shall be paid for under other Contract Items, as specified in 251. Excavation, backfilling, and surface restoration shall be paid for as specified in 251.03. Installation of steel water pipe on bridges will be paid for under Item 251.

**256.02** Materials. Materials to be furnished for this work shall meet the requirements of the following sections:

Materials-General	715.01
Steel Pipe	715.05
Couplings	
Polyethylene Encasement	715.15
Sterilizing Powder	715.19

Steel Pipe and fittings shall be prefabricated so that, when installed according to the laying schedule, the pipe will conform to the lines and grades shown on the plans.

**256.03** Laying Schedule. The Contractor shall submit a laying schedule for approval by the Engineer prior to any construction. The laying schedule shall show where each numbered pipe section or fitting belongs in the line, and the numbers on the schedule shall correspond with those painted on the pipe sections and fittings. In addition, the laying schedule shall show other information required for the laying of the steel pipe and fittings, to the lines and grades shown on the plans, including but

not necessarily limited to stationing, elevations, grades, laying lengths, and deflections.

**256.04 Installation**. The pipe, fittings, adapters, closure pieces, couplings, and appurtenances shall be installed in accordance with 251 Water Mains-General, and as herein specified. All joints shall be of the type shown on the plans. Victaulic couplings shall be installed in accordance with the coupling manufacturer's instructions.

Where welded butt joints are permitted, the field material and the welding procedure shall conform to the latest revision of AWWA C206 - Standard Specifications for Welding of Field Water Pipe Joints. After the completion of the welding, the pipe shall be wire-brushed, cleaned and coated both on the inside as well as the outside, and wrapped on the outside in accordance with the coating requirements of 715.05.

When closure pieces are required in the field for steel pipe, the Contractor will be required to make all necessary measurements, and he shall be responsible for the correctness of the pieces.

Where plates are cut off with an acetylene torch or similar method, the burned edges shall be ground or chipped smooth before making the joints.

All pipe coating and wrapping damaged in cutting off the ends of closure pieces or other work shall be repaired as set forth in applicable sections of the American Water Works Association Specification C203.

**256.05** Method of Measurement. The length of pipe to be paid for shall be the length of pipe line in place and accepted, measured along the axis of the pipe, with no deductions for valves, special pipe sections, fittings, and closure pieces. in case of branch pipes, the length shall be measured from the axis of the main line to the end of the branch. Lengths for tees, Y-branches, or crosses set in the line for future use shall not be considered as length of pipe for measurement and payment.

**256.06 Basis of Payment**. Payment for laying buried steel water pipe and fittings will be made at the contract price for:

ItemUnitDescription256Linear Foot\_\_\_\_\_\_inch Buried steel water pipe

The above price shall include the cost of furnishing all labor, materials and equipment necessary to complete the work specified in 256.01 for the installation of buried steel water pipe and fittings, in the manner specified herein. The price shall also include the cost of other related work not specifically itemized in the bid schedule, as provided for in 251.
### **ITEM 257 EXPOSED STEEL WATER PIPE**

257.01	Description
257.02	Materials
257.03	Installation
257.04	Method of Measurement

257.05 Basis of Payment

**257.01 Description**. This work shall consist of installing exposed steel water pipe on bridge structures, including all special sections, couplings, hangers, supports, insulation, and other necessary appurtenances. Included in this Item are: Connecting the steel pipes to the ductile iron or concrete water pipes at either end of the bridge structures, cutting the steel pipes to fit in the line where required, sterilization of the steel pipe, pressure testing of the steel pipe, coating of all couplings and other uncoated portions of steel pipe, installing insulation for all pipe and couplings, and all incidental work not specifically designated for payment under another Item. The Contractor shall furnish all materials required for the above work.

**257.02** Materials. Materials required for this work shall meet the requirements of the following sections:

Materials-General	
Steel Pipe	
Couplings	
Sterilizing Powder	715.19
Insulation	

Hangers and/or supports shall be of the design, type, and size specified on the plans. Shop drawings shall be submitted to the Engineer for approval prior to construction.

**257.03 Installation**. Steel water pipe shall be installed in accordance with the applicable sections of 251 Water Mains-General, and as hereinafter specified.

Hangers and/or supports for steel water pipe shall be installed at the locations and in the manner shown on the plans.

The steel pipe shall be joined with the couplings at the locations shown in accordance with the coupling manufacturer's instructions. Expansion couplings shall be provided at the locations shown.

After installation, all couplings and other uncoated sections of the steel pipe shall be coated with the same type of material used by the pipe manufacturer for the pipe coating. The pipe and couplings shall be wrapped with a tight canvas, and the coating material poured into the space between the canvas and the pipe or coupling. After coating, the entire length of pipe and couplings shall be covered with insulation and protective jacket. Insulation and jacket shall be installed in accordance with the manufacturer's instructions.

**257.04** Method of Measurement. The length of pipe to be paid for shall be the total length of pipe installed and accepted, measured along the axis of the pipe. No deductions will be made for couplings or special sections.

**257.05** Basis of Payment. Payment for installation of exposed steel water pipe will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
257	Linear Foot	inch Exposed steel water pipe

The above price shall include the cost of furnishing all labor, materials, and equipment to complete the work as herein specified.

## **ITEM 258 VALVES**

- 258.01 Description
- 258.02 Materials
- 258.03 Installation
- 258.04 Method of Measurement
- 258.05 Basis of Payment

**258.01 Description**. This work shall consist of the furnishing of gate valves, butterfly valves, check valve, valve boxes, polyethylene encasement, Victaulic couplings and cast or ductile iron mechanical joint bell to shouldered Victaulic adapters for use with butterfly valves.

**258.02 Materials.** Materials to be furnished under this Item shall meet the requirements of the following sections:

Materials-General	
Mechanical Joint Bell to Victaulic Adapters	
Gate Valves	715.06
Butterfly Valves	
Check Valves	
Valve Boxes	
Victaulic Couplings	
Polyethylene Encasement	
Tapping Sleeve and Valve	
Valve Stem Extensions	

**258.03** Installation. Valve stems and valve boxes shall be set plumb, and the valve boxes set to grade. Valves shall be installed with polyethylene encasement.

Valves with flanged ends shall be installed in accordance with the valve manufacturer's instructions.

When the finished operating nut depth is more than six feet below grade, valve shall be furnished with a valve stem extension to raise the operating nut to a depth of four feet.

Butterfly valves with shouldered ends shall be joined to the pipe ends using either mechanical joint restraining glands or Victaulic couplings. Special pipe sections with shouldered Victaulic ends will be provided in the mains for this purpose, as specified in 715.03, 715.04, 715.05, and 715.09. Victaulic couplings shall be installed according to the manufacturer's instructions.

**258.04** Method of Measurement. The number of valves be paid for shall be the number of valves actually furnished and accepted in the completed water main.

**258.05 Basis of Payment**. Payment for furnishing valves will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
258	Each	inch Gate valve
258	Each	inch Butterfly valve
258	Each	inch Check valve

The prices bid for furnishing gate valves and butterfly valves shall include the cost of furnishing a valve box to be installed with each valve. The price bid for furnishing butterfly valves shall also include the cost of furnishing two Victaulic couplings for installing each valve, including gaskets and bolts. The cost of installing the above materials shall be included in the price bid for the item governing the pipe in which the valve will be installed.

### **ITEM 259 SPECIAL CASTINGS**

259.01	Description
259.02	Materials
259.03	Method of Measurement
259.04	<b>Basis of Payment</b>

**259.01 Description**. This work shall consist of furnishing cast or ductile iron special castings, and cast or ductile iron flange and bell pipe, for installation in ductile iron water mains. Cast or ductile iron special castings include items such as tees, bends, crosses, sleeves, adapters, reducers, and plugs. Special castings furnished shall be of the sizes and types shown on the plans.

Restrained joints for mechanical or push-on bells shall be made in accordance with 254.04.

**259.02 Materials.** Materials to be furnished under this item shall meet the requirements of the following sections:

Materials-General	715.01
Special Castings	715.03
Restrained Joints	715.16

**259.03** Method of Measurement. The number of special castings of a given size and type to be paid for shall be the actual number of such castings installed in the completed water main.

**259.04 Basis of Payment**. Payment for furnishing special castings will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
259	Each	inch Casting, special

### **ITEM 260 FIRE HYDRANTS**

- 260.01 Description
- 260.02 Materials
- 260.03 Installation
- 260.04 Method of Measurement
- 260.05 Basis for Payment

**260.01 Description**. This work shall consist of the furnishing and setting of fire hydrants for water mains.

**260.02 Materials**. Materials required for this work shall meet the requirements of the following sections:

Materials-General	
Fire Hydrants	
Restrained Joints	
Wood Blocking	
Anchoring Pipe	

**260.03 Installation**. Excavation, backfilling, and surface restoration required for the setting of fire hydrants shall be performed and paid for in accordance with 251.03 and 251.05. Hydrants shall be handled in accordance with 251.07.

#### 260.04

Excavation for hydrants shall be made to a depth of six inches below the bottom of the hydrant and the hydrant set firmly on a suitable stone or concrete block not less than one-foot square. The lower two and one-half feet of the excavation shall be refilled with #57 washed gravel meeting the material requirements for coarse aggregate specified in Table 703-1 of 703.01. Gravel containing slag or cinders will not be permitted.

Hydrants shall be set on the end of the hydrant run pipe, carefully to grade as designated by the bury line on the hydrant barrel, plumb, and square to the street line. Hydrants shall be blocked against thrust as specified in 251.10. The hydrant drain holes shall be kept free of all blocking so as to provide drainage during shutdown.

All joints between the hydrant inlet bell and the branch of the hydrant tee shall be restrained in accordance with 254.04.

Following the successful completion of the water main pressure test, the Contractor shall be responsible for rotating the steamer nozzle perpendicular to the street from which the hydrant is connected.

**260.04** Method of Measurement. The number of fire hydrants to be paid for shall be the number of hydrants furnished, installed and accepted on the completed water main.

**260.05 Basis of Payment**. Payment for fire hydrants will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
260	Each	Fire Hydrants

The above price shall include the cost of furnishing all labor, materials, and equipment necessary for furnishing and installing the hydrant as herein specified, including furnishing and placing a stone or concrete foundation block, a wood thrust block if required, and the gravel drain for the hydrant. The price shall also include the cost of other related work necessitated by the installation of the hydrant when such work is not specifically itemized in the bid schedule, as provided for in 251.

## **ITEM 261 POLYETHYLENE ENCASEMENT**

- 261.01 Description
- 261.02 Method of Measurement
- 261.03 Basis of Payment

**261.01 Description.** This work shall consist of furnishing and installing polyethylene encasement for all ductile iron, prestressed concrete, or steel pipe,

special castings, valves, and couplings at all locations shown on the plans or as otherwise directed by the Engineer. Polyethylene encasement shall be installed according to and meet the material requirements of 715.15.

**261.02** Method of Measurement. Installation of polyethylene encasement will be paid for by the linear foot. Measurement for payment will be on the actual number of linear feet of water main, fittings, valves, and couplings that are encased, for each size of water main.

261.03 Basis of Payment. Payment will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>	
261	Linear Foot	Polyethylene encasement	_inch pipe

The above price shall include the cost of furnishing all labor and materials necessary to complete the work herein specified.

### **ITEM 262 AIR RELEASE ASSEMBLIES**

- 262.01 Description
- 262.02 Materials
- 262.03 Installation
- 262.04 Method of Measurement
- 262.05 Basis of Payment

**262.01 Description**. This work shall consist of furnishing and installing manual and automatic air release assemblies for water mains.

**262.02** Materials. Materials required for this work shall meet the requirements of the following sections:

Materials-General	715.01
Air Release Assemblies	715.12
Valve Boxes	715.10

**262.03 Installation**. Manual air release assemblies shall be installed with the materials, and in the configuration shown on the plans. A valve box shall be used to enclose the manual air release assembly on underground water mains.

The automatic air release valve and brass gate valve shall be installed as shown on the plans. The automatic air release assembly on underground water mains shall be installed in a manhole structure. The manhole shall be as shown on the plans or as directed by the Engineer. The City shall make all taps in ductile iron pipes for the installation of air release assemblies. For concrete and steel pipe, air release assemblies shall be installed in the taps provided by the pipe manufacturer.

**262.04** Method of Measurement. The quantity of air release assemblies to be paid for shall be the actual number of such assemblies furnished, installed and accepted on the completed water main.

**262.05 Basis of Payment**. Payment for air release assemblies shall be made at the contract unit price for:

Item	<u>Unit</u>	Description
262	Each	inch Automatic air release - tap required
262	Each	inch Automatic air release - no tap required
262	Each	inch Manual air release - tap required
262	Each	inch Manual air release - no tap required

The unit price shall include the cost of furnishing all labor, materials, and equipment necessary to install the air release assemblies as herein specified.

## **ITEM 263 TYING INTO EXISTING MAINS**

- 263.01 Description
- 263.02 Location of Existing Main
- 263.03 Existing Main Shut Off
- 263.04 Excavation
- 263.05 Cutting Pipes
- 263.06 Method of Measurement
- 263.07 Basis of Payment

**263.01 Description**. This work shall consist of cutting into existing ductile or cast iron water mains for the purpose of connecting new water mains to the existing water system. The work does not include the installation of the pipe and special castings required to construct the branch for connection to the new main, which shall be performed in accordance with, and paid for under, Item 254.

**263.02** Location of Existing Main. The Contractor shall be responsible for determining the elevation and alignment of the water main to be tied into, as specified in 251.24. The Contractor will receive no additional payment for re-excavation of the new main previously installed if alignments and elevations are not as shown on the plans.

**263.03** Existing Main Shut Off. The existing main to be cut will be shut off by the City at a time established by the City. The Contractor will not be compensated

for down time should the shut down take longer than anticipated. The City does not guarantee that a water tight shut down will be obtained, and the Contractor may have to work with some water in the pipe. The Contractor shall pump all water out of the existing main, if so directed by the Engineer.

**263.04 Excavation**. Excavation, backfilling, and surface restoration required for exposing the existing main for the tie-in shall be performed and paid for in accordance with 251.03 and 251.05.

**263.05** Cutting Pipes. The existing main shall be cut to permit the installation of the pipe and special castings for the branch as shown on the plans. The pipe shall be cut so as to leave a smooth end at right angles to the axis of the pipe. The cut ends of the existing main shall be cleaned and beveled as directed by the Engineer before installation of the pipe and special castings.

**263.06** Method of Measurement. The quantity of tie-ins to be paid for shall be the number of tie-ins completed and accepted on an existing main.

**263.07 Basis of Payment**. Payment for tie-ins will be made at the contract unit price for:

Item	<u>Unit</u>	<b>Description</b>	
263	Each	Tying into	inch main

The unit price shall include the cost of furnishing all labor and equipment necessary to cut and clean the existing main for the connection of special castings or pipe, including pumping of water out of the existing main when required, as herein specified.

### **ITEM 264 - STEEL CASING PIPE**

264.01 Description
264.02 Materials
264.03 General
264.04 Installation Procedures
264.05 Method of Measurement
264.06 Basis of Payment

**264.01 Description**. This item shall consist of furnishing all necessary labor, materials and equipment to furnish and install, at the location shown on the project plans, the steel casing pipe as shown on the plans, or as directed by the Engineer. This work shall include the excavation, boring and jacking, dewatering, sheeting, working shafts, steel casing, stainless steel casing spacers, granular material,

#### 264.02

grouting and all appurtenances which are required for the proper completion of the work.

In all cases the Contractor shall be responsible for meeting the requirements of all applicable building and safety codes; and it shall be the Contractor's responsibility to use methods and materials which will adequately protect the work and the people employed thereon.

**264.02 Materials**. Materials to be furnished for this work shall meet the requirements of the following sections:

Materials-General	715.01
Steel Casing Pipe	715.14

**264.03 General.** Horizontal boring and jacking is specialized construction, and the Contractor must demonstrate to the Engineer that he is fully qualified and experienced in this work, otherwise he will be required to sublet this work to a firm with ability and experience acceptable to the Engineer in this specialized field.

The Contractor shall submit to the Engineer complete detail drawings describing all materials he proposes to use and method of construction intended in his performance of this work. These drawings must receive the Engineer's approval prior to commencement of work.

**264.04 Installation Procedures**. Jacking equipment shall be set up in a trench or shaft with a backstop erected to counterbalance the thrust developed by jacking the casing pipe. Working shafts required for the construction shall be located at the ends of the casing. Sizes of the shafts and the type of sheeting to be used shall be approved by the Engineer. The backstop shall be constructed of heavy timbers, rails or structural shapes as approved by the Engineer and shall be securely anchored to prevent any lateral displacement which would cause misalignment of the pipe during the jacking operation. The guide timbers and other members supporting the casing pipe shall be accurately placed in line and set to grade.

Pressure shall be applied by the jacks to produce a thrust coaxial with the casing pipe. Pressure on the casing pipe shall be maintained at all times, except when another section is added. The following section shall be placed on the guides, and connected with a full penetration weld.

All materials encountered shall be excavated, regardless of the nature thereof, by approved boring methods and all excavated material must be removed and disposed of in accordance with 105.17. Excavation shall be confined within the limits of the casing and executed in such a manner as to eliminate any settlement in the ground over or near the casing.

Alignment and grade shall be checked at regular intervals as directed by the Engineer, and if any deviation is found, corrections shall immediately be made in a manner satisfactory to the Engineer to return the casing to the proper alignment and grade. If significant deviations in the alignment or grade of the casing pipe render it unacceptable for the installation of the carrier pipe, then the Engineer will direct the Contractor to remove or abandon the casing pipe installed and proceed with an alternate installation. No payment will be made for casing pipe that is installed and subsequently removed or abandoned.

In lieu of the casing pipe installation shown on the plan, the Contractor may elect to install a tunnel liner. The tunnel liner may be used subject to the approval of the Engineer and will be paid at the unit price bid for the casing pipe.

The Contractor shall furnish and maintain the necessary electric lighting and ventilating installations which are required by the State and City codes. He shall also provide such barricades, lights, flagmen, and watchmen above ground as may be necessary or as ordered by the Engineer, for the proper protection of persons and property. No extra payment will be allowed for lights, barricades, watchmen, flagmen, etc., associated with this work.

Carrier pipe shall be furnished and placed in accordance with the appropriate item indicated on the plans. The carrier pipe shall be installed and fixed in correct alignment using casing spacers as described in 715.22.

The casing pipe shall be thoroughly lubricated to facilitate sliding the carrier pipe into place. The carrier pipe installation sealing the end of the casing pipe and filling the annular space between the casing and carrier pipes with blown sand or other material shall be in accordance with the plans.

Voids around the outside of the casing shall be grouted with a mixture consisting of one part Portland cement and one part mortar sand, thoroughly mixed with sufficient water to permit a steady flow under pressure through the grout pipes. Proportions of the grout may be varied when field conditions so require and the Engineer so directs. Should it be necessary to decrease the setting time of the grout, quick setting cement or an approved admixture shall be used as directed by the Engineer.

The grouting equipment shall have adequate capacity and design to properly and expeditiously handle the required volume of grout at the pressures necessary to completely fill all voids outside the casing. Arrangements shall be made before starting the work for an ample supply of grouting materials to avoid interruptions once underway. Upon the completion of satisfactory grouting operations at a particular location, the grout pipe shall be removed from the grout hole after the grout has taken its initial set. The space occupied by the grout pipe shall be completely filled with a stiff cement mortar and troweled smooth.

**264.05** Method of Measurement. The quantity to be paid under this item shall be the actual number of linear feet of steel casing pipe complete in place,

### 264.06

measured horizontally along the centerline of the casing pipe actually in place and accepted.

**264.06 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

 Item
 Unit
 Description

 264
 Linear Foot
 \_\_\_\_\_" Steel Casing Pipe (\_\_\_\_" Min. Wall)

### **ITEM 265 WATER MAIN VALVE BOXES ADJUSTED**

- 265.01 Description
- 265.02 Material
- 265.03 Construction Methods
- 265.04 Method of Measurement
- 265.05 Basis of Payment

**265.01 Description**. This item shall consist of raising or lowering water main valve boxes to conform to the grade of the pavement, sidewalk or other improvements.

**265.02** Material. If any new valve box castings are needed, except as provided under Section 107.13, they will be furnished by the City of Akron, Division of Water Distribution.

**265.03** Construction Methods. The Contractor shall excavate, by hand, around all water main valve boxes sufficient to permit their adjustment after which he shall raise or lower the box as necessary to conform to the grade of the new pavement, sidewalk or other improvement and maintain the box in its proper position until the improvement is completed.

**265.04 Method of Measurement**. The quantity to be paid for shall be the number of valve boxes actually adjusted to grade. The number of boxes shall be determined by counting them complete in place.

**265.05 Basis of Payment**. Payment for accepted quantities shall be made at the contract price for:

ItemUnitDescription265EachWater Main Valve Boxes Adjusted

The above price shall constitute full compensation for furnishing all labor, materials, equipment tools and incidentals necessary to complete the item as specified.

## **ITEM 266 TAPPING WATER MAINS AND INSTALLING SERVICES**

266.01	Description
266.02	General
266.03	Materials
266.04	Other Work
266.05	Installation Procedures
266.06	Inspection and Testing
266.07	Method of Measurement
266.08	<b>Basis of Payment</b>

**266.01 Description**. Water mains shall be tapped and service lines installed of the size and at the location specified by the Engineer in accordance with these specifications, materials, and methods or as established by the Engineer.

**266.02 General**. The Contractor shall demonstrate to the Engineer that he is fully qualified in this field and has satisfactorily completed work of this type. If the Engineer determines that the Contractor has not demonstrated that he is fully qualified in this type of work, he shall sublet this work to those with ability and experience acceptable to the Engineer in this type of work.

**266.03** Materials. The Contractor shall furnish all water service materials, including piping, fittings and valves. Contractor shall use proper and suitable tools and appliances for the safe and convenient handling and pipelaying.

Materials to be used in this work shall meet the requirements of the following sections.

Polyethylene Encasement	715.15
Brass Service Fittings	
Copper Tubing	
Curb Boxes	
Tapping Saddles	

**266.04 Other Work**. Other work to be furnished in conjunction with the installation of water main service taps shall meet the requirements of the following sections.

Item 252 - Trenches for Copper Water Services Item 253 - Boring for Water Services

The Engineer shall determine which of the above methods of work will be used to install the service.

**266.05** Installation Procedures. Taps for corporation stops will be installed in place on active or inactive polyethylene-encased water mains. Corporation taps will be installed at either a ten o'clock or two o'clock position on the circumference of the pipe, screwed directly into a tapped and threaded hole in the main. Taps 1 inch in diameter shall be installed in water mains without any additional appurtenances. Taps  $1\frac{1}{2}$  inches and larger in diameter in water mains less than 12 inches in diameter shall be installed with a saddle.

The Contractor shall be prepared and shall have on the site all equipment, materials, and personnel needed to install the tap in an expeditious manner. After the size and location of the tap are identified, the site over the main shall be excavated and necessary procedures followed to ensure safety to the workers and to not cause an inconvenience to the public.

After the entire circumference of the pipe has been carefully exposed, its exterior and wrapping shall be cleaned of soil, standing water, and debris to a minimum of six inches below the water main. All taps shall be made on active mains under pressure or taps made for pipe sterilization using a tapping machine which clamps onto the pipe barrel.

Corporation taps shall have tapered AWWA threads on the inlet side and flared copper on the outlet side. Bits shall be clean and sharp and properly lubricated according to the manufacturer's instructions. The tapping machine shall bore and thread the hole into the main before the closed corporation stop is inserted to a depth where one to three threads are exposed and the machine removed.

The corporation stop shall be installed by tapping directly through the polyethylene encasement after applying two or three wraps of polyethylene tape to cover the area where the tap is to be made. After the tap has been completed, the work will be inspected by the Engineer and cuts in the polyethylene and any other damage to the film shall be repaired with polyethylene adhesive tape as described in the latest revision of AWWA Specification C105.

After the tap has been made and the corporation stop installed, a length of copper tubing shall be attached between the outlet and the curb stop at the location determined by the Engineer. The copper tubing shall be given shallow bends, if necessary, to maintain its proper depth and supported with permanent wooden blocking within two feet of the corporation stop to prevent any undue stress loading on the tap threads. Another length of copper tubing shall be connected between the outlet of the curb stop to the property line or other location designated by the Engineer where the service line shall terminate. A curb box and rod shall be installed over the curb stop. (Copper service lines shall be wrapped with polyethylene encasement or a suitable dielectric tape for a minimum clear distance of three (3) feet away from the water main.)

The Contractor shall install at the end of the service line a flared copper to copper union to which the houseline shall be attached. If no houseline exists, a short piece of copper tubing no less than six inches long shall be connected to the union and the end crimped.

The minimum depth of the service line at any point shall be no less than  $4\frac{1}{2}$  feet and shall maintain the minimum horizontal and vertical clearance distances from sewers and other utilities and structures as required by the Engineer.

**266.06 Inspection and Testing**. After the work has been completed, the tap, service line and fittings will be tested to line pressure and inspected for leakage by the Engineer. If any leaks are present, the Contractor shall replace any or all of the components of the tap, service line, and fittings to the satisfaction of the Engineer to stop any leakage noted. After the service has been tested, inspected, and approved, the Contractor shall submit the following information regarding the work to the Engineer:

Name of Contractor Date and time of installation Lot number and address Fittings used Primary and secondary locations of curb or meter box referenced from property line and other aboveground water appurtenances Length of service from tap to curb box Service line material used Depth of service Tap size Main size Box number

**266.07** Method of Measurement. After the work has been inspected and approved by the Engineer, the diameter of the service line and the linear feet of service line installed from the corporation stop to the copper-to-copper union fitting will be measured in place by the Engineer.

**266.08 Basis of Payment**. Payment for the above work shall include the cost of furnishing all material, equipment, and labor necessary for the proper tapping and installation of water service lines as specified herein. Compensation for excavating trenches, boring, installing meter pits, and restoration of pavement and other areas will be paid for under their respective items as described in other work.

### **ITEM 267 FIRE HYDRANT RELOCATION**

- 267.01 Description
- 267.02 Materials
- 267.03 Contractor Qualification
- 267.04 Installation
- 267.05 Method of Measurement
- 267.06 Basis for Payment

**267.01 Description**. This work shall consist of furnishing materials, and removing and relocating existing fire hydrants and fire hydrant runs which conflict with other planned work.

**267.02** Materials. Materials required for this work shall meet the requirements of the following sections:

Materials – General	715.01
Ductile Iron Pipe	
Couplings	
Fire Hydrants	
Restrained Joints	
Wood Blocking	
Gasket Lubricant	
Sterilizing Powder	
Anchoring Pipe	

**267.03 Contractor Qualification**. Fire hydrants and hydrant run relocations may be scheduled to be performed by the Akron Public Utilities Bureau forces or, if conditions predicate, by a qualified Contractor. A Contractor will be deemed qualified after showing competence and previous experience of performing similar water main work. The choice of installer will be at the discretion of the Akron Public Utilities Bureau.

**267.04 Installation**. Installation shall be performed and paid for in accordance with Items 251.03, 251.05, 254, and 260.

**267.05** Method of Measurement. The length of hydrant run to be paid for shall be the length of pipe in place and accepted, measured along the axis of the pipe; and the number of hydrants to be paid for shall be the number of hydrants furnished, installed, and accepted.

**267.06 Basis of Payment**. Payment for fire hydrants and hydrant runs will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
254	Linear Foot	Water Main
260	Each	Fire Hydrants

The above prices shall include the cost of furnishing all labor, equipment, and materials, and the removal of scrap materials for the excavation, restoration, and installation of fire hydrants and hydrant runs as specified herein.

## **300 BASES**

### ITEM 301 BITUMINOUS AGGREGATE BASE

301.01 Description
301.02 Composition
301.03 Materials
301.04 Mixing Plants
301.05 Plant Ticket
301.06 Spreading and Finishing
301.07 Thickness Tolerance
301.08 Method of Measurement
301.09 Basis of Payment

**301.01 Description**. This work shall consist of constructing a base course of aggregate and bituminous material, mixed in a central plant and spread and compacted on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, and typical sections shown on the plans or established by the Engineer.

The general plant mix specifications, 401, shall apply; deviations from these are as follows:

**301.02** Composition. The gradation of the aggregate portion of the mix shall be within the limits in the following table:

Sieve	Total Passing, % by wt.	
2 inch	100	
1 inch	75-100	
1/2 inch	50-85	
No. 4	25-60	
No. 8	15-45	
No. 16	10-35	
No. 50	3-18	
No. 200	1-7	

The Contractor shall submit for the Laboratory's approval the desired percentage of the aggregate passing the No. 4 sieve which will produce a satisfactory mix. The Laboratory will then establish the required bitumen content within a range of 4 to 8 percent. Changes in these job-mix formula values due to unsatisfactory results or other conditions shall be made only as authorized by the Laboratory.

301.03 Materials. Materials shall be:

Aggregate	
Asphalt Binders	
Mineral Filler	

For asphaltic concrete 301 the Contractor shall have a choice of using all virgin materials, or a combination of virgin materials with reclaimed materials up to a maximum of 30 percent recycled materials.

All asphaltic materials removed shall become the property of the Contractor unless otherwise noted on the plan or in the Proposal.

All recycled hot mix projects shall be constructed in accordance with the following:

- a. Option of crushing or milling of pavement to be left to the Contractor.
- b. The job mix formula shall fall within the specification limits of the item specified.
- c. The combination of reclaimed asphalt, and new asphalt shall meet requirements of PG64-28 when recovered by the Abson Method.
- d. The Contractor shall submit test results showing the percentages of reclaimed materials, new aggregates, and new asphalt required to meet the Job Mix Formula for the Engineers approval.
- e. Reclaimed materials shall be identified as to material contents.

When reclaimed materials are used, the acceptance procedures shall be the same as for the original specified bid item of work.

## **301.04 Mixing Plants**. As specified in 401.05.

**301.05 Plant Ticket**. Total net weight of all loads of mixture shall be recorded in triplicate upon Plant Ticket forms.

With each load delivered to the project, the driver shall present one copy of the plant ticket to the Engineer or Inspector in charge, and another to the authorized representative of the Contractor. Any changes in the amount set forth on the tickets, necessitated by the rejection of any material or in the designation as to where material is used, shall be noted by the Engineer or Inspector upon all copies, and a reason stated for such rejection. At any time during the delivery of material, for the purpose of checking the operation and weighing equipment of the plant, the Engineer may direct the Contractor to weigh or cause to be weighed on tested and approved scales at the Contractor's expense, the contents of any truck that is to be delivered to the project.

**301.06** Spreading and Finishing. The maximum compacted depth of any one layer shall be four inches. The variation of the surface from the testing edge of a 10-foot straightedge shall not exceed 3/8 inch, except that when this item is used as a subbase for 305, 451, or 452 the variation shall not exceed 1/4 inch.

Variations in excess of slope or surface tolerances shall be corrected by adding or removing material in a manner satisfactory to the Engineer. The Contractor may use asphalt concrete approved by the Engineer.

At no time shall the temperature of the mixture upon arrival at the project site be below a minimum of  $140^{\circ}$  C (280° F) or above a maximum of  $165^{\circ}$  C (325° F).

The temperature of the mixture at the time of placement shall be a minimum of  $120^{\circ}$  C (250° F).

**301.07** Thickness Tolerance. The average thickness of the base shall not be more than 1/4 inch less than the specified thickness, determined as hereinafter specified. As used herein, a lot shall be defined as the amount of bituminous aggregate base completed to design thickness in one day's work.

The lot average thickness shall be determined from the mean thickness of five cores taken at random from each lot. The thickness of each core shall be determined by the average of three measurements of each core. No allowance shall be made for bases exceeding the specified thickness. If the thickness of a core as determined above exceeds the specified thickness, the specified thickness shall be used to determine the average thickness of the lot.

In areas designated by the plan as variable thickness, no cores will be taken.

Lots will be paid for in accordance with the following schedule:

#### Thickness Adjustment of Bid Price Per Lot

Lot average (5 samples)	Percent of contract	
deficiency in thickness	<u>price paid</u>	
0 to .25 inch	100	
.26 to .35 inch	90	
.36 to .45 inch	70	
.45 to .55 inch	40*	
.55 and over	0*	

\*The Contractor will be given the opportunity to use accepted methods, approved by the Engineer, to bring the course into tolerance. If this cannot be accomplished, the course shall be removed and replaced at the Contractor's expense.

**301.08 Method of Measurement**. The quantity of Bituminous aggregate base course to be paid for under this item shall be the number of cubic yards of base course placed and finished in accordance with the plans and these specifications.

The gross, tare and net weight of each truck load of mixture shall be recorded to the nearest 100 pounds in duplicate on plant ticket forms. The Engineer reserves the right to assign an RPR and/or ticket writer to the Contractor's plant. One copy of the plant ticket shall accompany each load delivered to the paver and shall be presented to the Engineer.

The total of the weights recorded on the plant tickets representing mixture finished in accordance with contract requirements shall be converted to cubic yards for payment using the conversion factors in the following table. However, when there is a mix design available on the project, the Laboratory shall establish the conversion factor to be used for the approved mix design.

When courses of uniform thickness are specified, the number of cubic yards to be paid for shall not exceed the quantity calculated from plan lines and dimensions.

Aggregate	Pounds per Cubic Yard
Gravel and Stone	4000

**301.09 Basis of Payment**. Payment for accepted quantities shall be made at the contract unit price bid which price shall constitute full compensation for the base course complete in place, including the furnishing of materials, labor, equipment, tools and incidentals necessary to complete this Item as specified; provided, however, that for Bituminous Aggregate Base course found deficient in thickness, only the reduced price as determined in 301.07 shall be paid.

No payment will be made for quantities of Bituminous Aggregate Base course in excess of the quantity calculated from plan lines and dimensions.

Payment will be made at the contract unit price for:

ItemUnitDescription301Cubic Yard\_\_\_\_\_\_inch Bituminous aggregate base

## **ITEM 302 ASPHALT CONCRETE**

- 302.01 Description
- 302.02 Composition
- **302.03** Spreading and Finishing
- **302.04** Surface Tolerances

### 302.05 Basis of Payment

**302.01 Description.** This work shall consist of constructing an intermediate course of aggregate and asphalt cement mixed in a central plant and spread and compacted on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades and typical sections shown on the plans or established by the Engineer.

The general plant mix pavement specifications, 401, shall apply; deviations from these are as follows.

**302.02 Composition.** Prior to producing bituminous mixtures, the Contractor shall submit, in writing to the Engineer for review and approval, a proposed job-mix formula for the proposed aggregate. The job-mix formula shall be in accordance with 441.02 of the 2002 Ohio Department of Transportation Construction and Material Specifications for Type 2 Asphalt Concrete. As an alternative, the Contractor may submit a job-mix formula which has been approved within 15 months of the date of submission by the Ohio Department of Transportation for Item 302 Asphalt Concrete for the proposed aggregate.

**302.03** Spreading and Finishing. Where the mixture is placed for correcting irregularities in the existing pavement, the maximum compacted depth of any one layer shall be 3 inches.

**302.04 Surface Tolerances.** The variation of the surface from the testing edge of the 10-foot straightedge shall not exceed 1/4 inch. Variations in excess of slope or surface tolerances shall be corrected by adding or removing material in a manner satisfactory to the Engineer.

**302.05** Basis of Payment. Measurement shall be made in accordance with 401.21.

Payment for accepted quantities shall be made at the contract unit price bid which price shall constitute full compensation for the asphalt concrete complete in place, including the furnishing of materials, labor, equipment, tools and incidentals necessary to complete this item as specified.

When courses of uniform thickness are specified, the number of cubic yards to be paid for shall not exceed the quantity calculated from plan lines and dimensions.

Payment will be made at the contract unit price for:

Item	<u>Unit</u>	<b>Description</b>	
302	Cubic Yard	Asphalt Concrete,	Inch Thickness
302	Cubic Yard	Asphalt Concrete, Var	riable Thickness

### **ITEM 304 AGGREGATE BASE**

304.01Description304.02Aggregate304.03Placing304.04Compaction304.05Method of Measurement304.06Basis of Payment

**304.01 Description**. This work shall consist of furnishing, placing and compacting one or more courses of aggregate, including furnishing and incorporating all water required for compacting, on a prepared surface in accordance with these specifications, in reasonably close conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the Engineer.

**304.02** Aggregate. The aggregate shall be crushed limestone, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slags, slacker aggregate or other types of suitable materials meeting the requirements of this item and having the approval of the Engineer. Crushed limestone, crushed gravel, crushed air-cooled slag or mixtures of crushed and granulated slags shall meet the following gradation requirements and the requirements of 703.04. In addition, open-hearth and basic-oxygen furnace slags shall conform to the stockpiling and aging requirements of 703.01. Shale shall not exceed 5 percent.

Sieve	Total Percent Passing
2 inch	100
1 inch	70 - 100
3/4 inch	50 - 90
No. 4	30 - 60
No. 40	7 - 30
No. 200	0 - 13

Unblended granulated slag shall meet the requirements of 703.08. Slacker aggregate shall meet the requirements of 703.09.

Aggregate acceptance shall be determined prior to incorporation into the work based on samples taken from stock piles.

Prior to placing, aggregate shall have a reasonably uniform moisture content at or near optimum for compaction.

Material used for Item 203, Aggregate Refill Type 1, shall be crushed limestone. No other 304 materials are permitted for use as aggregate refill if paid for as Aggregate Refill, Type 1.

**304.03 Placing**. When vibratory equipment is used in conjunction with other methods of compaction, the compacted depth of a single layer shall not exceed 6 inches. When vibratory compaction equipment is not used, the maximum compacted thickness of one layer shall not exceed 3 inches. When the required compacted depth of the base course exceeds 6 inches, the base shall be constructed in two or more layers of approximately equal thickness.

The aggregate shall be placed with self-propelled spreading machines capable of placing the aggregate true to line and grade. Approved hand placing methods may be used in small areas where machine spreading is impractical.

Unless the base course is placed in a trench section, the edges shall be backed up with an 18-inch width of soil, placed to such a height that it will be consolidated to the height of the lift being compacted and furnish positive lateral support during compaction of the course.

Adequate surface drainage of the berm shall be provided at all times.

**304.04** Compaction. At the beginning of the compaction operation, the density requirement shall be determined by compacting a short section, at the direction of the Engineer, until no further increase in density is obtained. The remainder of the course shall be compacted to a density not less than 98 percent of the test density. A new density requirement may be determined when the aggregate characteristics change appreciably. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates firmly keyed. Water shall be uniformly applied over the base materials during compaction in the amount necessary to maintain the moisture at or near optimum.

The finished surface shall not vary more than 3/8 inch from a 10-foot straightedge parallel to the centerline nor more than 1/2 inch from a template conforming to the required cross section. The Contractor shall furnish straightedges, templates or other devices satisfactory to the Engineer and check the surface for conformance with these requirements.

The base shall be sprinkled as required to maintain the moisture content until covered by subsequent construction.

**304.05** Method of Measurement. Aggregate base course will be measured by the number of cubic yards computed from plan lines, compacted in place.

When variable depth is specified, the number of cubic yards of aggregate will be measured by conversion from weight on the following basis:

Crushed stone	
Crushed gravel	
Crushed slag, less than 90 lbs. per cu. ft	

### 304.06

Crushed slag, 90 to 100 lbs. per cu. ft	4000 lbs. per cu. yd.
Crushed slag, more than 100 lbs. per cu. ft.*	4500 lbs. per cu. yd.
Slacker aggregate	
Granulated slag	

\*Based on average dry rodded weight on record at the Laboratory.

The pounds per cubic yard for mixtures of crushed and granulated slags shall be determined by use of the density of the short section required under 304.04 Compaction.

**304.06 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at contract prices for:

Item	<u>Unit</u>	<b>Description</b>
304	Cubic yard	Aggregate base

# ITEM 305 PORTLAND CEMENT CONCRETE BASE

- 305.01 Description
- **305.02** Method of Measurement
- 305.03 Basis of Payment

**305.01 Description**. This work shall consist of constructing a portland cement concrete base on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer. This work shall conform to the same specifications and requirements as 451 except that:

(a)Concrete shall be 499 Class "C".

- (b) Fabricated steel reinforcement is not required. Load transfer devices are required only at transverse construction and expansion joints.
- (c) A minimum of one gallon of curing membrane shall be applied for each 200 square feet of surface treated.
- (d) Transverse contraction joints shall be constructed in accordance with standard drawings or as shown on the plans.

Standard longitudinal joints shall be constructed between lanes in accordance with 451.09(a).

Sealing is required for transverse joints only, using material meeting requirements of 705.01 or 705.02.

- (e) The final surface shall have a uniform gritty texture as obtained with a burlap drag or other approved method.
- (f) Smoothness shall be as specified in 451.13 except that the specified tolerance shall be 1/4 inch.

**305.02** Method of Measurement. The quantity under this item will be the number of square yards completed and accepted in place. The width for measurement will be the width of the base shown on the typical cross section of the plans and additional widening where called for, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the center line of each street, roadway or ramp. The quantities as adjusted for changes, errors, and deviations in excess of allowable tolerances as specified in 451.17 will be the method of measurement.

**305.03 Basis of Payment**. The accepted quantities of concrete base will be paid for at the contract unit price per square yard, which price and payment shall be full compensation for furnishing and placing all materials; provided, however, that for base found deficient in thickness only the reduced price stipulated in 451.17 shall be paid.

No additional payment over the unit contract bid price will be made for any base which has an average thickness in excess of that shown on the plans.

Payment will be made for:

 Item
 Unit
 Description

 305
 Square Yard
 \_\_\_\_\_\_inch Portland cement concrete base

## **ITEM 310 SUBBASE**

### 01

310.01 Description
310.02 Materials
310.03 Construction Methods
310.04 Method of Measurement
310.05 Basis of Payment

**310.01 Description**. This work shall consist of furnishing, placing and compacting subbase, including furnishing and incorporating water required for

### 310.02

compaction, in reasonably close conformity with the lines, grades and cross sections shown on the plans or established by the Engineer.

Type I subbase shall meet one of the gradations listed in 310.02 at the time of incorporation into the work. Type II subbase shall meet Grading A, 310.02, after all operations of placing and compaction have been completed.

**310.02 Materials**. Materials furnished under this item shall be crushed gravel, crushed slag, crushed stone, sand, granulated slag, a mixture of crushed and granulated slags, slacker aggregate or other types of suitable materials meeting the requirements of this item and having the approval of the Engineer. The sodium sulfate soundness loss for all aggregates except sandstone shall not exceed 15 percent. However, where the major portion of the unsound material in a coarse aggregate acquires a mud-like condition when tested for soundness, the maximum loss shall be five percent for all uses. In addition, open-hearth and basic-oxygen furnace slag shall conform to stockpiling and aging requirements of 703.01. Material for Grading C shall meet requirements of 703.01 and 703.04

Total Passing - Percent					
Sieve	Grading A	Grading A Grading B			
2-1/2 inch	100	100	Size No. 4		
1 inch	70-100	70-100			
No. 4	25-100	25-100			
No. 40	5-50	10-50			
No. 200	0-10	5-15			

Broken salvaged road material, unblended granulated slag, and slacker aggregate may be used for either Type I or Type II. For Type I, unless otherwise specified, these materials shall meet the following requirements.

Broken salvaged road material shall pass a 3-inch square sieve and not more than 20 percent shall pass a No. 200 sieve.

Unblended granulated slag shall conform to 703.08.

Slacker aggregate shall conform to 703.09.

The fraction of these materials passing a No. 40 sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than six.

Materials containing free water shall not be placed upon the subgrade.

Where material from an untested and/or undeveloped source is furnished, the Contractor shall submit to the Engineer, at least ten days in advance of delivery of such material to the work, a report of exploration including a plan showing the location of the source, the depth of overburden to be removed, and the area and depth to which the source is to be operated. The report shall include test data, satisfactory to the Engineer, which show the source is capable of furnishing material meeting the requirements of these specifications, in sufficient quantity for the work. After the report and test data have been reviewed and the roadside source inspected, the Engineer may conditionally authorize the Contractor to furnish material from the source, provided samples selected from the material produced for delivery to the work and from material delivered conforms to the requirements of these specifications. In addition, the Engineer may require that the material be stockpiled in quantities of at least 100 cubic yards for sampling and testing prior to delivery to the work. Engineer reserves the right to use Type I or Type II.

**310.03** Construction Methods. The subbase material shall be spread upon the subgrade after the prescribed subgrade and subbase drainage has been placed except that for portland cement concrete pavements, pipe underdrains need not be placed prior to placing subbase material, providing adequate surface drainage of the subgrade is maintained during construction.

The subbase shall be constructed in layers not to exceed 6 inches compacted depth, except that for variable depth subbase used under concrete pavement or in the shoulder adjacent to concrete pavement, the material may be placed in single course thickness of not more than 8 inches compacted depth. The moisture content shall be as determined by the Engineer to obtain the desired compaction. Subbase material which does not contain sufficient moisture to compact in accordance with this section shall be sprinkled with water as directed by the Engineer. The water shall not be applied in a manner that will soften the subgrade. Water shall be applied when ordered by the Engineer.

Compaction of the subbase course shall immediately follow the spreading operation. Compaction to be a minimum of 98% of maximum density as determined by AASHTO T-99.

The finished surface of this course shall have sufficient stability to support loaded construction equipment used in construction of this and the subsequent course without rutting or deflection in excess of the surface tolerance permitted herein. When material falling within a grading permitted by this specification is used and surface stability cannot be obtained, a sufficient quantity of crushed angular material shall be added to secure the required stability.

The finished surface for the subbase shall conform to the plan requirements within the tolerances set forth under 203.06, except that when this item is used as a subbase for 451 or 452 pavement, the variation shall not exceed 1/4 inch.

Any irregularities or depressions that develop in the finished surface of the subbase under rolling shall be corrected by loosening the surface and adding or removing material until the surface presents a smooth regular appearance.

## 310.04

**310.04 Method of Measurement**. The quantity measured shall be the number of square yards computed from plan lines, of subbase material compacted in place.

**310.05 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
310	Square Yard	inch Subbase
310	Cubic Yard	#4 Limestone

# **400 FLEXIBLE PAVEMENT**

## ITEM 401 ASPHALT CONCRETE PAVEMENTS—GENERAL

401.01 Description 401.02 Mix Design and Quality Control 401.03 Materials **401.04 Reclaimed Asphalt Concrete Pavement 401.05 Mixing Plants** 401.06 Weather Limitations 401.07 Notification 401.08 Asphalt Binder Preparation **401.09** Aggregate Preparation 401.10 Mixing 401.11 Hauling 401.12 Spreading Equipment 401.13 Rollers 401.14 Conditioning Existing Surface 401.15 Spreading and Finishing 401.16 Compaction 401.17 Joints 401.18 Asphalt Binder Compatibility 401.19 Spreading and Surface Tolerances 401.20 Asphalt Binder Price Adjustment 401.21 Method of Measurement 401.22 Basis of Payment

**401.01 Description.** This specification is applicable to all types of asphalt concrete pavements irrespective of gradation of aggregate, kind, and amount of asphalt binder, or pavement use. Deviations from these general requirements are covered in the specific requirements for each type according to the appropriate contract item or items.

Work consists of one or more courses of asphalt concrete constructed on a prepared foundation. The asphalt concrete consists of a mixture of uniformly graded aggregate and specified type and grade of asphalt binder.

The asphalt concrete pavement thickness shown on the plans or stated in the Proposal is for the exclusive use in calculating the weight required to be placed per unit of surface area.

**401.02** Mix Design and Quality Control. The quality control and acceptance requirements of Item 403 apply.

#### 401.03

If required to perform the mix design or quality control, provide a laboratory and personnel meeting the requirements of ODOT Supplement 1041 to perform mix design and quality control tests.

Calibrate asphalt content nuclear gauges according to ODOT Supplement 1043 using personnel with a Level 1 rating according to ODOT Supplement 1041. Mix and test the calibration verification sample with a Department employee present.

Provide and dispose of the solvent used for cleaning the asphalt content nuclear gauge pans.

### 401.03 Materials. Furnish materials conforming to:

Asphalt binder (asphalt concrete, 401.14, 401.15)	702.01
Asphalt material (401.14, 401.18) 702.01, 702.04, or	702.13
Aggregates (base courses)	703.04
Aggregates (intermediate and surface courses)	703.05
Mineral filler	703.07

Sample aggregate, asphalt binder, asphalt material, and mineral filler according to 106.01.

Use of steel slag for coarse or fine aggregate will not be permitted.

**401.04 Reclaimed Asphalt Concrete Pavement.** The Contractor may use a blend of new materials in combination with reclaimed asphalt concrete pavement obtained from either a City of Akron, Department of Transportation or Ohio Turnpike Commission project for base and intermediate course only. The Contractor may use a maximum of 10 percent of reclaimed asphalt concrete pavement without adjusting the Job Mix Formula (JMF). This percentage is based on the dry weight of all the materials used. Ensure that the combined mixture falls within the gradation limits of the contract item specified.

Use of reclaimed asphalt pavement for surface courses will not be permitted.

Identify the reclaimed asphalt concrete pavement as to type, source, gradation, and asphalt binder content. Ensure that the stockpile is free of contamination and uniform in composition. Before stockpiling, clean, grade, and compact the proposed sites for storing the reclaimed asphalt concrete pavement to produce a firm, level base. Stockpiles are subject to approval by the Engineer before use. Do not add additional reclaimed asphalt concrete pavement to an approved stockpile, except if it is being reclaimed concurrently with the production of the asphalt concrete incorporating it.

Ensure that the reclaimed asphalt concrete pavement is the proper size to allow for complete breakdown in the plant. During production, place a 2-inch (50 mm) screen on the cold feed. If mixing is incomplete, place a smaller screen on the cold feed. Due to variations in the reclaimed asphalt concrete pavement gradation, the City of

Akron will tolerate a maximum of 5 percent oversize material in the completed mix, provided the Contractor can incorporate it into the work with satisfactory results.

**401.05** Mixing Plants. The City of Akron will approve mixing plants before preparation of the mixtures. General requirements for asphalt concrete mixing plants are specified in Item 402.

All mixing plants shall maintain a current, valid certification to provide Bituminous Asphalt Concrete by the Ohio Department of Transportation.

Set the asphalt binder controls for the computerized plant at the virgin asphalt binder content of the JMF at all times unless change is authorized by the Laboratory.

**401.06 Weather Limitations.** Place asphalt concrete only if the surface is dry and if weather conditions are such that proper handling, finishing, and compaction can be accomplished. Never place asphalt concrete if the surface temperature is below the minimum established in Table 401.06-1.

Table 401.06-1		
Course Thickness	Minimum Sur	face Temperature
3.0 inches (75 mm) and over	36° F <sup>[1]</sup>	$(2^{\circ} C)^{[1]}$
1.0 to 2.9 inches (38 to 74 mm)	40° F	(5° C)
Less than 1.0 inch (25 mm)	50° F	(10° C)
Variable Intermediate, 0 to 3.0 inches (0 to 75 mm) $40^{\circ}$ F $(5^{\circ}$ C)		
[1] Instead of 36° F (2° C), use a minimum air temperature of 40° F (5° C) if paving on		
an aggregate base or subgrade.		

In addition to the above surface temperature requirements, do not place surface courses if the air temperature is less than  $40^{\circ}$  F (5° C).

For Type 1H asphalt concrete or any surface course with a polymer modified asphalt binder, ensure that the surface of the existing pavement is at least  $50^{\circ}$  F ( $10^{\circ}$  C) and the air temperature is at least  $50^{\circ}$  F ( $10^{\circ}$  C). Do not place any Type 1H asphalt concrete or any surface course with a polymer modified asphalt binder after November 1, regardless of pavement or air temperature.

**401.07** Notification. Notify the Engineer at least 24 hours before starting paving on a project. After starting paving, if paving operations are stopped for 1 week or more, notify the Engineer at least 24 hours before resuming paving on a project.

**401.08** Asphalt Binder Preparation. Heat the asphalt binder and deliver it to the mixer within the temperature range specified in Table 702.00-1. Do not use asphalt binder while it is foaming.

**401.09 Aggregate Preparation.** Feed aggregates in their proper proportions and at a rate to permit correct and uniform control of heating and drying. Remove all aggregates in the plant that will produce a mix outside the temperature limits or that contain excessive moisture or expanding gases causing foaming in the mixture, and return them to the proper stockpiles.

**401.10 Mixing.** Maintain the temperature of the mix at the plant within the range set by the Laboratory for the JMF. The Engineer will determine the required temperature of the mixture on arrival at the project site based on the temperature range set for the mix design and heat losses in transit.

The temperature of the asphalt concrete mixtures at the time of placement shall be as follows:

Minimum Laydown Temperature		
Surface Temperature	Minimum Lift Thickness (inches)	
(Degrees Fahrenheit)		
	1.25 to 2.99	3 or more
36 - 40°	305	280
40 - 50°	300	275
50 - 60°	295	270
60 - 70°	285	265
70 - 80°	280	265
80 - 90°	270	260
90° or higher	265	255

The Engineer may request an increase in the above minimum temperatures should high wind conditions prevail causing rapid heat dissipation.

At no time shall the temperature of the mixture upon arrival at the project site be above a maximum of  $325^{\circ}$  F (165° C).

For batch plants, after all of the aggregate is in the mixer, add the asphalt binder in an evenly spread sheet over the full length of the mixer. The mixing time is defined as the interval between the start of application of the asphalt binder and the opening of the mixer gate. Discharge all asphalt binder required for one batch in not more than 30 seconds. After the asphalt binder is added, the Laboratory will establish a minimum mixing time, which will not be less than 30 seconds.

**401.11 Hauling.** Use trucks for hauling asphalt concrete that have tight, clean, smooth metal beds from which the entire quantity of mixture is discharged smoothly into the spreading equipment.

Before loading, apply a thin coating of an approved release agent to the inside surfaces of the truck bed to prevent adhesion of mixture to the bed surfaces. The Ohio Department of Transportation maintains a list of approved release agents. Do not use fuel oil for this purpose. Drain truck beds before loading.

Provide a single place on the project for cleaning trucks when excessive sticking of material in truck beds occurs. If the Contractor does not resolve excessive sticking of material in truck beds in a reasonable time and the sticking is in areas of the truck that would indicate excessive cooling of the mix (front corners, bottom, etc.) due to a long haul, the Engineer will require an insulated bed. The Contractor may only make changes in policy regarding release agents for beds or other procedure changes for better mix handling at the discretion of the Laboratory.

Equip each truck with a securely fastened, waterproof cover of suitable material to adequately protect the mixture from wind and weather. At the request of the Engineer, remove covers before dumping into the paver.

If transporting hot asphalt concrete at prevailing air temperatures below  $50^{\circ}$  F (10° C) or if the length of haul exceeds 20 miles (32 km), insulate all truck beds to maintain mix temperature, at time of placement, within the range set forth in table 401.10-1, and ensure that all covers are fastened to exclude the wind. Do not exceed a distance of 50 miles (80 km) from the asphalt concrete plant to the paving site except by specific permission of the Engineer.

**401.12 Spreading Equipment.** Use self-contained spreading equipment of sufficient size, power, and stability to receive, distribute, and strike-off the asphalt concrete at rates and widths meeting the typical sections and other details shown on the plans. Use spreading equipment that has automatic control systems that maintain the screed in a constant position relative to profile and cross-slope references. These references shall be such that control of the screed position is reasonably independent of irregularities in the underlying surface and of the spreader operation. The Engineer will base approval of spreading equipment on the demonstrated capability of the equipment to place the mixture to the required cross-section, profile and alignment in an acceptable, finished condition ready for compaction.

Where the use of standard full-scale spreading equipment is impractical due to the size or irregularity of the area to be paved, use specialized equipment or hand methods approved by the Engineer to spread the asphalt concrete.

**401.13 Rollers.** Use only steel wheel and pneumatic tire types of rollers meeting the minimum requirements of the following tables. Conform to manufacturer's specifications for all ballasting.

Roller Type	Maximum Capacity
	square yards per hour (m <sup>2</sup> /hr)
Tandem	700 (600)
Three-Wheel	700 (600)
Trench	15 per inch width (13 per 25 mm width)
Pneumatic Tire, Type 1	1000 (850)
Pneumatic Tire, Type 2	700 (600)
Vibratory, Vibrating Roll	15 per inch width (13 per 25 mm width)
Vibratory, Static Roll	3 per inch width (3 per 25 mm width)
(not vibrating)	

### TABLE 401.13-1 ROLLER CAPACITY

#### **TABLE 401.13-2 STEEL WHEEL ROLLERS**

Roller Type	Three-	Tandem	Vibratory	Trench
	Wheel		Static	
Total weight, tons	10	8 to 12	8 to 12	
(metric tons)	(9)	(7 to 11)	(7 to 11)	
Compression rolls, pounds per	300	200	120	300
inch width (kN/m), minimum	(53)	(35)	(21)	(53)

## **TABLE 401.13-3 PNEUMATIC TIRE ROLLERS**

Туре І		
Tire size, minimum	9.00 x 20 in (229 x 508 mm)	
Wheel load, minimum	5000 lb (2250 kg)	
Average tire contact pressure, minimum85 psi (590 kPa)		
Type II		
Tire size, minimum	7.50 x 15 in (191 x 381 mm)	
Wheel load, minimum	2000 lb (900 kg)	
Average tire contact pressure, minimum	55 psi (380 kPa)	

For pneumatic tire rollers, use self-propelled, reversible units with vertical oscillation on all wheels on at least one axle. Determine the tire inflation pressure necessary to meet the specified minimum contact area and contact pressure requirements. Furnish the tire manufacturer's charts or tabulations to the Engineer for verification of the required inflation pressure. Check tire inflation pressure as the Engineer directs and maintain it within 5 pounds per square inch (35 kPa) of the required pressure.

Provide rolls and wheels with the necessary accessories to prevent adhesion of the mixture, and keep them properly moistened with water, water containing a detergent, or water containing an approved additive. Do not use excess liquid.

**401.14 Conditioning Existing Surface.** Clean the surface on which the asphalt concrete is to be placed, and keep it free of accumulations of materials that

would, in the judgment of the Engineer, contaminate the mixture, prevent bonding, or interfere with spreading operations. Where approved subgrade or pavement courses previously constructed under the Contract become loosened, rutted, or otherwise defective, correct the deficiency according to the contract item or items involved before the spreading of a subsequent pavement course.

If a quantity of asphalt concrete is specified for use in spot leveling or patching an existing pavement surface, spread and compact the material needed to effect the corrections as directed by the Engineer.

Paint contact surfaces of curbing, gutters, manholes, and other structures with a thin, uniform coating of asphalt material before placing the asphalt concrete against them.

If placing asphalt concrete against the vertical face of an existing pavement structure, clean the vertical face of foreign material and apply asphalt material that results in a coating of approximately 0.25 gallon per square yard (1  $L/m^2$ ).

Before placing a surface course onto an intermediate course, apply a tack coat to the intermediate course according to 407.06.

In areas where the surface is required to be feathered to meet an adjoining surface, coat the existing surface uniformly with a thin coat of asphalt binder.

**401.15 Spreading and Finishing.** Spread the mixture at a rate calculated using the specified thickness and the compacted width of the pavement course being placed, and the weight-to-volume conversion factors established in 401.21. Maintain the actual rate of spreading the mixture equal to the required calculated rate within the tolerance specified in 401.19. For pavement courses specified for leveling an existing pavement surface, the actual rate of spreading the mixture may vary from the required calculated rate as approved by the Engineer to accomplish the intended purpose.

For base and intermediate courses, make the maximum compacted depth of any one layer 4 inches (100 mm).

Spread and finish the mixture using approved equipment or methods such that compaction can follow immediately. Preheat screeds before placing any asphalt concrete. Use side plates sufficient to contain the mixture laterally during spreading. If paving in excess of the nominal paver width, use only a permanent extension or an adjustable extension with full auger extensions when matching a previously placed pavement course. Use extensions that have the ability to heat. The Contractor may use strike-off plates on adjacent berm areas. Perform supplemental hand forming and tamping where irregularities develop and where placing the mixture by hand methods. Ensure that the mixture as spread and finished is uniform in composition and surface texture. Correct conditions causing objectionable segregation of the mixture components or irregularities in surface texture in a manner satisfactory to the Engineer. Remove and replace, or otherwise correct, any portion of the pavement course found to be defective in surface texture or composition before or after compaction in a manner satisfactory to the Engineer. Coordinate the spreading operation with the rate of production and delivery of the mixture to attain uniform, continuous progress. Avoid erratic spreader operation due to irregular contact with the hauling vehicle, surging in the feed and distribution of the mixture, or other cause. Maintain sufficient control of the spreading equipment with regard to line and grade references so that the pavement course, when compacted as specified, is in reasonable conformance with the Contract Documents.

Do not displace or damage bridge deck waterproofing membranes during spreading operations on the membranes.

Do not allow traffic on the compacted mixture until it has cooled sufficiently to prevent glazing as determined by the Engineer.

After completion of the surface course, seal gutters with asphalt binder as directed by the Engineer. Apply the material at a uniform width of approximately 4 inches (100 mm) and at a rate just sufficient to fill surface voids.

**401.16 Compaction.** Immediately after spreading the asphalt concrete and adjusting any surface irregularities, compact the mixture uniformly using rollers conforming to 401.13. Do not use a spreading rate that exceeds the total of the specified capacities of the rollers in use; however, if compacting a mixture spread as an intermediate or pre-leveling course less than 1 inch (25 mm) thick, do not use a spreading rate that exceeds twice the total capacity of the rollers in use.

Coordinate the spreading of the mixture with the required roller coverage, considering the rate of cooling of the mixture as affected by lift thickness and environmental conditions. Complete the required roller coverage during the period of time in which the temperature of the mixture is sufficient for the roller coverage to be effective in compacting the mixture.

At no time shall the mixture temperature be allowed to cool below 185 degrees F prior to the completion of the roller coverage.

Compact base mixtures using a combination of both steel and Type I pneumatic tire rollers; however, in small areas, compact these mixtures as approved by the Engineer using any of the rollers specified in 401.13. Compact intermediate and surface mixtures using a three-wheel roller in the breakdown position (roller immediately behind the paver) of the roller train; however, in small areas, compact these mixtures as approved by the Engineer using any of the roller types specified in 401.13.

Compact variable depth courses using a combination of both steel and pneumatic tire rollers; however, in small areas, compact these mixtures as the Engineer approves using any of the roller types specified in 401.13.

For Type 1H asphalt concrete or mixes using a polymer modified asphalt binder, give a copy of the JMF approval letter containing the design compaction temperature to the Engineer before any mix is placed. Ensure that the mix temperature immediately before rolling is not less than 290 F (145 C). Pneumatic tire rollers are not recommended for polymer asphalt concrete because of excessive pick up.

Do not use vibratory rollers on courses with a thickness under 1 1/2 inches (38 mm).

If using vibratory rollers, supplement them with three-wheel or pneumatic tire rollers.

Unless otherwise directed, begin rolling at the sides and proceed longitudinally parallel to the centerline at a slow, uniform speed. After each coverage or complete round trip, move the roller towards the crown of the road to begin its next pass, overlapping the previous pass by at least one-half the width of the previous pass. On superelevated curves, begin rolling at the low side and progress toward the high side. Where a longitudinal joint is being made, roll the joint then follow the applicable rolling procedure.

Continue rolling until full coverage of the course is complete and all roller marks are eliminated. Take care to prevent displacement of the edgeline and grade. Where displacement occurs, correct the area immediately in a manner satisfactory to the Engineer.

Along curbs, headers, walls, and in other areas not accessible to rollers, thoroughly compact the mixture with hot, hand tampers or with mechanical tampers. On depressed areas, the Contractor may use trench rollers or rollers fitted with compression strips.

Replace mixture that becomes loose, broken, contaminated, or otherwise defective with fresh, hot mixture. Compact it to match with the surrounding area.

**401.17 Joints.** Place the asphalt concrete mixture as continuous as possible. Set up joints at the proper height above the adjacent construction to receive maximum compaction. Where the edge of the new surface has been significantly rounded by the action of traffic, trim it to a vertical face before placing the adjacent pavement. On projects where traffic is allowed to cross the edge of the new pavement lane, complete the longitudinal joint of the adjacent lane or berm within 24 hours.

Form hot longitudinal joints using pavers operating in contiguous lanes, one just ahead of the other. Maintain the distance between pavers in adjacent lanes such that
it does not exceed the distance that a normal size load of mixture will cover. Alternate loads of mixture between the pavers. Do not allow rollers performing the initial rolling operation in one lane closer than 12 inches (0.3 m) to the longitudinal joint until the adjacent lane is placed.

Instead of hot joint construction using multiple pavers, the Contractor may use full width construction with a single unit paver.

Compact all cold longitudinal joints on intermediate and surface courses using a three-wheel roller.

For surface courses, form or cut all transverse construction joints to a vertical.

Seal all cold longitudinal and transverse construction joints on surface courses, and any asphalt concrete course that is open to traffic for more than 30 days, by coating the vertical face of the cold joint with asphalt material, applied at a rate of 0.25 gallon per square yard.

**401.18 Asphalt Binder Compatibility.** If excess fat spots, regular random areas of flushing, or excess drain down occur on a project that are not attributable to over rolling, plant operation, or mix quality compared to the JMF, the City of Akron will consider the asphalt binder incompatible. The City of Akron will reject any on-hand asphalt binder because of incompatibility. The City of Akron may use its discretion in determining if problem areas can be corrected, but if an unsafe condition exists, remove and replace the area in question. Demonstrate to the Laboratory through reporting actual testing analysis the compatibility of another asphalt binder and that proper equipment is in place in order to be allowed to resume.

**401.19 Spreading and Surface Tolerances.** If a uniform course is specified, make checks and adjustments to maintain the rate of spreading within a tolerance of  $\pm 5$  percent of the required calculated weight per unit of area.

If a variable depth course is specified, place the mixture as shown on the plans.

If a longitudinal profile is specified by elevations on the plans, the longitudinal profile of the completed pavement surface shall not deviate from parallel with the specified profile by more than 7/8 inch in 50 feet (21 mm in 15 m). Before placing the surface course, check the profile of the preceding course at 50-foot (15 m) intervals along the outside edge of each traffic lane and along any additional line described in superelevation tables, and submit a tabulation of the results to the Engineer for approval. Perform corrective work necessary for compliance with the profile tolerance before placing the surface course. The requirements of this paragraph do not apply to small incidental areas of pavement less than 500 feet (150 m) in length.

Do not vary the transverse slope of the surface of the completed course from the specified slope by more than 3/8 inch in 10 feet (10 mm in 3 m).

Do not vary the surface of each completed intermediate or surface course from the testing edge of a 10-foot (3 m) straightedge by more than 1/4 inch (6 mm). Furnish straightedges and straightedges equipped with levels or other devices satisfactory to the Engineer. The Engineer will check the surface course for variations in slope or surface.

Correct variations in excess of slope or surface tolerance by removing mixture to neat lines and replacing, or by surface grinding in a manner satisfactory to the Engineer.

**401.20 Asphalt Binder Price Adjustment.** No adjustment for asphalt binder price will be made.

**401.21 Method of Measurement.** The Contractor is responsible for recording the net weight of each truckload of mixture to the nearest 100 pounds (50 kg) in triplicate on plant ticket forms approved by the City of Akron. If the pay quantities are established by platform scales, the Contractor shall provide a tare weight for each truck at the beginning of each day's operation and a minimum of every 4 hours of operation each day. The Engineer may require additional tare weight measurements at any time. The Engineer will have the right to monitor all weighing operations and may require re-weighing trucks at any time or location. The Contractor shall correct any discrepancies immediately. Continued non-compliance will result in the City of Akron taking necessary and appropriate action, such as, but not limited to, assigning a City of Akron ticket writer to the plant. The Contractor shall present it to the Engineer.

The Engineer will convert the total of the weights recorded on the plant tickets representing mixture finished according to contract requirements to cubic yards (cubic meters) using a conversion factor established by the Laboratory. The Laboratory will establish this conversion factor from the approved JMF. However, if a mix design is not available, the Laboratory will use the conversion factors in Table 401.21. If a uniform course is specified, the City of Akron will not pay for a number of cubic yards (cubic meters) that exceeds the quantity calculated from plan lines and dimensions.

<b>Table 401.21</b>		
Aggregate	lb/yd <sup>3</sup>	$(kg/m^3)$
Gravel and stone	4000	(2370)

**401.22 Basis of Payment.** The City of Akron will pay for all work performed and measured as specified above according to the appropriate contract items for each type.

For asphalt material used to seal the cold longitudinal joint according to 401.17, the City of Akron will pay for accepted quantities at the unit bid price for Item 407 Tack Coat. If the Contract does not include the pay item 407 Tack Coat, the cost of sealing the joints is included in the unit price bid for the asphalt concrete.

The City of Akron will assess all costs against the Contractor that it incurs as a result of taking necessary and appropriate action due to the Contractor's continued non-compliance.

If an unsafe condition exists, the City of Akron will not pay for removing and replacing incompatible asphalt binder areas.

# **ITEM 402 ASPHALT CONCRETE MIXING PLANTS**

402.01 Description 402.02 General 402.03 Scales 402.04 Thermometers 402.05 Storage 402.06 Calibration 402.07 Computerized Plant System 402.08 Polymer Binders

**402.01 Description.** This specification consists of the minimum requirements for an asphalt concrete mixing plant to produce asphalt concrete mixes according to City of Akron specifications.

Conform asphalt concrete mixing plants to the requirements of ASTM D 995 in addition to the following.

All mixing plants shall maintain a valid, current certification to provide bituminous asphalt concrete by the Ohio Department of Transportation.

**402.02 General.** If more than one kind of asphalt binder is to be used concurrently, separately store each kind.

Ensure that the adjustments for total and proportional feed are continuously variable and capable of being locked at any position.

Use batch plant hot bins that have an oversized material discharge pipe of not less than 6 inches (150 mm) in diameter. The pipes shall discharge material at points outside the plant operation and shall not create a hazard or discomfort.

In batch plants, use a non-tilting asphalt binder bucket with a loose sheet metal cover. Ensure that the length of the discharge opening or spray bar is not less than three-fourths the length of the mixer and that it discharges directly into the mixer. Ensure that the asphalt binder bucket, its discharge valve or valves, and spray bar are fully jacketed or heated. Use jackets that drain efficiently and ensure that all connections are constructed to not interfere with the efficient operation of the asphalt binder bucket with a capacity of at least 10 percent greater than the weight of asphalt binder required in any batch. Ensure that the plant has an adequately heated, quick-acting, nondrip, charging valve directly over the asphalt binder bucket.

**402.03 Scales.** Use scales and test weights that conform to the regulations of the Ohio Department of Agriculture. Seal scales as often as the Laboratory directs to ensure their continued accuracy. Seal test weights at least every 3 years at places designated by the Ohio Department of Agriculture. Equip the plant with one 50-pound (20 kg) test weight for each 400 pounds (200 kg) of the maximum batch weight with a minimum of ten test weights.

Provide a truck scale or recording batch plant scales for the purpose of obtaining the net weight of each load of asphalt mixture as required in 401.21.

Use truck scales that indicate the total weight within 20-pound (10 kg) increments and have a rated capacity of at least 10 percent greater than the largest load weighed. Provide a platform large enough to receive the largest truck used for a single weighing.

Use batch plant scales that have a capacity of at least 10 percent greater than the largest weight required for any one batch.

**402.04 Thermometers.** Equip the plant with an adequate thermometric instrument, clearly legible from the mixer operator's station, to monitor the temperature of the asphalt binder. Locate the sensing element or unit in the feed line near the charging valve at the mixer. Where a pyrometer is used, connect the indicator to the thermocouple by a weatherproof extension wire.

Also, equip the plant with either an approved dial-scale, mercury-actuated thermometer; an electric pyrometer; or other approved thermometric instrument so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heated aggregates.

**402.05 Storage.** Provide storage bins capable of storing hot asphalt concrete mixtures up to 24 hours. Insulate or heat storage bins if mixtures are stored for more than 8 hours. Ensure that the system is capable of maintaining the required

temperature without creating hot spots within the stored mixture. In addition, if hot asphalt mixtures are stored from 8 to 24 hours, then introduce a silicone admixture into the asphalt binder at the rate of 1 fluid ounce per 5000 gallons (1 mL/640 L).

**402.06 Calibration.** Calibrate the plant for each combination of aggregate, reclaimed asphalt concrete pavement, and asphalt binder type/content for the mixtures to be produced. Ensure that the calibration is accurate within 1.0 percent.

## 402.07 Computerized Plant System.

**A. General**. Produce all asphalt concrete in a plant with a computerized plant system approved by the Ohio Department of Transportation Laboratory. Ensure that the computerized plant system's device the asphalt binder content is capable of being locked or sealed. After initial calibration of the plant, the Ohio Department of Transportation may lock or seal the monitoring device.

Ensure that all printouts contain the following information:

- 1. Date.
- 2. Time.
- 3. Job Mix Formula (JMF) number.
- 4. Moisture content of the reclaimed pavement.
- 5. Percent asphalt binder in the reclaimed pavement to the nearest 0.1 percent.
- 6. Percent virgin asphalt binder to the nearest 0.1 percent.
- 7. Percent total asphalt binder calculated to the nearest 0.01 percent.

Ensure that all printouts are preapproved by the Ohio Department of Transportation Laboratory and are turned over to The City of Akron at the end of the project or the end of the production year.

Ensure that the computerized plant system prints "SIMULATE" on the ticket or printout whenever the computerized plant system is only simulating asphalt concrete production.

Ensure that the computerized plant system has an audible alarm system that notifies the plant operator when the amount of asphalt binder, aggregate, or reclaimed pavement being mixed into the asphalt concrete is outside the tolerances established by the Contractor's Quality Control Manager. The plant operator must make appropriate adjustments when production is outside the tolerances.

**B.** Batch Plants. In addition to the requirements of 402.07A, print the information on each weight ticket if the asphalt concrete is directly loaded into the truck or on a separate printout for every 16 tons (15 metric tons) or less of production if the asphalt concrete is loaded into a storage silo. Ensure printouts contain the following additional information:

- 1. Tare weight of the asphalt binder scale.
- 2. Tare weight of the aggregate scale.

- 3. Pounds (kilograms) of virgin asphalt binder.
- 4. Pounds (kilograms) of virgin aggregate.
- 5. Pounds (kilograms) of reclaimed pavement measured by a batch scale.
- 6. Tons per hour (metric tons per hour) of reclaimed pavement measured by a belt scale.

**C. Drum Mix Plants**. In addition to the requirements of 402.07A, print the information every 5 minutes during production. Ensure printouts contain the following additional information:

- 1. Tons per hour (metric tons per hour) of virgin asphalt binder.
- 2. Tons per hour (metric tons per hour) of virgin aggregate.
- 3. Tons per hour (metric tons per hour) of reclaimed pavement.
- 4. Moisture content of the virgin aggregate.

**402.08 Polymer Binders.** If a binder is modified by SBR polymer at an asphalt concrete mixing plant, equip the plant with an SBR polymer flow meter and monitoring system. Obtain the City of Akron Laboratory's approval of the system before operating. Demonstrate the system calibration to the Engineer. If the Engineer waives the demonstration, provide a letter documenting calibration data for the flow system to the City of Akron for each project.

For drum mix plants, introduce the SBR polymer directly into the asphalt binder line through means of an in-line motionless blender able to provide a homogeneous blend. Locate a sampling valve between the in-line blender and the plant drum.

For batch plants, add the SBR polymer after the aggregate has been completely coated with asphalt binder. Continue mixing for a minimum of 20 seconds after SBR polymer is added and long enough to provide a uniform mixture.

Use a 1-inch (25 mm) magnetic flow meter that employs balanced electrode plane technology. Ensure that the flow meter has two grounding electrodes located in the same measurement plane as the sensing electrodes. The flow meter does not require grounding rings if installed in nonmetallic piping. No straight run is required in piping before or after the flow meter to maintain accuracy, except if located downstream of a pump or modulating valve. Ensure that the totalizer displays a total volume measured and rate indication in any standard engineering units. Ensure that accuracy is  $\pm 2.0$  percent over flow range from 0.8 to 47.5 gallons per minute (3 to 180 L/min). Install the flow meter in the piping downstream of all recirculation lines. Provide a lockable sample valve downstream of the flow meter for calibration purposes. Interface the flow meter with a data logging flow computer. The flow computer shall produce printouts of the logged data every 5 minutes for a drum mix plant or every batch for a batch plant. Include time, date, flow rate, and flow total in the logged data. Flow rate is not necessary for batch plant production.

#### 403.01

Balling or wadding of SBR polymer or uncoated aggregate indicates improper mixing. Cease production immediately and until corrected to the City of Akron satisfaction.

# ITEM 403 ASPHALT CONCRETE QUALITY CONTROL AND ACCEPTANCE

403.01 Description
403.02 General
403.03 Quality Control Program (QCP)
403.04 Plant Calibration
403.05 Quality Control Tests
403.06 Verification Acceptance (VA)
403.07 Unconditional Acceptance
403.08 Acceptance Tables for 448 Mixes

**403.01 Description.** This specification outlines the Contractor requirements for controlling asphalt concrete, asphalt concrete base, or other asphalt mixtures as specified.

**403.02 General.** The Contractor will maintain Verification Acceptance (VA) approval, in accordance with item 403 of the 2002 Ohio Department of Transportation "Construction and Materials Specification", to provide bituminous asphalt concrete for the Ohio Department of Transportation. If the Contractor fails to maintain VA, the City of Akron will accept asphalt mixtures by Unconditional Acceptance in accordance with item 403.07.

Acceptance does not relieve the Contractor of responsibility for supplying and installing a finished product conforming to all requirements of the Contract.

**403.03 Quality Control Program (QCP).** Create and implement a Quality Control Program (QCP) for each paving season in accordance with item 403.03 of the 2002 Ohio Department of Transportation "Construction and Materials Specification".

Provide a copy of the current JMF, the Ohio Department of Transportation VA approval letter, and a copy of the ODOT approved QCP for each paving season to the City of Akron, Materials Testing Laboratory no later than April 1.

**403.04 Plant Calibration.** Conform to the requirements of Item 402.

Maintain plant calibrations in accordance with Item 403.04 of the 2002 Ohio Department of Transportation "Construction and Material Specifications".

**403.05 Quality Control Tests.** Perform quality control tests to control the asphalt concrete mix within the appropriate specifications.

Perform all Item 446 and 448 mix testing and quality control according to 441.09. The Contractor may test a 448 Sublot sample instead of the required quality control test provided the sample is tested in the half day in which the Sublot sample mix was produced and is tested for all required quality control properties.

For mixes that do not use Item 446 or 448 acceptance (e.g. Items 301 and 302), test the mix according to 441.09 for asphalt binder content and gradation (Basic). Other requirements of 441.09 and 441.10 do not apply. Control the Basic mixes as follows:

A. If a single asphalt binder content is more than 0.5 percent beyond the JMF, immediately take and test an additional sample.

B. If two consecutive asphalt binder content tests are more than 0.5 percent beyond the JMF, notify the Monitoring Team and cease production until the problem is corrected.

C. If the Range difference in any three consecutive asphalt binder content tests is greater 0.6 percent for basic mix (301and 302) immediately notify the Monitoring Team.

D. If the Range difference in any three consecutive gradation tests for the No. 4 (4.75 mm) sieve is greater than 10.0 percent, immediately notify the Monitoring Team.

E. If Range deviations as specified continue, cease production.

Range is defined as the difference between the largest and the smallest acceptance test result within an acceptance period (production day or Lot).

**403.06 Verification Acceptance (VA).** The City of Akron will perform VA. If the random City of Akron sampling and testing verifies the accompanying Contractor tests, the results of all the Contractor's quality control tests for each day (for Basic mix) or the Contractor's tests for each Lot (for 446 or 448 mix) will determine acceptance.

**A. Sampling**. The City of Akron will perform the VA by testing split (for Basic or 448 mix) or core (for 446 mix) samples.

For plant sampling for Basic acceptance or 441 quality control testing, the Contractor's technician shall randomly select the truck in which to take a sample by using a random number procedure as outlined in the QCP. The Contractor's technician shall give no indication to anyone of the time that the sample is to be taken. For other than job start, previous mix production problems, low production tonnage, or as requested by the Monitoring Team, exclude the first three trucks from sampling. Include the random number and sample tonnage location and time of taking on the daily Quality Control Report (ODOT Form TE-199) with each test. Tests, other than the required random sample tests, are at the Contractor's discretion according to the QCP.

#### 403.06

Provide a clean area of sufficient size to perform sample splitting. Split samples by quartering according to AASHTO T 248, Method B and recombining for the City of Akron and Contractor's sample. The City of Akron split sample size is generally 22 to 27 pounds (10,000 to 12,000 g). Except for 446 mixes, ensure that every quality control or Item 448 Sublot sample taken by the technician has a labeled split for the City of Akron. Wrap and label the City of Akron split samples as to Lot or Sublot, time, location (tonnage), and accompanying Contractor test identification. Label all cores with a Contractor identifier such that all Contractor cores may be correlated with Monitoring Team VA cores and core data on the Core Reports (ODOT Form TE-217). The Monitoring Team will pick up all City of Akron split samples samples size, consistency, or pre-testing) will result in a change to Unconditional Acceptance.

For Item 446 mixes, obtain two acceptance cores at each location according to 446.05. Take the two cores longitudinally from each other rather than transversely. Send one set to the City of Akron following current procedures. Test one set of cores at the plant laboratory no later than the following production day. If necessary in a Monitoring Team review of a comparison problem, the City of Akron may request the Contractor to not destroy cores during testing. Trim cores by sawing such that tack coat and other pavement courses are removed.

For Item 448 mixes, conform to the procedures of ODOT Supplements 1035, 1038, 1039, and 1043 except take samples from a truck at the plant. If workmanship problems continue on the project (segregation, etc.) or if quality control problems persist, the Monitoring Team may require sampling on the road according to ODOT Supplement 1035. Lots will be 3000 tons (3000 metric tons), and Sublots will be 750 tons (750 metric tons). However, when production is limited to less than 3000 tons (3000 metric tons), consider the quantity produced as a partial Lot. Split and test all Sublot acceptance sample locations, as selected by the Monitoring Team and taken by the Contractor. The Contractor may test a Sublot sample instead of the required random quality control test provided the sample is tested in the half day in which the Sublot sample mix was produced and is tested for all required quality control properties. Label City of Akron split samples as Sublot or quality control samples.

**B. Reporting**. Report all testing performed and sample identification on a Quality Control Report (ODOT Form TE-199). Deliver (fax, e-mail, hand) completed Quality Control Reports and Core Reports (ODOT Form TE-217) by the end of each day in which testing is conducted, but not more than 1 day after cores are cut. If desired by the Monitoring Team and always for unsigned E-mail versions, mail the originals. After startup adjustments, report any plant operation changes on the Quality Control Report. Ensure that each Quality Control Report contains technician comments as to production quality, input materials received, and condition and includes any other quality control activities as specified in the QCP.

Ongoing problems with inadequate, incomplete, or illegible reporting will result in a change to Unconditional Acceptance. The Contractor's technician shall sign each Quality Control Report.

Report test results to the accuracy of the following decimal places. When the figures to be dropped in rounding off are exactly one-half of unity in the decimal place to be retained, the value shall be rounded up or down to the nearest even number in the decimal place to be retained.

	Single Test	Mean
Asphalt Binder Content	0.1	0.01
No. 200 (75 μm) sieve	0.1	0.01
Other sieves	1.0	0.1
Core (BSG)	0.001	0.001

For Item 446 mixes, in addition to quality control results on the Quality Control Report, fill out the Core Report in its entirety and include the bulk specific gravity (BSG) for each core.

For Item 448 mixes, track the Item 448 Sublot and Lot tonnages through the project and identify on the Quality Control Report each random Sublot test as to Lot number and Sublot tonnage location. Ensure that a copy of the technician's gradation worksheets with actual sieve weights for each Sublot sample has the Sublot/Lot identification and is submitted with each day's Quality Control Report. Attach computerized plant printouts representing samples tested to that day's report, if desired by the Monitoring Team, or otherwise keep it with the quality control records. Ensure that the technician notes on the accompanying printout in which tonnage the quality control sample was taken with accompanying test results for AC content and percent passing the No. 4 (4.75 mm) sieve. Keep remaining printouts in the plant laboratory for the duration of the project. Keep a copy of all quality control reports for a project in the Contractor's plant laboratory.

**C.** Verification Testing and Monitoring. For Basic and Item 448 mixes, the Monitoring Team will randomly choose one City of Akron split sample in every four production days for VA testing to confirm Contractor testing and mix control. In addition, the Monitoring Team will sample and split, or witness sampling and splitting of one random Contractor sample in every 4 production days. This provides two City of Akron tests in four production days. On larger production projects, if mix production is proven consistently acceptable by City of Akron VA testing and the Engineer concurs, the City of Akron may not test the additional random sample taken or witnessed by the City of Akron monitor. However, the City of Akron monitor must witness the Contractor split sample test to completion.

For Item 446 mixes, the City of Akron must test a minimum of five random cores in every 2 production days for City of Akron VA testing. The number of cores may be reduced at the Engineers discretion.

For Basic and Item 448 mixes, the Monitoring Team may opt to test the City of Akron split sample in the plant laboratory with the Contractor's permission, according to the Contractor's safety practices, and with the restriction of only the Contractor's technician placing a sample in the AC Gauge. Record the results in the City of Akron project record.

One day may be added to the above City of Akron sample testing frequency for each day production is less than 500 tons (450 metric tons).

For all mixes, the City of Akron may increase the VA testing frequency if desired.

All City of Akron VA test results will be given to the Contractor by a reasonable arrangement acceptable to both.

Table 403.06-1 City of Akron Verification Comparison				
	Percent	Percent	BSG	
	Asphalt Binder	Passing No.		
	_	4 (4.75mm)		
Basic, (301 and 302)	<u>+</u> 0.3	<u>+</u> 4.0		
448[1]	<u>+</u> 0.3	<u>+</u> 4.0		
446[2]			0.010	
[1]COA mix test deviation from Contractor split.				
[2]COA core test deviation from Contractor result.				

If the City of Akron VA tests confirm Contractor testing is within the verification tolerances, but a pattern of high or low results exist that suggests mix control is not at the JMF or field densities are inaccurately determined, then investigate with the Monitoring Team's assistance to correct the problem to the Monitoring Team's satisfaction. Direct questions regarding interpretation of circumstances to the Laboratory.

- D. Contractor Tests are Verified. Production is acceptable if:
  - 1. The Monitoring Team verifies the Contractor's QCP is being fully followed; and
  - 2. The Department VA tests are within the limits specified in 403.06.C; and
  - 3. For Basic mixes, the remaining sieves do not exceed the limits of the applicable specification.

Failure on the Contractor's part to respond and resolve Monitoring Team concerns may result in a change to Unconditional Acceptance.

Acceptance is based on Table 403.06-2.

Table 403.06-2   Mix Acceptance				
Mix Type	Acceptance Tolerar	Acceptance Tolerances or Method		
Basic Mixes		Deviation from JMF	Range	
	Asphalt Binder Content	<u>+</u> 0.5%	1.0	
	No. 4 (4.75 mm) sieve	<u>+</u> 6%	12	
Basic Mixes (acceptance limits stated in appropriate specification)	Use acceptance limits in appropriate specification			
446 Mixes	Calculate pay factor according to 446.05			
448 Mixes	Calculate pay factor according to 403.08			

**E.** Contractor Tests not Verified . If the City of Akron VA test does not verify the accompanying Contractor test within the verification tolerances, then the Monitoring Team will investigate by notifying the Contractor immediately and by testing one additional mix sample or the remaining cores from the days or Lot in question and comparing to the accompanying Contractor test.

If the deviation between the City of Akron and Contractor test is greater than the limits in Table 403.06-3 immediately cease production until resolved. If the deviation is less than the above limits and discrepancies continue, performs additional tests.

Table 403.06-3 Deviation Limits		
Property	Mix	Limits
Asphalt Binder Content	All	<u>+</u> 0.5 %
No. 4 (4.75 mm) sieve	All	<u>+</u> 6.0%
BSG	446	<u>+</u> 0.015

Additional tests may include any testing necessary to resolve the problem. If the additional testing does not resolve the problem by one-half production day or 1000 tons (1000 metric tons), whichever occurs first, to the Monitoring Team's satisfaction, stop production, if not already, until problems are resolved. If the City of Akron testing program is confirmed by the additional tests and Monitoring Team investigation and no reason to question the original test exists, then the original City of Akron tests will stand.

After the above investigation, one of the three following actions will occur:

1. Mix Production Compares Well to the JMF. If the City of Akron test and investigation shows mix is actually controlled well compared to the JMF or field density is accurate in spite of the Contractor test, the City of Akron does not have to test additional samples if the Contractor testing problem is corrected.

2. Mix Production Does Not Compare Well. If the City of Akron tests and investigation shows lack of Contractor mix control compared to the JMF or

incorrect field density, the City of Akron will test the remaining City of Akron samples for the days or Lots represented by the original tests. The City of Akron will use the test results to calculate the acceptance. While working with the City of Akron, immediately take steps to correct the problem according to the QCP. Failure to achieve a quick resolution will result in a change to Unconditional Acceptance.

**3. COA Testing Problem**. If the City of Akron testing program has a problem as confirmed by the additional testing and City of Akron review, the City of Akron will correct the problem, throw out the original test results, and take new City of Akron samples from the samples representing the days or Lots in question for the VA tests.

**F.** Contractor Removal, Restoration. If repeated problems with poor comparison of tests are not the City of Akron fault; or poor comparison of Contractor tests to the JMF; or with plant operation, input materials, or any of the other requirements of City of Akron specifications occur in a single project or successive projects, the City of Akron will request an opinion from the Engineer before notifying the Contractor of removal from City of Akron VA. The Engineer will immediately notify the Contractor of the removal with a follow up letter by the Construction Division Manager. Once notified, acceptance of asphalt mixtures is by Unconditional Acceptance. Restoration of the VA procedures may occur on a future project with a Laboratory recommendation to the Engineer based on consistent improved plant operation and mix control, a review of the Contractor problems and resolutions, and a review of the QCP by the Engineer.

**403.07 Unconditional Acceptance.** If the Contractor is removed from Department VA, the following will occur.

The Contractor must bring its QCP and operation to a level acceptable to the City of Akron before production continues. The City of Akron will accept all material for City of Akron projects from the facility under Unconditional Acceptance. While the facility is under Unconditional Acceptance, acceptance of small quantities under the small quantities policy will not apply.

Quality control testing requirements specified in 403.05 are modified as follows:

A. The required number of test series is a minimum of three each per production day or night. If a production day is less than 6 hours, the City of Akron may reduce the frequency but not less than one test series per every 3 production hours.

B. For Basic mixes, if the variation from the JMF for one test is 8 percent passing the No. 4 (4.75 mm) sieve or 0.3 percent asphalt binder content, investigate and correct the problem, then resample and test. Maintain the moving average of three tests within 4 percent passing the No. 4 (4.75 mm) sieve and 0.2 percent asphalt binder content. In addition to the Quality Control Report, maintain control charts according to 441.10 for asphalt binder content and the No. 4 (4.75 mm) sieve. If the Range difference in any three consecutive tests is greater than 0.6 percent for asphalt binder content or 10.0 percent passing the No. 4 (4.75 mm) sieve, notify the Monitoring Team. If Range deviations as specified continue, cease production.

C. Report each day's testing on a Quality Control Report, according to 446.04. The Contractor shall report all testing performed by the Contractor's technician on the Quality Control Report. After startup adjustments, report any plant operation changes on the Quality Control Report. Ensure that each Quality Control Report contains technician comments as to production quality, input materials received, and condition and includes any other quality control activities required in the QCP. The Contractor's technician shall sign each Quality Control Report. Attach each day's computerized plant printouts to that day's report. The technician shall note on the accompanying printout in which tonnage the quality control sample was taken with accompanying test results for asphalt binder content and percent passing the No. 4 (4.75 mm) sieve. Keep a copy of all Quality Control Reports for a project in the Contractor's plant laboratory.

The City of Akron will monitor according to 441.06, except notification for ceasing production does not have to be in writing. Additional samples may be obtained for City of Akron test at any time.

For Basic mixes, if the mean of the Lot or partial Lot acceptance tests for any sieve other than the No. 4 (4.75 mm) sieve exceeds the specification limits, the pay factor is determined as follows:

Table 403.07-1 Basic Mix Pay Factors				
Number of Tests	1	2	3	4
Pay Factor	0.98	0.97	0.96	0.95

For Item 446 mixes, the City of Akron will test all acceptance cores. City of Akron core testing under Unconditional Acceptance will receive a lower testing priority than other VA projects.

For Item 448 mixes, the City of Akron will perform acceptance sampling and testing according to 403.06 and 403.08. Sublots and acceptance samples may be taken from the roadway or plant at the Engineers discretion. City of Akron testing under Unconditional Acceptance will receive a lower testing priority than other VA projects.

**403.08** Acceptance Tables for 448 Mixes. A Lot is considered acceptable for gradation and asphalt binder content if the deviation of the mean from the JMF and the Range is no more than the tolerances shown in Table 403.08-1.

Mix Property	Deviation	Range
	from JMF	(Percent)
	(Percent)	
Asphalt Binder Content	0.4	1.0
1/2 inch (12.5 mm) sieve	6	15
No. 4 (4.75 mm) sieve	5	15
No. 8 (2.36 mm) sieve	4	15
[1]Based on mean of four Lot	Acceptance tests	

Table 403.08-1 Deviation from the JMF and Range Tolerances[1]

If the mean of the Lot acceptance tests for a particular sieve or sieves, or for asphalt binder content deviates from the JMF by more than the tolerances shown in Table 403.08-1, but falls within the tolerances shown in Table 403.08-2, then the Lot is considered reasonably acceptable and may remain in place with payment at a reduced pay factor as show in Table 403.08-2.

If the Range of the Lot acceptance tests for asphalt binder content or for any particular sieve, or sieves, exceeds the tolerance shown in Table 403.08-1, the City of Akron will apply a pay factor of 0.95.

Mix Property	Pay Factor				
1 0		1Test	2Tests	3Tests	4Tests
	1.00	0 to 0.80	0 to 0.57	0 to 0.46	0 to 0.40
Asphalt	0.98	0.81 to 0.90	0.58 to 0.64	0.47 to 0.52	0.41 to 0.45
Binder	0.94	0.91 to 1.00	0.65 to 0.71	0.53 to 0.58	0.46 to 0.50
Content	0.85	1.01 to 1.10	0.72 to 0.78	0.59 to 0.64	0.51 to 0.55
	0.70	1.11 to 1.20	0.79 to 0.85	0.65 to 0.69	0.56 to 0.60
	[2]	> 1.20	> 0.85	> 0.69	> 0.60
1/2 inch	1.00	0 to 12	0 to 8 5	0 to 6.9	0 to 6 0
1/2 men (12.5 mm)	0.99	13 to 14	8 6 to 9 9	7.0  to  8.1	61  to  7.0
(12.5 mm) ·	0.97	15 to 16	10.0 to 11.3	8 2 to 9 2	7.1 to 8.0
sieve	0.94	17 to 18	11.4 to 12.7	9 3 to 10 4	8.1 to 9.0
	0.90	19 to 20	12.8 to 14.1	10.5 to 11.5	9.1 to 10.0
	[3]	> 20	> 14.1	> 11.5	> 10.0
No. 4	1.00	0 to 10	0 to 7.1	0 to 5.8	0 to 5.0
(4.75  mm)	0.99	11 to 12	7.2 to 8.5	5.9 to 6.9	5.1 to 6.0
(4.75 mm)	0.97	13 to 14	8.6 to 9.9	7.0 to 8.1	6.1 to 7.0
sieve	0.94	15 to 16	10.0 to 11.3	8.2 to 9.2	7.1 to 8.0
	0.90	17 to 18	11.4 to 12.7	9.3 to 10.4	8.1 to 9.0
	[3]	> 18	> 12.7	> 10.4	> 9.0
No.8	1.00	0 to 8	0 to 5 7	0 to 4 6	0 to $4.0$
(2.26  mm)	0.99	9 to 10	5.8 to 7.1	4.7 to 5.8	4.1  to  5.0
(2.30 1111)	0.97	11 to 12	7.2 to 8.5	5 9 to 6 9	5.1 to 6.0
sieve	0.94	13 to 14	8.6 to 9.9	7.0 to 8.1	6.1 to 7.0
	0.90	15 to 16	10.0 to 11.3	8.2 to 9.2	7.1 to 8.0
	[3]	>16	> 11.3	> 9.2	> 8.0

[1]Based on mean of Lot Acceptance tests from the JMF.

[2]Remove and replace material.

[3]Engineer will determine if the material may remain in place. Pay factor for material allowed to remain in place is 0.70.

The City of Akron will determine payment for the Lot by multiplying the contract unit price by the pay factor. When two or more pay factors for a specific Lot are less than 1.00, use lowest pay factor to calculate the payment.

The City of Akron will base acceptance of partial Lots on the mean and the Range of the results of tests on the number of samples obtained.

## **ITEM 406 BITUMINOUS ROAD MIX**

- 406.01 Description
- 406.02 Aggregate
- 406.03 Bituminous Material
- 406.04 Weather Limitations
- 406.05 Equipment
- 406.06 Preparation of Base
- 406.07 Spreading Coarse Aggregate
- 406.08 Applying Bituminous Material, Mixing and Spreading
- 406.09 Compacting and Finishing
- 406.10 Surface Requirements
- 406.11 Method of Measurement
- 406.12 Basis of Payment

**406.01 Description**. This work shall consist of constructing one or more courses of road mix bituminous pavement on a prepared base or road surface in reasonably close conformity with the lines, grades, quantity per square yard and typical cross sections shown on the plans or established by the Engineer.

**406.02** Aggregate. Aggregate used in the mix shall conform to 703.05 and shall be Nos. 6, 7, 8, 67 or 57. Aggregate used in the choke shall conform to 703.05 and shall be Nos. 7, 8 or 9 as specified.

Coarse aggregates for the mix, except where asphalt emulsions are used, shall be surface dry before the application of bituminous material. When asphalt emulsions are used in the mixture, a uniform control over the moisture content of the aggregate shall be maintained within such limits that a proper coating of bituminous material may be obtained.

In lieu of the requirements for dry aggregate, the bituminous material shall be treated with an agent that will permit the coating of wet aggregate within the normal mixing period, provided such treatment is approved by the Engineer.

When a Contractor uses treated bituminous material, the agent shall comply with 712.08.

**406.03 Bituminous Material**. Bituminous material of the type and grade specified shall meet the applicable requirements of 702. When two or more grades

### 406.04

of one type of bituminous material are specified in the contract, the grade to be used shall be determined by the Engineer.

**406.04 Weather Limitations**. The construction of road mix shall be carried on only when the existing surface is dry, the atmospheric temperature is above  $50^{\circ}$ F and has not been below  $40^{\circ}$ F during the preceding 24 hours. Road mix shall not be placed between October 1st and May 15th of the succeeding year except by permission of the Engineer; nor shall bituminous road mix be placed when impending weather conditions are such that proper spreading, finishing and ample curing may not be obtained.

**406.05 Equipment**. Mixing and spreading equipment shall consist of two or more motor graders. Motor graders shall be rubber-tired and be constructed rigidly, and shall be free from worn parts, so that no jumping or chattering of the blades occurs. The weight of the grader shall be such that it will cut through hard surfaces without skidding over the surface. Moldboards shall be 12 to 14 feet in length and not less than 20 inches in height and curved sufficiently to cascade coated aggregate in front of it.

Motor graders shall have a wheel base of not less than 17 feet. The moldboards shall be equipped with two aprons, adjustable to width and grade. The aprons shall be securely fastened to the moldboard and shall be of sufficient height and length to form a pocket of material and be adjusted to secure a straight edge.

Bituminous distributors shall be designed, equipped, maintained and operated so that bituminous material is applied at the specified rate per square yard with uniform pressure over the required width of application. The distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank. An accurate thermometer with a range covering the specified application temperature for the bituminous material shall be mounted at approximately center height of the tank with the stem extending into the bituminous material. The distributor shall have a full circulating system with a spray bar, adjustable laterally and vertically. The spray bar shall be maintained at a constant height above the pavement under variable load conditions. Each distributor shall have suitable charts showing truck and pump speeds and other pertinent application data necessary to obtain the required results.

Distributors shall meet the following requirements: The actual application in gallons per square yard shall be determined by a check on the project. The application shall be considered satisfactory when the actual rate is within plus or minus 10 percent of the required rate and the material is applied uniformly with no visible evidence of streaking or ridging.

Rollers shall conform to 401.11.

**406.06 Preparation of Base**. The base or old pavement shall be cleaned in accordance with 407.04.

**406.07 Spreading Coarse Aggregate**. Coarse aggregate shall be evenly spread, with approved spreader boxes, upon the surface to a uniform depth in the specified quantity and to a width approximately 2 feet less than the overall width of the gathering blades of the mixing unit. Aggregate shall not be spread in advance of the mixing operation more than the length of the section which the Contractor can mix and roll in a day's operation.

Coarse aggregate shall have a uniform distribution of size, and all patches or areas of fine or undersized material shall be immediately removed and replaced with suitable material.

The Contractor shall arrange operations to avoid hauling over the work.

**406.08 Applying Bituminous Material, Mixing and Spreading**. After aggregate has been spread as specified and when in a warm, dry condition, bituminous material heated to the specified temperature shall be uniformly applied at the rate per square yard specified or directed by the Engineer, in one or more applications. The rate will vary within the limits specified, depending upon the weight of aggregate applied. The bituminous material shall be applied at a rate that will not result in flow off the road material.

Immediately after each application of bituminous material, the aggregate and bituminous material shall be thoroughly mixed until all particles of aggregate are coated and the whole mass has a uniform color free from fat or lean spots, balls or uncoated particles.

Should the mixture show an excess, or deficiency, or uneven distribution of bituminous material, the condition shall be corrected by the addition of aggregate or bituminous material, as required, and remixing. The mixture shall be bladed until the moisture and volatile content are satisfactory. When mixing operations have been satisfactorily completed, the mixture shall be formed into a windrow of uneven cross section and spread to the specified thickness.

**406.09 Compacting and Finishing**. At least two rollers shall be operated throughout construction of the pavement except that when less than 150 tons of aggregate are mixed and placed per 8 hour day, one steel wheel roller may be used. Rollers may be used in any combination except that when a pneumatic tire roller is used it shall be used in combination with one of the other steel wheel rollers specified. Capacity of the rollers shall be considered to be 30 tons of aggregate mixed and placed per hour except that capacity of the pneumatic tire roller shall be considered 60 tons per hour.

After the initial rolling, choke aggregate of the size and quantity specified shall be uniformly spread over the entire surface through an approved spreader, and the rolling completed as described above. Choke aggregate shall be broom-dragged if required by the Engineer. The rolling shall proceed continuously at such a rate that thorough compaction of the surface may be obtained at approximately the same rate that the mixing and spreading operation proceeds.

All courses shall be rolled when the course spread has set sufficiently to be rolled, and when the rolling does not cause undue displacement or shoving.

The rollers shall operate approximately together on each side of the section being treated. Rollers shall operate forward and backward over the section overlapping the portions as required. No turning of rollers on the finished work will be permitted.

Rollers on initial trips shall operate so that the 18 inches at the outside edges of the treatment will not be rolled. The second trips of the rollers, or when the edges are sufficiently cured to support the weight of the rollers without appreciable lateral displacement, shall begin at the outside edges and progress toward the center. The surface shall then be rolled until thoroughly compacted and free from roller marks. The edges of the surface course shall be maintained to a straight line or regular curves.

**406.10** Surface Requirements. When the surface course is placed on a newly constructed base course or is one inch or more in thickness, the surface, both before and after the application of the seal coat, shall be such that it will not vary more than 1/2 inch from a template cut to the cross section of the road nor more than 3/8 inch from a 10 foot straightedge applied parallel to the centerline of the pavement. Depressions which may develop after the initial rolling shall be remedied by loosening the surface mixture laid, and adding new material to bring such depressions to the specified surface. Portions of the pavement defective in composition or compression, that show surface variations in excess of those given above, or that do not in all other respects comply with requirements, shall be replaced or readjusted with suitable material in a manner satisfactory to the Engineer.

**406.11** Method of Measurement. Quantities measured shall be the number of cubic yards of aggregate and the actual number of gallons of bituminous material, all in place, completed and accepted.

Measurements of bituminous material shall be in accordance with 109.

Aggregate shall be measured by weight in accordance with 109 and converted to cubic yards in accordance with the following for 703.05 aggregate:

Aggregate	<b>Pounds Per Cubic Yard</b>
Crushed gravel	2600
Stone and heavy slag	2400
Slag	2000

\*Slag with an average dry rodded weight on record at the Laboratory of 90 pounds per cubic foot or more.

When the moisture content of the aggregate at the time of weighing does not exceed 3 percent by weight, no deduction will be made from the scale weights for moisture. When the moisture content exceeds 3 percent by weights, deductions will be made from the total weight of the aggregate for the weight of moisture in excess of 2 percent.

**406.12 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
406	Cubic Yards	Aggregate for road mix
406	Cubic Yards	Aggregate for choke
406	Gallon	Bituminous material for road mix

# **ITEM 407 TACK COAT**

- 407.01 Description
- 407.02 Materials
- 407.03 Equipment
- 407.04 Weather Limitations
- 407.05 Preparation of Surface
- 407.06 Application of Asphalt Material
- **407.07** Application of Cover Aggregate
- 407.08 Method of Measurement
- 407.09 Basis of Payment

**407.01 Description.** This work consists of preparing and treating a paved surface with asphalt material, and cover aggregate if required.

**407.02 Materials.** Conform to the applicable requirements of 702 for the asphalt material and use one of the following types: 702.04 RS-1, SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h; or 702.13. Conform to 703.06 for cover aggregate.

**407.03 Equipment.** Provide adequate cleaning equipment, spreader boxes, and distributors.

Use distributors designed, equipped, maintained, and operated to apply asphalt material at the specified rate per square yard (square meter) with uniform pressure over the required width of application. Ensure that the distributor includes a tachometer, pressure gauges, accurate volume measuring devices, or a calibrated tank. Mount an accurate thermometer with a range covering the specified application temperature for asphalt material at approximately center height of the tank with the stem extending into the asphalt material. Ensure that the distributor has a full-circulating system with a spray bar that is adjustable laterally and vertically. Ensure that the spray bar will maintain a constant height above the pavement under variable load conditions. Supply each distributor with suitable charts showing truck and pump speeds and other pertinent application data necessary to obtain the required results.

**407.04 Weather Limitations.** Do not apply the asphalt material if the surface temperature is below the minimum placement temperature for the pavement course to be placed, as specified in 401.06.

**407.05 Preparation of Surface.** Ensure that the surface is thoroughly clean and dry when the asphalt material is applied. Remove material cleaned from the surface and dispose of it as the Engineer directs.

**407.06 Application of Asphalt Material.** Uniformly apply the asphalt material with a distributor. Emulsions may be diluted with water to achieve a more uniform application.

For irregular areas such as driveways and intersections, apply the asphalt material using a method the Engineer approves.

If paving asphalt concrete directly onto portland cement concrete or brick pavement, tack the pavement with rubberized asphalt emulsion conforming to 702.13.

Before placing a surface course onto an intermediate course, apply a tack coat on the intermediate course.

Apply the tack coat in a manner that offers the least inconvenience to traffic and that allows one-way traffic without pickup or tracking. Only apply the tack coat to areas that will be covered by a pavement course during the same day.

The Engineer will approve the quantity, rate of application, temperature, and areas to be treated before application of the tack coat. The Engineer will determine the actual application in gallons per square yard (Liters per square meter) by a check on the project. At no time will the application rate be less than 0.1gallon/square yard on new base courses, and 0.20 gallon/square yard on courses being resurfaced. The application is considered satisfactory when the actual rate is within 10 percent of the required rate and the material is applied uniformly with no visible evidence of streaking or ridging.

**407.07 Application of Cover Aggregate.** Immediately following the application of the asphalt material in areas that will be exposed to traffic, uniformly apply sufficiently dry cover aggregate to form a bonded layer that, after curing, will not be picked up by traffic. The Engineer will not accept excessive application resulting in an unbonded layer of cover aggregate.

**407.08** Method of Measurement. The City of Akron will measure Tack Coat and Tack Coat for Intermediate Course by the number of gallons (liters) of undiluted asphalt material applied for each according to Item 109.

**407.09 Basis of Payment.** The cost of cover aggregate and water to dilute an emulsion is incidental to Tack Coat.

The City of Akron will pay for accepted quantities at the contract prices as follows:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
407	Gallon (Liter)	Tack Coat
407	Gallon (Liter)	Tack Coat for Intermediate Course

## **ITEM 408 PRIME COAT**

- 408.01 Description
- 408.02 Asphalt Material
- 408.03 Cover Aggregate
- 408.04 Weather Limitations
- 408.05 Equipment
- 408.06 Preparation of Surface
- 408.07 Application of Asphalt Material
- 408.08 Application of Cover Aggregate
- 408.09 Method of Measurement
- 408.10 Basis of Payment

**408.01 Description.** This work consists of preparing and treating an existing surface with asphalt material, and cover aggregate if required.

**408.02** Asphalt Material. Conform to the applicable requirements of 702 for asphalt material and use one of the following types: 702.02 RC-70, RC-250, MC-30, MC-70, or MC-250; or 702.03 Primer 20.

**408.03 Cover Aggregate.** Use cover aggregate conforming to No. 9 size or gradation requirements of 703.05 or 703.06.

**408.04** Weather Limitations. Do not apply asphalt material on a wet surface. Do not apply prime coats for asphalt concrete or surface treatment work when the atmospheric temperature is below  $50^{\circ}$  F ( $10^{\circ}$  C) or when the air temperature within the preceding 24 hours has been  $40^{\circ}$  F ( $5^{\circ}$  C) or lower. The Contractor may apply prime coats on stabilized and granular base courses, when the atmospheric temperature is  $40^{\circ}$  F ( $5^{\circ}$  C) or higher.

**408.05 Equipment.** Use equipment conforming to 407.03.

**408.06 Preparation of Surface.** Shape the surface to be primed to the required grade and section. Ensure the surface is free from all ruts, corrugations, segregated material or other irregularities and is smooth and uniformly compacted at the time of application of the asphalt material. Clean the surface in a manner that will thoroughly remove all mud, earth, and other foreign material. Take care to clean the edges of road to be primed to ensure uniform application of the asphalt material directly onto the existing base or pavement surface. Remove material cleaned from the surface and dispose of it as the Engineer directs.

**408.07 Application of Asphalt Material.** Apply asphalt material in a uniform continuous spread to the width of the section to be primed by means of a distributor conforming to 407.03. When traffic is maintained, do not treat more than one-half of the width of the section in one application. Take care that the application of asphalt material at the junction of spreads is not in excess of the specified amount. Squeegee excess asphalt material from the surface. Correct skipped areas or deficiencies.

When traffic is maintained, allow one-way traffic on the untreated portion of the road bed. As soon as the asphalt material has been absorbed by the surface and will not be picked up, transfer traffic to the treated portion and prime the remaining width of the section. The Engineer will approve the quantity, rate of application, temperatures and areas to be treated before application of the prime coat.

**408.08 Application of Cover Aggregate.** If, after applying the prime coat, the asphalt material fails to penetrate and traffic must use the roadway, spread cover aggregate in the amount required to absorb any excess asphalt material.

**408.09** Method of Measurement. The City of Akron will measure Prime Coat by the number of gallons according to 109.

**408.10 Basis of Payment.** The cost of cover aggregate is included under Prime Coat.

The City of Akron will pay for accepted quantities, complete in place, at the contract price as follows:

Item	<u>Unit</u>	<b>Description</b>
408	Gallon	Prime Coat

# **ITEM 409 CHIP AND SEAL**

409.01 Description

- 409.02 Bituminous Material
- 409.03 Cover Aggregate Material
- 409.04 Weather Limitations
- 409.05 Equipment
- **409.06 Preparation of Surface**
- 409.07 Applying Bituminous Material
- 409.08 Cover Aggregate
- 409.09 Method of Measurement
- 409.10 Basis of Payment

**409.01 Description**. This work shall consist of the construction of a wearing surface composed of one or more applications of bituminous material and cover aggregate, in place and compacted, in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

**409.02 Bituminous Material**. The bituminous material shall meet the applicable requirements of 702 and shall be one of the following: 702.02 RC-250, RC-800, RC-3000, MC-800 or MC-3000; or 702.03 CBAE-800; or 702.04 RS-1, RS-2, CRS-1 or CRS-2. Cut-back asphalts 702.02 and cut-back asphalt emulsions 702.03 may only be used after September 15 and before May 15.

**409.03** Cover Aggregate Material. The cover aggregate shall conform to 703.05. The sizes of aggregate shall be No. 6, No. 67, No. 8 or No. 9 as specified. The surface moisture of the cover aggregate shall not exceed that which will permit the proper coating and adhesion of the type of bituminous material specified, except that the bituminous material may be treated with some agent that will assist in obtaining sufficient coating to hold the aggregate in place, provided such treatment is approved by the Engineer. When a Contractor desires to use treated material, the agent shall comply with 712.08.

**409.04** Weather Limitations. No bituminous material shall be applied unless the temperature is  $50^{\circ}$ F and rising or when the temperature has been below  $40^{\circ}$ F in the preceding 24 hours, except as provided for seal coat application on shoulders. No bituminous material shall be applied while the surface is wet or when impending weather conditions are such that proper curing may not be obtained.

For chip and seal application on shoulders, cutback asphalt, cutback asphalt emulsion, or tar may be applied when the air temperature is between  $40^{\circ}$ F and  $50^{\circ}$ F, providing the cover aggregate is heated and is free of surface moisture at the time of application. The temperature of the aggregate shall be  $150^{\circ}$ F or higher if necessary to produce coated, bonded particles on completion of construction operations.

**409.05** Equipment. Bituminous distributors shall conform to 407.03. Rollers shall be pneumatic tire conforming to 401.11 with the following exceptions: the minimum tire size shall be  $7.50 \times 15$ ; the minimum wheel load shall be 2,000 pounds and the contact area pressure requirements and maximum capacity shall not

#### 409.06

apply. Tires shall be inflated to a pressure producing a minimum average contact pressure of 55 psi.

Aggregate spreaders may be self-propelled or truck mounted and shall be equipped with hoppers, revolving cylinders and adjustments necessary to produce a uniform distribution of particles at the specified rate.

**409.06 Preparation of Surface**. The pavement shall be cleaned in accordance with 407.04.

**409.07 Applying Bituminous Material**. The bituminous material, heated to a temperature within the specified range, shall be applied by means of a pressure distributor. The material shall be applied with sufficient uniformity to prevent ridging or streaking in the completed surface. The rate of application specified in the contract may be adjusted with the approval of the Engineer when necessary to result in satisfactory embedment and retention of the cover aggregate.

At the beginning and at the end of the contract section, the application shall be started and stopped on paper or other suitable material sufficiently wide to permit full application on the surface being treated. Transverse and longitudinal laps shall be made in such manner that the texture of the finished surface will be uniform and continuous.

Prior to starting the application of bituminous material, sufficient cover aggregate shall be available for immediate application.

**409.08 Cover Aggregate**. Immediately following the application of the bituminous material, cover aggregate shall be applied uniformly without ridges or laps at the specified rate adjusted as directed by the Engineer to produce a minimum of excess loose particles. Spreading shall be accomplished in such manner that the tires of the truck or aggregate spreader at no time contact the uncovered and newly applied bituminous material. Deficiencies in the application of cover aggregate shall be corrected prior to rolling in a manner satisfactory to the Engineer.

Rolling shall begin immediately behind the spreader and shall consist of four complete coverages. When three-wheeled rollers are required they shall be used for at least the initial coverage. A roller coverage shall consist of two trips or passes over the same area. Rollers shall not be operated at speeds which cause pick up or dislodging of aggregate particles.

Following the completion of rolling, the Contractor shall protect the surface from traffic damage during the period of time required for the bituminous material to cure sufficiently to prevent dislodging of the aggregate particles by normal traffic. During this period, deficiencies in cover aggregate shall be corrected by spreading additional aggregate or by light brooming as directed by the Engineer. Excess cover aggregate shall be swept from the surface by means of rotary brooms as soon after the bituminous material has cured sufficiently to prevent dislodging of the embedded aggregate particles.

**409.09** Method of Measurement. Quantities measured shall be the number of cubic yards of aggregate and the actual number of gallons of bituminous material, all in place, completed and accepted.

Measurements of bituminous material shall be in accordance with 109.

Aggregate shall be measured by weight in accordance with 109 and converted to cubic yards in accordance with the following for 703.05 aggregate:

Aggregate	Pounds Per Cubic Yard
Crushed gravel	2600
Stone and heavy slag*	2400
Slag	2000

\*Slag with an average dry rodded weight on record at the Laboratory of 90 pounds per cubic foot or more.

When the moisture content of the aggregate at the time of weighing does not exceed 3 percent by weight, no deduction will be made from the scale weights for moisture. When the moisture content exceeds 3 percent by weight, deductions will be made from the total weight of the aggregate for the weight of moisture in excess of 2 percent.

**409.10 Basis of Payment**. The quantities measured as above provided will be paid for at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
409	Gallon	Chip and seal bituminous material
409	Cubic Yard	Chip and seal cover aggregate No.

## **ITEM 410 DRIVE AND WALKWAY SEALCOAT**

- 410.02 Materials
- 410.03 Composition
- 410.04 Surface Preparation
- 410.05 Application
- 410.06 Method of Measurement
- 410.07 Basis of Payment

### 410.01

**410.01 Description**. This work shall consist of the surface preparation and furnishing and applying a coal tar pitch emulsion sealcoat to designated asphaltic parking lots, walkways, driveways, play areas, etc. indicated on the plans or as directed by the Engineer.

**410.02 Materials**. Bituminous Material - The bituminous material shall be a coal tar pitch emulsion prepared from a high temperature coal tar pitch conforming to the requirement of Federal Specification R-T-143. Oil and water gas tar shall not be used even though they comply with R-T-143. The coal tar pitch emulsion shall conform to all requirements of Federal Specification R-P-355d, except the water content shall not exceed 50 percent.

Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, must be submitted to the Engineer and approval obtained before use of such material begins. The Contractor shall furnish manufacturer's certification that each consignment of the emulsion shipped for this project meets the requirements of Federal Specification R-P-355d with the exception that the water content shall not exceed 50 percent. The manufacturer's certification shall be subject to verification by testing samples of the emulsion received for use on the project.

Aggregate - The aggregate shall be a natural product composed of clean, hard, durable, uncoated particles, free from clay and all organic matter. The aggregate shall meet the gradation shown below:

Sieve Size	% Passing by Weight
No. 16	100
No. 20	85 -100
No. 30	5 - 15
No. 40	2 - 5
No. 100	0 - 2

The gradation test shall be made as per ASTM C136.

Water - The water used in mix design shall be clear, fresh, potable water having a temperature of  $50^{\circ}$ F or higher.

**410.03 Composition**. The coal tar pitch emulsion sealcoat shall consist of a mixture of coal tar pitch emulsion, water and aggregate in the proportions shown below:

	Coal Tar	Water (Gal. Per	Minimum Sand	Application
	Pitch	Gal. Of	(Lbs. Per Gal. Of	Rate (Gal. Per
	Emulsion	Emulsion)	Emulsion)	Sq. Yd.)
	(Gal.)			
1st Coat	1.0	0.8 (max.)	10	0.35
2nd Coat	1.0	0.8 (max.)	5	0.25

The coal tar pitch emulsion sealcoat shall be applied in two coats at rates specified above.

**410.04** Surface Preparation. Prior to placing the sealcoat, the pavement surface shall be cleaned by power blowers, power brooms and other appropriate methods to leave the surface clean and free from dust, dirt and other loose foreign matter, vegetation, oil, grease or any type of film that may be detrimental to bonding of the sealcoat.

All cracks 1/4 inch and wider are to be sealed in accordance with Item 414. Cracks less than 1/4 inch wide shall be cleaned with high pressure water and/or compressed air of no less than 90 psi pressure.

All methods employed in performing the work and all equipment, tools and machinery used for handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started.

**410.05 Application**. The materials shall be proportioned accurately and mixed by suitable mixing equipment. The mixing shall produce a smooth, free flowing homogenous mixture of uniform consistency. During the entire mixing process, no breaking, segregating or hardening of the emulsion, nor balling, lumping or swellings of the aggregate shall be permitted. The emulsion shall be continuously agitated from the time it has been mixed until its application to the surface.

Immediately prior to application of the sealcoat, the pavement surface shall be dampened.

The application of the slurry shall be either by hand methods using rubber squeegees for spreading, by spreader boxes or distributor equipment or by any other suitable method approved by the Engineer. The application of the first coat shall be by hand methods only using rubber squeegees for spreading. The slurry shall be applied at a uniform rate to provide the specified amount. The slurry shall be worked into the cracks carefully in order to fill the entire crack with the slurry. The first coat shall be allowed to dry and cure sufficiently to drive over without pick up or damage before the second coat is applied. In no case shall the cure time be less than four hours. The second coat shall be applied uniformly at the specified rate and allowed to dry and cure a minimum of 24 hours before permitting any traffic on the sealed surfaces. During the application, surface of adjacent structures shall be protected to prevent them from being spattered or marred.

The sealcoat shall not be applied when rain is imminent within 24 hours of application, nor when the ambient or pavement surface temperature is below  $50^{\circ}$ F (10°C), unless otherwise approved by the Engineer.

**410.06 Method of Measurement**. The quantity to be paid for under this item shall be the number of square yards of surfaces sealed, complete and accepted.

**Basis of Payment** 

**410.07 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
410	Square Yards	Drive and Walkway Sealcoat

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the work as specified herein.

# ITEM 411 ATHLETIC COURT SEALCOAT

411.01 Description
411.02 Materials
411.03 Surface Preparation
411.04 Application
411.05 Method of Measurement
411.06 Basis of Payment

**411.01 Description**. This work shall consist of the surface preparation, and furnishing and applying crack filler (if required), and seal and color coats to designated athletic courts indicated on the plans, or as directed by the Engineer.

**411.02 Materials**. Crack filler, seal and color coat materials for athletic courts shall be:

Crack filler	"Plexipave" crack filler
First application:	"Acrylic Resurfacer"
Second application:	"Fortified Plexipave" as manufactured by
	California Products Corp.,
	P.O. Box 569, 169 Waverly St.
	Cambridge, Mass. 02139
	Telephone 1-800-225-1141

Or: Crack filler "Court Flex" First Application "Acrylic Resurfacer" Second Application "Color Concentrate" as manufactured by SealMaster Industries, Inc. P.O. Box 2277 Sandusky, Ohio 44870 1-800-395-7325

All color coats shall be light green, unless otherwise specified on the plan.

All coating applications must be of compatible materials from the same manufacturer. For sealcoat renew, a 3 foot square test patch area shall be performed by the Contractor on the existing court prior to approval of the sealcoat material.

Manufacturer's printed specifications shall be submitted to the Engineer prior to beginning any work on the courts.

Sand to be used shall be of the gradation recommended by the sealcoat manufacturer.

Water to be used shall be clear, fresh and potable having a temperature of  $50^{\circ}$ F (10°C) or higher.

Cracks less than  $\frac{1}{2}$  inch wide shall be filled in accordance with manufacturer's recommendations and 414.03. Cracks between  $\frac{1}{2}$  and  $1-\frac{1}{2}$  inches shall be filled in accordance with 416.

**411.03 Surface Preparation**. All surfaces to be coated shall be thoroughly cleaned by the use of power brooms, compressed air and/or washing with water to remove all dust, dirt, debris and other foreign matter. If fungus is present, use a two percent sodium hypochlorite solution to clean the affected area. Once the fungus is removed, rinse the court thoroughly. Concrete renew courts shall then be cleaned with a solution of muriatic acid and water at a rate of 1.5 gallons of muriatic acid per 800 square yards of court. The muriatic acid shall then be thoroughly rinsed off with clean water. Oil and grease spots, if any, shall be removed by methods approved of by the Engineer.

**411.04 Application**. On new courts, apply two coats of the first application and two coats of the second application, per manufacturer's specifications. On renew courts, apply crack filler (if required), one coat of the first application and two coats of the second application per manufacturer's specifications.

**411.05** Method of Measurement. The quantity to be paid for under this item shall be the number of square yards of sealcoat applied, complete and accepted.

**411.06 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
411	Square Yards	Athletic Court Sealcoat (New)
411	Square Yards	Athletic Court Sealcoat (Renew)
411	Gallon	Athletic Court Crack Filler

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the work as specified herein.

412.01 Description412.02 Composition412.03 Basis of Payment

**412.01 Description**. This work shall consist of constructing a surface course of aggregate and asphalt cement mixed in a central plant and spread and compacted on a prepared surface in accordance with these specifications and in reasonable conformity with the lines, grades and typical sections shown on the plans or established by the Engineer.

This item shall be in accordance with 401 except for composition.

**412.02** Composition. Aggregate shall be 703.05. Coarse aggregate and fine aggregate shall be combined in such proportions that the resulting blend shall be as directed by the Engineer but within the following limits.

Sieve	Total Passing, % by wt.
3/8 inch	100
1/4 inch	90 - 100
No. 4	50 - 95
No. 8	15 - 70
No. 16	10 - 50
No. 50	5 - 20
No. 200	0 - 8

Bitumen content shall be as approved by the Engineer and within the following limits:

Bitumen (Percent of total mix) 5.0% to 10%

**412.03 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>	
412	Square Yard	Sand Asphalt,	inches thick
412	Ton	Sand Asphalt, var	riable thickness

# **ITEM 413 ASPHALT CONCRETE CURBING**

- 413.01 Description
- 413.02 Materials
- 413.03 Construction Methods
- 413.04 Method of Measurement

## 413.05 Basis of Payment

**413.01 Description**. This work shall consist of furnishing and constructing asphalt concrete curb, in reasonably close conformity with the lines, grades and cross sections shown on the plans or established by the Engineer. This item shall also include necessary excavation and backfill and the disposal of surplus excavation and discarded materials in accordance with 203.

**413.02 Materials**. Asphalt concrete shall meet the composition requirements of 448 with the fine aggregate content set at the maximum permitted under this composition. Mineral filler meeting the requirements of 703.07 may be added provided the composition requirements of 448 are met. The method of introducing mineral filler shall be approved by the Engineer.

**413.03** Construction Methods. The specified asphalt concrete material shall be furnished and placed to form a curb of the cross section shown on City of Akron Standard Drawing A-5430-P, by the following method or by any other method approved by the Engineer.

After completion of the surface course, the area to be occupied by the curb shall be painted or sprayed with bituminous material meeting the requirements of 407.02 and applied at the rate of 0.15 gallons per square yard. Only the area to be occupied by the curb shall be so treated. The curb shall then be placed with a hand-operated or self-propelled machine consisting of a hopper and power-driven screw which forces the material through a tube by an extrusion method. The proper density and cross section of the curb shall be obtained by forcing the material through a die attached to the end of the extrusion tube.

The top of the curb shall be depressed for driveways to two inches above the surface of the pavement or gutter and shall be sloped as directed.

**413.04 Method of Measurement**. The footage measured will be the actual number of linear feet of curb complete in place, measured along the front face of the curb section.

**413.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
413	Linear Foot	Asphalt Concrete Curb

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the item as specified.

- 414.01 Description414.02 Materials414.03 Construction Methods414.04 Method of Measurement
- 414.05 Basis of Payment

**414.01 Description**. This item shall consist of furnishing and installing a resilient and adhesive crack sealing filler capable of effectively sealing cracks  $\frac{1}{2}$  inch and smaller in asphalt or concrete pavements.

**414.02 Materials**. Crack sealers: Crack sealing materials shall meet the requirements of ASTM D3405 - Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements. Material for Item 414 shall be "Court Flex", as manufactured by SealMaster Industries, Inc., P.O. Box 2277, Sandusky, Ohio, 1-800-395-7325.

Each lot or batch of sealing compound shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number and the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

**414.03 Construction Methods**. Cracks shall be sealed before any sealcoat, fabric sealant or fabric is placed. The pavement temperature shall be above  $50^{\circ}$ F ( $10^{\circ}$ C) at the time of installation of the poured crack sealing material.

Immediately before sealing, the cracks shall be thoroughly cleaned of all laitance, dirt, debris and other foreign material. Cleaning shall be accomplished by routing, sandblasting, or other approved method. Upon completion of cleaning, the cracks shall be blown out with compressed air. The crack faces shall be surface dry when the seal is applied.

Air compressors shall be portable and furnish not less than 90 psi air pressure at the nozzle.

Cracks shall be inspected for proper preparation, and shall be approved by the Engineer before sealing is allowed. Sealant shall be installed in accordance with the following requirements.

The crack sealant shall be applied uniformly solid from bottom to top in all cracks  $\frac{1}{2}$  inch and smaller and without formation of entrapped air or voids. The heating kettle shall be indirect heating type, constructed as a double boiler. A

positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated higher than 20°F (11°C) less than the safe heating temperature. A direct connecting pressure type extruding device with nozzles shaped for insertion into the crack shall be provided. Any sealant spilled on the surface of the pavement shall be removed immediately.

**414.04** Method of Measurement. The quantity to be paid for under this item shall be the actual number of pounds installed, complete and accepted.

**414.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>	
414	Pounds	Crack Sealing Filler	

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the work as specified herein.

## **ITEM 415 LINE MARKING**

- 415.01 Description
- 415.02 Materials
- 415.03 Layout
- 415.04 Application
- 415.05 Method of Measurement
- 415.06 Basis of Payment

**415.01 Description**. This item shall consist of laying out and applying white painted lines for all playing courts as specified herein and as directed by the Engineer.

**415.02** Materials. The paint shall be one of the following:

 "Stripe-Kote" white line paint as manufactured by Tech Tone Products Division/Koch Materials Company, 4900 South Mason Avenue, Chicago, Illinois 60630, Telephone 312-458-4330,

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or
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- 2. "Dynastripe" latex striping paint as manufactured by Neyra Industries, Inc., 10700 Evendale Drive, Cincinnati, Ohio 45241, Telephone 513-733-1000, or
- "Plexicolor" line paint as manufactured by California Products Corporation, P. O. Box 569, 169 Waverly Street, Cambridge, Mass. 02139, Telephone 1-800-225-1141

or an approved equal.

**415.03 Layout**. Prior to applying sealcoat, the Contractor shall establish reference points to assure proper placement of restored markings in existing locations, where applicable. Otherwise, the playing areas shall be marked in accordance with United States Tennis Courts and Track Builders Association regulations. All lines shall be two inches wide.

**415.04 Application**. The Contractor shall clean all visible loose or foreign matter from the surface to be marked for painting. Masking tape or templates shall be used to insure a clean, sharp definition of the lines. The paint shall be applied by brush at a rate of 600 linear feet per gallon, or as required depending on surface porosity and application method. If spray equipment is used, paint may be diluted in accordance with the manufacturer's printed specifications. Paint shall be allowed to dry for twenty-four hours before allowing use of playing areas.

**415.05** Method of Measurement. The quantity to be paid for under this item shall be the number of linear feet of line marking applied, complete and accepted.

**415.06 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>	
415	Linear Feet	Two inch Line Marking	

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the work as specified herein.

## **ITEM 416 CRACK SEALING FILLER FOR ATHLETIC COURTS**

- 416.01 Description
- 416.02 Materials
- 416.03 Construction Methods
- 416.04 Method of Measurement
- 416.05 Basis of Payment

**416.01 Description**. This item shall consist of furnishing and installing a resilient and adhesive crack sealing filler capable of effectively sealing cracks between  $\frac{1}{2}$  and  $1\frac{1}{2}$  inch and in asphalt or concrete pavements.

**416.02 Materials**. Crack sealers: Crack sealing materials shall meet the requirements of AASHTO-M173. Material for Item 416 shall be Product 9075 -

Flex-A-Fill, as manufactured by Koch Materials Company, 4<sup>th</sup> and Duke Streets, P. O. Box 191, Northumberland, PA, Phone (800) 521-9593, and distributed by K&L Sealers, 20819 Westwood Drive, Strongsville, OH 44136, Phone (440) 238-7920.

Each lot or batch of sealing compound shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number and the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

**416.03 Construction Methods**. Cracks shall be sealed before any sealcoat, fabric sealant or fabric is placed. The pavement temperature shall be above  $50^{\circ}$  F (10°C) at the time of installation of the poured crack sealing material.

Immediately before sealing, the cracks shall be thoroughly cleaned of all laitance, dirt, debris and other foreign material. Cleaning shall be accomplished by routing, sandblasting, or other approved method. Upon completion of cleaning, the cracks shall be blown out with compressed air. The crack faces shall be surface dry when the seal is applied.

Air compressors shall be portable and furnish not less than 90 psi air pressure at the nozzle.

Cracks shall be inspected for proper preparation, and shall be approved by the Engineer before sealing is allowed. Sealant shall be installed in accordance with the following requirements.

Sand should fill the crack to within 3/4 inch of the surface. The crack sealant shall be applied uniformly solid from bottom to top in all cracks and without formation of entrapped air or voids. The heating kettle shall be indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated higher than  $20^{\circ}$ F ( $11^{\circ}$ C) less than the safe heating temperature. A direct connecting pressure type extruding device with nozzles shaped for insertion into the crack shall be provided. Any sealant spilled on the surface of the pavement shall be removed immediately.

**416.04** Method of Measurement. The quantity to be paid for under this item shall be the actual number of gallons installed, complete and accepted.

**416.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
416	Gallon	Crack Sealing Filler For Athletic Courts

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the work as specified herein.
## ITEM 441 CONTRACTOR MIX DESIGN AND QUALITY CONTROL— GENERAL

- 441.01 Description
- 441.02 Composition
- 441.03 Use of Reclaimed Pavement
- 441.04 Antistrip Additive
- 441.05 Job Mix Formula (JMF) Field Adjustment
- 441.06 Monitoring
- 441.07 Quality Control Program (QCP)
- 441.08 Testing Facilities
- 441.09 Quality Control Tests
- 441.10 Control Charts
- 441.11 Quality Control Reports

**441.01 Description.** This specification includes general requirements applicable to all types of asphalt concrete pavements where the Contractor is responsible for performing the mix design or quality control. Deviations from these general requirements will be covered in the specific requirements for each type.

The requirements of Item 401 apply, except as follows.

Develop a Quality Control Program (QCP) for the purpose of design and control of the asphalt concrete according to this specification. Submit the QCP to the City of Akron for review and approval. The City of Akron will closely monitor this QCP.

Compose the asphalt concrete of aggregates and asphalt binder. Develop a JMF to comply with the specified composition limits and mix design criteria and submit it to the Laboratory for approval prior to the start of production.

During production of the mixture, perform quality control procedures adequate to furnish assurance to the Engineer that the mixture delivered to the paving site reasonably conforms to the specification requirements and can be incorporated in the work with satisfactory results.

The Contractor's control of the mixture is based on the composition of samples the Contractor takes and analyzes, according to the approved QCP.

**441.02 Composition.** Before producing asphalt concrete, submit a proposed JMF for each combination of aggregates in writing to the Laboratory. Base the optimum percentage of asphalt binder selected for each JMF on the results of the specified tests evaluated, insofar as practical, as recommended in Chapter 5 of the *Asphalt Institute Manual Series No.* 2. The optimum percentage of asphalt binder is

the percentage that yields the Design Air Voids, provided that the other requirements of Table 441.02-1 are met. Provide a mix design with at least four graph points, including a minimum of two graph points above and two graph points below the optimum asphalt binder content. For each JMF submitted, include test data to demonstrate that mixtures conforming to the proposed JMF will have properties as specified. Submit the proposed JMF and all supporting data on forms the Laboratory approves. In addition, submit the following samples of asphalt concrete conforming to the proposed JMF for Laboratory examination and evaluation:

A. A 5-pound (2000 g) minimum uncompacted sample (all mixes).

B. A 10-pound (4000 g) minimum uncompacted sample (Type IH only).

C. A total of three Marshall specimens (Type IH only).

The Laboratory may require additional samples of individual materials or of asphalt concrete conforming to the proposed JMF.

As an alternative, the contractor may submit a job mix formula which has been approved within 12 months of the date of submission by the Ohio Department of Transportation.

The Laboratory may perform additional tests to ensure adequate mix performance.

The Laboratory may perform these tests on material conforming to a proposed JMF or on material obtained during production of an approved JMF. Based on the results of these tests, the Laboratory may require the Contractor to design a new JMF. Allow time for this additional testing.

The Contractor may begin asphalt concrete production after the Laboratory approves the JMF and the City of Akron is properly notified. This JMF approval by the Laboratory is subject to field verification. It is the intent of this specification that the materials used in the production of the asphalt concrete will result in a mixture that conforms to the JMF. If the produced asphalt concrete mixture fails to conform to the JMF, the Laboratory may reject the JMF and require the Contractor to establish a new JMF.

Do not apply the gradation requirements of 703.05 for fine aggregate.

In the JMF, propose definite single values for:

A. The percentage (in units of one percent) of aggregate passing each specified sieve, except the No. 200 (75 m), based on the dry weight of aggregate.

B. The percentage (in units of one-tenth of 1 percent) of aggregate passing the No. 200 (75 m) sieve, based on the dry weight of aggregate.

C. The percentage (in units of one-tenth of 1 percent) of asphalt binder to be added, based on the total weight of mixture.

D. The value (calculated to the nearest one-tenth) of the fines to asphalt (F/A) ratio, which is the percentage of aggregate passing the No. 200 (75 m) sieve divided by the percentage of asphalt binder. If the F/A ratio using total asphalt binder content is

### 441.02

greater than 1.0, then recalculate it using the effective asphalt binder content. Calculate the effective asphalt binder content according to Chapter 4 of the *Asphalt Institute Manual Series No. 2*.

E. The value (calculated to the nearest percentage point) of the Fifty to Thirty (F-T) value, which is the percent of total aggregate retained between the No. 50 (300 m) and No. 30 (600 m) sieves, minus the percent of total aggregate retained between the No. 30 (600 m) and No. 16 (1.18 mm) sieves.

The composition limits and properties of Table 441.02-1 are extreme ranges within which the JMF must be established. Use the criteria for Medium Traffic Volumes unless otherwise specified.

Use a 2-hour cure for all mix samples used in the design process. Ensure that the cure temperature for all samples is the mix holding temperature used before specimen compaction.

For Type 1H mixes, ensure that the coarse aggregate retained on the No. 4 (4.75 mm) sieve has a minimum of 65 percent mechanically crushed particles. A mechanically crushed particle is a particle having rough angular edges. Count particles exhibiting mechanically crushed characteristics as mechanically crushed regardless of how the fracture occurred. Ensure that a minimum of 50 percent of the virgin fine aggregate is sand manufactured from stone, gravel or air-cooled slag. If the sand is manufactured from gravel, ensure that it is crushed from gravel material retained on the 3/8 inch (9.5 mm) sieve.

If a Type 1H asphalt concrete mix is used, use a PG 70-22M asphalt binder.

If a Type 2 asphalt concrete mix designed for a Heavy traffic volume is specified, use a PG 64-28 asphalt binder regardless of the amount of reclaimed asphalt concrete pavement used in the mix. Perform the analysis specified in 441.03.

For all driveways and all asphalt concrete used under guardrails, regardless of the PG binder specified use PG 64-22 asphalt binder and use a Type 1 medium gradation designed using either Medium or Heavy design requirements.

Table 441.02-1			
Course		Type 1 Surface	
Traffic	Heavy	Medium	Light
1 inch $(25.0 \text{ mm})^{[1]}$			
3/4 inch (19.0 mm) <sup>[1]</sup>	100		
1/2 inch (12.5 mm) <sup>[1]</sup>	95 to 100	100	100
3/8 inch (9.5 mm) <sup>[1]</sup>	70 to 85	90 to 100	90 to 100
No. 4 $(4.75 \text{ mm})^{[1]}$	38 to 50	45 to 57	45 to 57
No. 8 $(2.36 \text{ mm})^{[1]}$	20 to 37	30 to 45	30 to 45
No. 16 (1.18 mm) <sup>[1]</sup>	14 to 30	17 to 35	17 to 35
No. 30 (600 μm) <sup>[1]</sup>	10 to 22	12 to 25	12 to 25
No. 50 (300 μm) <sup>[1]</sup>	6 to 15	5 to 18	5 to 18
No. 100 (150 μm) <sup>[1]</sup>	4 to 10	2 to 10	2 to 10
No. 200 $(75 \ \mu m)^{[1]}$	2-6		
Asphalt Binder <sup>[2]</sup>	5.6 to 10.0	5.8 to 10.0	6.0 to 10.0
Virgin Asphalt Binder (min.)		5.0	5.2
F/A Ratio, max. <sup>[3]</sup>	1.2	1.2	1.2
F-T Value <sup>[4]</sup>	+2	+2	+2
Blows <sup>[5]</sup>	75	50	35
Stability, min., pounds <sup>[5]</sup>	1800	1200	750
(N)	(8006)	(5338)	(3336)
Flow, 0.25 mm <sup>[5]</sup>	8 to 14	8 to 16	8 to 18
Design Air Voids <sup>[6]</sup>	3.5	3.5	3.5
VMA, min. <sup>[7]</sup>	14	16	16
Special Designation	1H		
1]Sieve, percent passing			
2]Percent of total mix			
3]Using effective asphalt binder	content		
4]Percentage points maximum			
5]AASHTO T 245			
6]Percent, Supplement 1036			
[7] Percent, Supplement 1037			

Course	1	Type 1 Intermedia	te
Traffic	Heavy	Medium	Light
3/4 inch (19.0 mm) <sup>[1]</sup>			
1/2 inch (12.5 mm) <sup>[1]</sup>	100	100	100
3/8 inch (9.5 mm) <sup>[1]</sup>	90 to 100	90 to 100	90 to 100
No. 4 (4.75 mm) <sup>[1]</sup>	50 to 72	50 to 72	50 to 72
No. 8 (2.36 mm) <sup>[1]</sup>	30 to 55	30 to 55	30 to 55
No. 16 (1.18 mm) <sup>[1]</sup>	17 to 40	17 to 40	17 to 40
No. 30 (600 μm) <sup>[1]</sup>	12 to 30	12 to 30	12 to 30
No. 50 (300 µm) <sup>[1]</sup>	5 to 20	5 to 20	5 to 20
No. 100 (150 μm) <sup>[1]</sup>	2 to 12	2 to 12	2 to 12
No. 200 $(75 \ \mu m)^{[1]}$			
Asphalt Binder <sup>[2]</sup>	5.0 to 10.0	5.0 to 10.0	5.0 to 10.0
F/A Ratio, max. <sup>[3]</sup>	1.2	1.2	1.2
F-T Value <sup>[4]</sup>	+2	+2	+2
Blows <sup>[5]</sup>	75	50	35
Stability, min., pounds <sup>[5]</sup>	1800	1200	750
(N)	(8006)	(5338)	(3336)
Flow, 0.25 mm <sup>[5]</sup>	8 to 14	8 to 16	8 to 18
Design Air Voids <sup>[6]</sup>	4	3.5	3.5
VMA, min. <sup>[7]</sup>	16	16	16
Special Designation			
1]Sieve, percent passing			

Table 441.02-1 (Continued)

[2]Percent of total mix

[3]Using effective asphalt binder content

[4]Percentage points maximum

[5]AASHTO T 245

[6]Percent, Supplement 1036 [7]Percent, Supplement 1037

Course	010 441.02-1 (COI	Type 2 Surface	
Traffic	Heavy	Medium	Light
1 1/2 inch (37.5 mm) <sup>[1]</sup>	100	100	100
1 inch (25.0 mm) <sup>[1]</sup>	95 to 100	95 to 100	95 to 100
3/4 inch (19.0 mm) <sup>[1]</sup>	85 to 100	85 to 100	85 to 100
$1/2$ inch $(12.5 \text{ mm})^{[1]}$	65 to 85	65 to 85	65 to 85
3/8 inch (9.5 mm) <sup>[1]</sup>			
No. 4 $(4.75 \text{ mm})^{[1]}$	35 to 60	35 to 60	35 to 60
No. 8 $(2.36 \text{ mm})^{[1]}$	25 to 48	25 to 48	25 to 48
No. 16 (1.18 mm) <sup>[1]</sup>	16 to 36	16 to 36	16 to 36
No. 30 (600 μm) <sup>[1]</sup>	12 to 30	12 to 30	12 to 30
No. 50 (300 μm) <sup>[1]</sup>	5 to 18	5 to 18	5 to 18
No. 100 (150 µm) <sup>[1]</sup>	2 to 10	2 to 10	2 to 10
No. 200 (75 µm) <sup>[1]</sup>			
Asphalt Binder <sup>[2]</sup>	4.0 to 9.0	4.0 to 9.0	4.0 to 9.0
F/A Ratio, max. <sup>[3]</sup>	1.2	1.2	1.2
F-T Value <sup>[4]</sup>	+2		
Blows <sup>[5]</sup>	75	50	35
Stability, min., pounds <sup>[5]</sup>	1800	1200	750
(N)	(80 06)	(5338)	(3336)
Flow, 0.25 mm <sup>[5]</sup>	8 to 14	8 to16	8 to 18
Design Air Voids <sup>[6]</sup>	4	4	4
VMA, min. <sup>[7]</sup>	13	13	13
Special Designation			
[1]Sieve, percent passing			
[2]Percent of total mix			
[3]Using effective asphalt binde	er content		
[4]Percentage points maximum			
[5]AASHTO T 245			
[6]Percent, Supplement 1036			
[7]Percent, Supplement 1037			

Table 441.02-1 (Continued)

Course		Type 2 Intermedia	te	
Traffic	Heavy	Medium	Light	
1 1/2 inch (37.5 mm) <sup>[1]</sup>	100	100	100	
1 inch (25.0 mm) <sup>[1]</sup>	95 to 100	95 to 100	95 to 100	
3/4 inch (19.0 mm) <sup>[1]</sup>	85 to 100	85 to 100	85 to 100	
1/2 inch (12.5 mm) <sup>[1]</sup>	65 to 85	65 to 85	65 to 85	
3/8 inch (9.5 mm) <sup>[1]</sup>				
No. 4 (4.75 mm) <sup>[1]</sup>	35 to 60	35 to 60	35 to 60	
No. 8 (2.36 mm) <sup>[1]</sup>	25 to 48	25 to 48	25 to 48	
No. 16 (1.18 mm) <sup>[1]</sup>	16 to 36	16 to 36	16 to 36	
No. 30 (600 μm) <sup>[1]</sup>	12 to 30	12 to 30	12 to 30	
No. 50 (300 μm) <sup>[1]</sup>	5 to 18	5 to 18	5 to 18	
No. 100 (150 μm) <sup>[1]</sup>	2 to 10	2 to 10	2 to 10	
No. 200 (75 μm) <sup>[1]</sup>				
Asphalt Binder <sup>[2]</sup>	4.0 to 9.0	4.0 to 9.0	4.0 to 9.0	
F/A Ratio, max. <sup>[3]</sup>	1.2	1.2	1.2	
F-T Value <sup>[4]</sup>	+2			
Blows <sup>[5]</sup>	75	50	35	
Stability, min., pounds <sup>[5]</sup>	1800	1200	750	
(N)	(8006)	(5338)	(3336)	
Flow, 0.25 mm <sup>[5]</sup>	8 to 14	8 to 16	8 to 18	
Design Air Voids <sup>[6]</sup>	4	4	4	
VMA, min. <sup>[7]</sup>	13	13	13	
Special Designation				
[1]Sieve, percent passing				
[2]Percent of total mix				
[3]Using effective asphalt binder of	content			
[4]Percentage points maximum				
[5]AASHTO T 245				
[6]Percent, Supplement 1036				
[7]Percent, Supplement 1037				

Table 441.02-1 (Continued)

**441.03** Use of Reclaimed Pavement. In addition to the requirements of 401.04, the Contractor may use more than 10 percent of reclaimed asphalt concrete pavement for base coarse, provided the reclaimed asphalt concrete pavement is included in the mix design process to establish the Job Mix Formula in accordance with 441.02. Use of reclaimed asphalt concrete pavement for surface courses will not be permitted. For intermediate courses, the Contractor may use up to a maximum of 35 percent of reclaimed asphalt concrete pavement. These percentages are based on the dry weight of all the materials used.

Whenever more than 10 percent of reclaimed asphalt concrete pavement is used, conform to the requirements of the specified asphalt binder for the asphalt binder proposed for use in the mixture, by a combination of reclaimed asphalt binder, virgin asphalt binder, and rejuvenating agents. Specify the percentages of reclaimed

asphalt concrete pavement, virgin aggregates, virgin asphalt binder, and rejuvenating agents (if used) required to meet the JMF. Meet the quality and gradation requirements of this specification for all materials used.

Determine final reclaimed asphalt concrete pavement gradation and asphalt binder content on four separate stockpile (or roadway for concurrent grinding) samples all agreeing within 0.4 percent for asphalt binder content and 5 percent passing the No. 4 (4.75 mm) sieve. Report all 4 test results and an average in the JMF submittal.

If greater than 20 percent of reclaimed asphalt concrete pavement is used, then use the viscosity of the recovered asphalt binder from the reclaimed asphalt concrete pavement in the analysis and submit it to the Laboratory with the proposed JMF.

**441.04** Antistrip Additive. If the proposed JMF meets any of the following requirements:

A. Contains any gravel coarse aggregate, or

B. Contains more than 25 percent natural sand, or

C. Contains more than 20 percent reclaimed asphalt concrete pavement containing gravel coarse aggregate, or

D. Designed according to Item 442,

Conduct the following tests:

A. Moisture damage potential test according to ODOT Supplement 1051.

B. Washed gradation according to AASHTO T 11 as modified by ODOT Supplement 1004.

C. Adherent fines test for each component according to ASTM D 5711.

Modify the mix with one of the following antistrip additives, if the results of the moisture damage potential test show the Tensile Strength Ratio (TSR) of the asphalt concrete mix to be less than 0.80 for 442 mixes and 0.70 for all other mix types:

**A.** Liquid Antistrip Material. Include liquid antistrip material at a rate of 0.5 to 1.0 percent by weight of the asphalt binder. However, if 442 is specified, include liquid antistrip material at a rate of 0.50 to 1.25 percent by weight of the asphalt binder. The TSR of the asphalt concrete mix shall be greater than or equal to 0.80 after the addition of the liquid antistrip material.

**B.** Hydrated Lime. Include hydrated lime in the dry form at a rate of 1.0 percent by the dry weight of aggregate for asphalt concrete. Conform to AASHTO M 303, Type 1 for hydrated lime. The Laboratory will maintain a list of approved sources of hydrated lime. To become an approved source, a source shall su bmit certified test data to the Laboratory showing their hydrated lime conforms to AASHTO M 303, Type 1.

#### 441.05

Annual submittal of certified test data by January 1 each year will be necessary to maintain approval. Provide the Engineer the following information for each shipment of hydrated lime:

- 1. Letter of certification.
- 2. Production date.
- 3. Shipment date.
- 4. Shipment destination.
- 5. Batch or lot number.
- 6. Net weight.

Include the antistrip additive in the mix design. Submit the following to the Laboratory with the proposed JMF:

- A. All TSR data (before and after the addition of the antistrip additive).
- B. Rate of addition of the liquid antistrip material, if used.

C. If using liquid antistrip material, product information, recent supplier State project information using the liquid antistrip material, and letter of certification.

D. Results of the washed gradation test of the individual components of the mix used in determining the combined gradation.

E. Results of the adherent fines testing for each component.

The Laboratory may perform additional tests according to ODOT Supplements 1004, 1051, and 1052. These tests may be performed on material conforming to a proposed JMF or on material obtained during production of an approved JMF. If a change in the aggregate production is suspected, the City of Akron may require the Contractor to perform washed gradations on components and calculate adherent fines to determine the need for additional TSR review. The Laboratory may obtain samples of the hydrated lime at any time to verify quality. If the quality of the hydrated lime is in question, the Laboratory may require independent laboratory testing for the hydrated lime supplier.

Store and introduce antistrip additives into the plant according to ODOT Supplement 1053. The Laboratory shall approve the antistrip additive storage and feed systems prior to the start of production. The Laboratory may require modifications in the method of introducing the antistrip additive into the mix, if the antistrip additive is not being properly dispersed into the mix.

Provide delivery tickets to the Engineer at the end of the project and at the end of each construction year on a multiple year project. The Engineer will verify the number of pounds of antistrip additive used is within 10 percent of the calculated amount of antistrip additive required for the total weight of asphalt binder, based on the JMF, used in the asphalt concrete.

**441.05** Job Mix Formula (JMF) Field Adjustments. If, during production, the Contractor determines from the results of quality control tests that adjustments are necessary to the mix design to achieve the specified properties in

place, the Contractor may adjust the JMF gradation within the below limits without a redesign of the mixtures.

Limit adjustments of the JMF to conform to actual production, without a redesign of the mixture, to 3 percent passing the 1/2 inch (12.5 mm), No. 4 (4.75 mm), and No. 8 (2.36 mm) sieves and 1 percent passing the No. 200 (75m) sieve, except do not exceed the limits in Table 441.02-1 in the adjusted JMF. The adjustment on the 1/2 inch (12.5 mm) sieve applies only to Type 1H and Type 2 mixes. Determine the need for any JMF gradation adjustments in the time specified. Should no adjustments be made, the City of Akron will base acceptance on conformance to the original JMF. After the time period specified, the City of Akron will allow no further adjustment of the JMF.

Should a redesign of the mixture become necessary, submit a new JMF according to the requirements for the initial JMF. A new acceptance lot will begin when a new JMF established by a redesign of the mixture becomes effective. Make any adjustment of this new JMF as provided for the original JMF.

Record both the design JMF and the adjusted JMF in effect during production of an acceptance lot on the Quality Control Report for that lot. In the event that a new design JMF is pro posed and approved, also make a notation on the ticket for the first load produced under the new design JMF.

**441.06 Monitoring.** The City of Akron will establish Monitoring Teams for the purpose of observing, testing and reviewing the Contractor's QCP for conformance with these Specifications. The Monitoring Team will include the Materials Lab Supervisor, Project RPR, Project Coordinator, Designer and the Construction Division Manager. The City of Akron may obtain comparison samples by split samples with the Contractor or independent samples from the plant or roadway. The City of Akron will test and analyze these samples according to the standard procedure for a comparison with the Contractor's quality control tests. If there is good comparison, production may continue. If there is poor comparison, the City of Akron will review the Contractor's program more closely. Based on their review, the Monitoring Team may at any time disallow production.

**441.07 Quality Control Program (QCP).** The Contractor will maintain certification in good standing in accordance with Item 403 of the ODOT CMS to provide bituminous asphalt concrete for the Ohio Department of Transportation.

**441.08** Testing Facilities. Provide testing facilities at the plant site conforming to ODOT Supplement 1041, with suitable space for Monitoring Team members to conduct a review of the work.

**441.09 Quality Control Tests.** Perform quality control tests to control the asphalt concrete mix within the specifications. Ensure that these quality control tests measure the asphalt binder content, gradation, air voids, and Maximum Specific Gravity (MSG) according to the Contractor's approved QCP. Perform each quality

#### 441.09

control test a minimum of o ne time each half of a production day or night (two tests per production day or night), or one each 1400 tons (1300 metric tons), whichever is less.

The City of Akron expects the Contractor to perform more sampling and testing than the minimum specified, especially at the start of production and during production when the quality control tests show the asphalt concrete being produced is near or outside the Warning Band Limits. The Contractor may determine the method of sampling and testing of the asphalt concrete beyond the minimum specified, and should detail the methods in the Contractor's approved QCP. Record all quality control testing on the Quality Control Report according to 441.11.

Perform the required quality control tests as follows:

**A.** Asphalt Binder Content. Determine the asphalt binder content of a sample of asphalt concrete by performing an Asphalt Content (AC) Gauge test according to ODOT Supplement 1043. Make all printouts available for review by the Monitoring Team at any time and turn them over to the City of Akron at the end of the project or the end of the production year.

Determine the moisture content of the asphalt concrete for each AC Gauge test. Maintain the moisture content at 0.8 percent or less.

**B.** Gradation. Perform at least one of the daily gradations on aggregate remaining after removing the asphalt binder with a solvent from an asphalt concrete sample used in an AC Gauge test (solvent sample); or on aggregate remaining after removing the asphalt binder with a preapproved asphalt ignition oven from an asphalt concrete sample used in an AC Gauge test (ignition oven sample). Correct each solvent sample for ash. Perform all other gradations on solvent samples, ignition oven samples, or on samples obtained according to the Contractor's approved QCP. Perform testing with an asphalt ignition oven according to ODOT Supplement 1054.

The gradation results of all the sieves must be representative of the JMF. If the Contractor fails to control the entire gradation, the Laboratory may require a redesign according to 441.02.

When the F-T value is specified for a mix in 441.02, calculate it for each gradation analysis. Maintain the F-T value at +4 percentage points or less for these mixes.

Calculate the F/A ratio for every solvent sample or ignition oven sample analysis. Maintain the F/A ratio so no F/A ratio is greater than 1.2 for all mixes. Use the asphalt binder content determined by the AC Gauge for calculating the F/A ratio. If the F/A ratio is greater than 1.0, recalculate the F/A ratio using the effective asphalt binder content.

Calculate the effective asphalt binder content on the calculation sheet using the asphalt binder content determined by the AC Gauge and attach it to the Quality Control Report. Use bulk and effective aggregate specific gravities and remaining values needed in the calculation from the approved JMF. Do not deviate from these

values without the Laboratory's approval. If the F/A ratio is greater than 1.0 for ignition oven samples, calculate the F/A ratio using the percent passing the No. 200 (75 m) sieve from a washed gradation of the ignition oven sample according to AASHTO T 30.

**C.** Air Voids and MSG. Determine the air voids of the asphalt concrete by analyzing a set of three compacted specimens and a corresponding MSG determination. Use the MSG to calculate the air voids of the compacted specimens. If a single air void test is less than 2 percent or greater than 6 percent, take and test a sample immediately. If two consecutive tests are outside this 2 to 6 percent range, cease production.

Use a 1-hour cure for all mix samples used in voids analysis. The Contractor may use a 2-hour cure time if voids are consistently near the low void warning band. In this case, use the 2-hour cure for all voids testing through the remainder of the project. Ensure that the cure temperature for all samples is the mix holding temperature used prior to specimen compaction.

Calculate the Voids in Mineral Aggregate (VMA) value for every set of compacted specimens according to ODOT Supplement 1037.

Calculate the average of all the MSG determinations performed each production day and report this average on the Quality Control Report. When the range of three consecutive daily average MSG determinations is equal to or less than 0.020, average these three average MSG determinations to determine the Maximum Theoretical Density (MTD). After the MTD is established, compare all individual MSG determinations to the MTD. The City of Akron will verify the MTD if the MSG determination has a deviation from the MTD of less than or equal to 0.020. If the MTD is not verified, establish a new MTD.

Whenever compacted specimens are to be made and an MSG determination is to be run, take a sample of sufficient size to run a corresponding AC Gauge test. When the air void and MSG test results are recorded, reference them to the AC Gauge test of the sample.

**D.** Other Requirements. Retain a split sample for each AC Gauge test and MSG test and all compacted specimens for monitoring by the City of Akron. Maintain MSG samples in the state described in ASTM D 2041, Section 7.1. The Contractor may dispose of the AC Gauge test samples after two days and all other split samples after seven days, if the City of Akron does not process the split samples.

After establishing the MTD, if the range difference in any three consecutive tests is greater than 2 percent for air voids or 8 percent for material passing the 4.75 mm (No. 4) sieve, notify the Monitoring Team. Continuing range deficiencies will be a reason for ceasing production.

Measure the temperature of the mixture and record and validate the results on the load tickets at least once during each hour of production.

The Contractor may conduct additional testing of any type. Record such additional testing along with all other quality control records and have these records readily available for the Engineer's review. The Laboratory may observe, review, and

approve the procedures at any time. Retain copies of all records documenting the Contractor's additional quality control inspections and tests throughout the life of the Contract and furnish them to the Engineer on request.

Multiple random non-specification individual tests or multiple range deficiencies can be cause for redesign. When production problems exist beyond a production day, a Contractor's representative holding a Level 2 qualification is required to be at the asphalt plant until a full production day is achieved with results satisfactory to the Engineer. The Laboratory will not approve any redesign it determines is unsatisfactory to provide acceptable mix performance. Submit this new design for approval according to 441.02, and at no additional cost to the City of Akron.

**441.10 Control Charts.** Post control charts at all times showing each individual test result and the moving average of three tests, as follows:

A. Plot tests showing the percent passing for the 1/2 inch (12.5 mm), No. 4 (4.75 mm), No. 8 (2.36 mm), and No. 200 (75 m) sieves as determined by a solvent sample or ignition oven sample analysis, the percent asphalt binder content as determined by the AC Gauge, the MSG and the percent air voids. Round all percentages to the nearest whole percent; however, round asphalt binder content, the No. 200 (75 m) sieve, and air voids to the nearest 0.1 percent.

B. Plot the moving average in red starting with the third test.

C. Show the Specification and Warning Band Limits on the control charts. These limits are specified in Table 441.10-1.

D. Label each control chart to identify it and its producer. Include an example when submitting the QCP for approval.

E. Record the range for three tests (moving range) under the appropriate running average point on the chart.

In the event two consecutive tests enter the Warning Band Limits, notify the Monitoring Team.

In the event the moving average falls outside the specification limits, cease operations. Do not resume production until corrective action has been taken and the Monitoring Team has approved.

	1ABLE 441.10-1		
Mix Characteristic	Specification	Warning Band	
	Limits	Limits	
Asphalt Binder Content <sup>[1]</sup>	-0.3% to 0.3%	-0.2% to 0.2%	_
1/2 inch (12.5 mm) sieve <sup>[1]</sup>	-6.0% to 6.0%	-5.0% to 5.0%	
No. 4 (4.75 mm) sieve <sup>[1]</sup>	-5.0% to 5.0%	-4.0% to 4.0%	
No. 8 (2.36 mm) sieve <sup>[1]</sup>	-4.0% to 4.0%	-3.0% to 3.0%	
No. 200 (75 m) sieve <sup>[1]</sup>	-2.0% to 2.0%	-1.8% to 1.8%	
Air Voids <sup>[2]</sup>	2.5 to 4.5	2.7 to 4.3	
Air Voids <sup>[3]</sup>	3.0 to 5.0	3.2 to 4.8	
$MSG^{[4]}$	-0.012 to 0.012		
[1]deviation from the JMF			
[2]for Design Air Voids of 3.5%			
[3]for Design Air Voids of 4.0%			
[4] deviation from the MTD			
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**441.11 Quality Control Reports.** Use Ohio Department of Transportation Form TE-199 for the Quality Control Report.

Record all test results on the Quality Control Report. Document all decisions regarding responses to test results on the Quality Control Report (referring to the particular test), including reasons why a particular problem may exist, how the problem was evaluated, what action was taken to correct the problem (plant operation or testing), and what communication with City of Akron personnel took place.

Submit one Quality Control Report to the City of Akron with all supporting documentation no later than specified. Ensure the report is complete with a concise statement of quality control activity related to the previously stated assurance purpose.

# **ITEM 446 ASPHALT CONCRETE**

446.01 Description
446.02 JMF Field Adjustments
446.03 Monitoring
446.04 Reports
446.05 Density Acceptance
446.06 Joints
446.07 Basis of Payment

**446.01 Description.** This work consists of constructing a surface course or an intermediate course of aggregate and asphalt binder mixed in a central plant and spread and compacted on a prepared surface.

The requirements of Item 441 apply, except as modified by this specification.

#### 446.02

The City of Akron will base acceptance of the compacted mixture in place on the level of density attained as sampled by the Contractor and analyzed by the City of Akron.

**446.02 JMF Field Adjustments.** Determine the need for any JMF gradation adjustments, provided for in 441.05, in the first 3 days or first 3000 tons (3000 metric tons) of production, whichever comes last. Give the Laboratory written notice of JMF adjustments no later than the end of the following day's production.

For projects smaller than the above JMF field adjustment period, give the Laboratory written notice of any JMF gradation adjustments within 1 workday following the last day of production.

**446.03 Monitoring.** If there is poor comparison between the City of Akron comparison samples and the Contractor's quality control tests, the Monitoring Team may at any time disallow production to continue under Item 446. In this case, conform to Items 448 and 446. The City of Akron will notify the Contractor in writing to stop production.

**446.04 Reports.** Submit the Quality Control Report according to 441.11 on the workday following the production day of the material represented by the report.

**446.05 Density Acceptance.** Use compaction equipment meeting the requirements of 401.13 or other types acceptable to the Engineer. A three-wheel roller and a vertical longitudinal joint is not required. If a wedge joint is used, construct it using a maximum slope of 3:1.

Obtain 10 cores for the City of Akron to test to determine the in-place density of the compacted mixture as a percentage of the average Maximum Specific Gravity (MSG) for the production day the material was placed. Compact shoulders using the same equipment and procedures as used on the mainline pavement. The requirements of 401.16, except for the last four paragraphs, are waived.

At the discretion of the Engineer the requirement of obtaining cores may be waived based upon density results obtained by the Nuclear Gauge method.

Payment for compaction of the completed mainline pavement and ramps is by Lot, based upon the degree to which density is attained. Payment for shoulders depends on the degree to which the density is obtained on the adjacent mainline pavement lane or ramp. However, when a cold longitudinal joint is made between a mainline pavement lane and an adjoining shoulder, payment for the shoulder will be based on the degree to which the density is obtained on the shoulder.

A Lot consists of an area of pavement placed during a production day, including the shoulders. If less than 400 tons (400 metric tons) is produced in a production day, then that production day is combined with the next production day into a single Lot. If greater than 250 tons (250 metric tons) and less than 400 tons (400 metric tons) is produced on the last day of production for the project, then the day's production is a separate Lot. If less than 250 tons (250 metric tons) is produced on the last production day for the project, it is part of the previous Lot for acceptance, provided the previous Lot was placed within 3 days; otherwise, it is a separate Lot.

Within 48 hours after the pavement is placed, obtain ten cores for each Lot at random locations the Engineer determines. The Engineer will divide a Lot into five equal areas and calculate the two random core locations from the mainline pavement or ramps. Cores can be obtained anywhere in the pavement mat up to 3 inches (75 mm) between the pavement edge and core edge. For the first part of a wedge joint, the pavement edge is defined as the point where the Contractor starts decreasing the thickness. For the second part of a wedge joint, the pavement edge is defined as the first part (the visible joint). Obtain cores 3 inches (75 mm) from the edge of the pavement when random numbers locate a core closer to the pavement edge than 3 inches (75 mm). Locate cores for the Contractor's quality control (sister core) longitudinally from and within 4 inches (100 mm) of the random core. The number of cores may be increased or decreased at the Engineers discretion.

The City of Akron will determine the pay factor for each Lot cored by the pay schedule in Table 446.05-1. The City of Akron will verify the MTD if the MSG determination has a deviation from the MTD of less than or equal to 0.020. If the MTD is not verified, establish a new MTD according to the procedures established in 441.09. If less than 10 cores are available for determining the mean, the Laboratory will determine disposition of the Lot.

Fill core holes by the next workday. Before filling, ensure the holes are dry and tack them with asphalt material conforming to 407.02. Properly compact the asphalt concrete used for filling the hole and leave it flush with the pavement.

	Pay Factor		
Mean of Cores <sup>[1]</sup>	Surface Course	Intermediate Course	
98.0% or greater	[2]	[2]	
97.0 to 97.9%	0.94	[2]	
96.0 to 96.9%	1.00	0.94	
94.0 to 95.9%	1.00	1.00	
93.0 to 93.9%	1.00	1.00	
92.0 to 92.9%	0.98	1.00	
91.0 to 91.9%	0.90	0.94	
90.0 to 90.9%	0.80	0.88	
89.0 to 89.9%	[3]	[3]	
Less than 89.0%	[2]	[2]	

TABLE 446.05-1

[1]Mean of cores as percent of average MSG for the production day.

[2]For surface courses, remove and replace. For other courses, the Engineer will determine whether the material may remain in place. If the Engineer determines the course should be removed and replaced, the Contractor shall remove and replace this course and all courses paved on this course. The pay factor for material allowed to remain in place is 0.60.

[3] The Engineer will determine whether the material may remain in place. If the Engineer determines the course should be removed and replaced, the Contractor shall remove and replace this course and all courses paved on this course. The pay factor for such material allowed to remain in place is 0.70.

**446.06 Joints.** Make a hot longitudinal joint between the mainline pavement lane and the adjoining shoulder and all ramps and the adjoining shoulders. If a hot longitudinal joint is specified between the mainline pavement lanes, the Engineer may allow the Contractor to construct a cold longitudinal joint between the mainline pavement lanes and the adjoining shoulders.

**446.07 Basis of Payment.** The City of Akron will pay for accepted quantities, completed in place, at the contract prices, as modified by 446.05, as follows:

<u>Item</u>	<u>Unit</u>	Description
446	Cubic Yard	Asphalt Concrete Intermediate Course, Type
446	Cubic Yard	Asphalt Concrete Surface Course, Type

# **ITEM 448 ASPHALT CONCRETE**

- 448.01 Description
- 448.02 JMF Field Adjustments
- 448.03 Reports
- 448.04 Acceptance
- 448.05 Basis of Payment

**448.01 Description.** This work consists of constructing a surface course or an intermediate course of aggregate and asphalt binder mixed in a central plant and spread and compacted on a prepared surface.

The requirements of Item 441 apply, except as modified by this specification.

The City of Akron will determine acceptance of the mixture by Lot, based on the composition of random samples taken and tested by the Contractor and verified by the City of Akron.

**448.02 JMF Field Adjustments.** Determine the need for any JMF gradation adjustments, provided for in 441.05, from the results of quality control and City of Akron verification tests of the first two acceptance lots. Following adjustment, the City of Akron will apply the adjusted JMF, for acceptance purposes, to the entire production including the first two lots. Give the Laboratory written notice of JMF adjustments no later than the end of the first workday following the notification of verification test results of the second acceptance lot.

For projects with less than two acceptance lots or for any JMF that will no longer be used on a project, give the Laboratory written notice of any JMF gradation adjustments within 1 workday following the notification of acceptance test results.

**448.03 Reports.** Submit the Quality Control Report according to 441.11 on the workday following the completion of production of each acceptance lot.

**448.04** Acceptance. Refer to Item 403 for acceptance requirements.

**448.05 Basis of Payment.** The City of Akron will pay for accepted quantities, completed in place, at the contract prices, or at the contract price as modified in 448.04, as follows:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
448	Cubic Yard	Asphalt Concrete Intermediate Course, Type
448	Cubic Yard	Asphalt Concrete Surface Course, Type
448	Cubic Yard	Asphalt Concrete Surface Course, Type 1,inches Thick, Driveway Reconstruction

# **450 RIGID PAVEMENT AND CONCRETE**

# ITEM 451 REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

- 451.01 Description
- 451.02 Materials
- 451.03 Equipment
- 451.04 Setting Forms
- 451.05 Finegrading of Subgrade or Subbase
- 451.06 Placing Concrete
- 451.07 Cold Weather Protection
- 451.08 Placing Reinforcement
- 451.09 Joints
- 451.10 Consolidating and Finishing
- 451.11 Curing
- 451.12 Removing Forms
- 451.13 Surface Smoothness
- 451.14 Sealing Joints
- 451.15 Opening to Traffic
- 451.16 Slip Form Placement
- 451.17 Pavement Thickness
- 451.18 Method of Measurement
- 451.19 Basis of Payment

**451.01 Description**. This item shall consist of a pavement composed of reinforced portland cement concrete constructed on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer.

451.02 Materials. Materials shall be:

Concrete (Class C)	
Joint sealer	
Preformed filler	
Curing materials	.705.05, 705.06, 705.07(Type II, Class B)
Reinforcing steel	
Dowel bars	
Expansion shield anchors	

**451.03 Equipment**. Equipment shall be as follows:

(a) Finishing Equipment. Regular finishing machines for finishing concrete pavement shall be mechanical, self-propelled spreading and finishing machines of

approved types, and shall be capable of compacting and finishing the concrete. If a machine has only one screed, the screed shall be not less than 18 inches in width and shall be equipped with compensating springs to minimize the effect of the momentum of the screed on the side forms. If the machine has two screeds, they shall be independently operated. The number of driving wheels, power of motor, and weight of the finishing machine shall be so coordinated as to prevent slippage. Any machine which causes displacement of the side forms from the line or grade or causes undue delay due to mechanical difficulties shall be removed from the work.

(b) Vibrators, for full width vibration of concrete paving slabs, shall be internal type with either immersed tube or multiple spuds. They may be attached to the spreader, the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators, and not less than 7,000 impulses per minute for spud vibrators.

(c) Forms. Side forms shall be of steel, straight, and of a depth equal to the thickness of the pavement at the edge, except forms of greater depth than specified pavement thickness may be used by written permission of the Engineer. Any additional cost caused by the use of forms of a greater depth shall be included in the bid price for this item. The use of bent or damaged side forms or forms with damaged joint locks or pin pockets shall not be permitted. All forms shall be cleaned and oiled each time they are used. They shall be furnished in sections not less than 10 feet in length, with horizontal joint and a base width equal to the depth of the forms. Flexible or curved forms shall be of a design acceptable to the Engineer and shall be used for construction of circular pavement edges where the radius is 100 feet or less. Forms shall be provided with adequate devices for secure setting so that, when in place, they will withstand the operation of the paving equipment. Built-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 600 square yards. The forms shall contain adequate joint locks for joining the ends of abutting form sections together tightly.

**451.04 Setting Forms**. All forms shall be set with reasonable conformance to the required grade and alignment, and be supported on thoroughly compacted material for their entire length during the entire operation of placing and finishing of the concrete. After the setting of side forms, the top face of the form shall not vary from a true plane

more than 1/8 inch in 10 feet, and the vertical face shall not vary more than 1/4 inch in 10 feet, and they shall be tested by the Contractor and variations from the above requirements shall be eliminated by resetting the forms. Shimming with loose earth, pebbles, etc., will not be permitted. The alignment and grade of all forms set shall be approved by the Engineer before and immediately prior to the placing of concrete.

**451.05 Finegrading of Subgrade or Subbase**. After side forms have been set to line and grade and securely fastened, the subgrade or subbase shall be brought to final grade by means of subgrader or subgrade planer. This finegrading operation

should involve a slight removal of the subbase material and bring the subbase material to a smooth dense condition. The subgrade or subbase shall be checked using a multiple pin template operated on the forms. Any high or low spots found shall be corrected and rechecked.

In lieu of the above operation, an automatic subgrader operating from a preset grade line may be used prior to the setting of the side forms. After the grade has been made by the automatic subgrader, the forms shall be set and checked as outlined in 451.04. The multiple pin template shall be operated on the forms and any necessary corrections of the subbase shall be made.

The grade shall be constructed sufficiently in advance of the placing of the concrete to permit checking. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete. If satisfactory stability of the subbase material cannot be obtained, it shall be stabilized by addition of admixes or angular aggregate particle at no additional cost to the City.

**451.06 Placing Concrete**. The subgrade or subbase shall be sprinkled at such times and in such manner as directed by the Engineer so that it will be in a thoroughly moistened condition, free of standing water, when the concrete is deposited thereon.

The concrete shall have a slump in accordance with 499.03 and shall be deposited on the grade in a manner that requires as little rehandling as possible. Workers shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign material.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless hopper is well centered on the assembly. Concrete shall be consolidated around expansion and construction joints by means of internal vibration.

No concrete shall be mixed, placed, or finished after dark, unless approved by the Engineer and an adequate and approved artificial lighting system is operated.

When the air temperature is above  $35^{\circ}$  F before placing, concrete temperature shall be maintained at not more than  $90^{\circ}$  F.

**451.07 Cold Weather Protection**. When concrete is being placed in cold weather and temperature may be expected to drop below  $35^{\circ}F$ , a supply of straw, hay, insulated curing blankets or other approved material shall be provided along the line of the work. At any time when the air temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the concrete to a sufficient depth to prevent freezing of the concrete. Concrete shall be protected from freezing temperatures until it is at least 5 days old. Any day

that the temperature does not exceed  $35^{\circ}F$  for a minimum of 6 hours shall not be counted as one of the 5 days. Concrete injured by frost action shall be removed and replaced at the Contractor's expense.

Except by specific written authorization, concreting shall cease when the descending air temperature in the shade and away from artificial heat falls below  $40^{\circ}$ F. It shall not be resumed until the ascending air temperature in the shade and away from artificial heat rises to  $35^{\circ}$ F.

When concreting is permitted during cold weather, the temperature of the mixed concrete shall be not less than 50°F, nor more than 80°F at the time of placing in the forms. The aggregates or water, or both, may be heated. The aggregates may be heated by steam or dry heat prior to being placed in the mixer. The water temperature shall not exceed 175°F. In no case shall concrete be deposited on a frozen subgrade nor shall frozen materials be used in concrete.

The size and arrangement of paving operations shall be so planned as to facilitate protection of the work from rain. An adequate supply of waterproof covering shall be available on the job site at all times. The Contractor shall replace, at his expense, any pavement damaged by rain.

Concrete test specimens will be in accordance with Section 499.

**451.08 Placing Reinforcement**. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off at such length and depth that the mat of reinforcement may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed as specified directly upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. The top layer of concrete shall be placed as soon as possible while the bottom layer is still plastic, but in no case shall the interval of time exceed 30 minutes. When reinforced concrete placement, or it may be placed in the plastic concrete, after spreading, by mechanical or vibratory means.

The mats of reinforcement forming each lap, in addition to being overlapped as specified, shall be securely fastened together at the edges of the sheets and at two additional points along the lap.

Reinforcing steel shall be as per Plans and shall be free from dirt, oil, paint and grease.

**451.09 Joints**. Joints shall be constructed of the type, dimensions, and at locations specified.

(a) Longitudinal Joint. The longitudinal joint shall be constructed by sawing or by forming. If the longitudinal joint between simultaneously placed lanes is made with

a concrete saw, the sawing shall be done to a minimum depth of one-third of the specified pavement thickness as soon as the saw can be operated without damaging the concrete. The width shall be approximately 1/8 inch.

If the longitudinal joint between separately placed lanes is made with a concrete saw, the sawing shall be done to a minimum depth of one inch. The width shall be approximately 1/8 inch.

If the longitudinal joint is formed, the groove for sealing shall be formed in the lane placed last.

Hook bolts, when used, shall be securely fastened to the form of the longitudinal construction joint.

Expansion bolt joints shall be constructed by installing expansion shield anchors in the center of the existing pavement slab in accordance with the manufacturer's recommendation after which hook bolts shall be threaded firmly into the expansion shield anchors.

(b) Load Transfer Devices. Dowels shall be held in position parallel to the surface and centerline of the slab by an approved metal device that is left in the pavement. Dowels may be placed in the full thickness of pavement by a mechanical device approved by the Engineer. Deformed steel tiebars, when used for longitudinal joints, shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement.

(c) Expansion Joint. Transverse expansion joints shall be provided on each approach to a bridge, or bridge approach slab at distances of approximately 20 feet and 60 feet, or as specified. If the pavement is constructed in two or more separately placed lanes, the joints shall form a continuous line for the full width of the pavement.

An opening 1 inch in width by 1 inch in depth shall be formed for installation of 705.01 joint sealer.

(d) Contraction Joint. Contraction joints shall be sawed as specified to a minimum depth of one-third of the specified pavement thickness, and a width of one-fourth inch (plus or minus 1/16 inch) determined at the time of sawing. If the pavement is constructed in two or more separately poured lanes, the joints shall be continuous for the full width of the pavement. Sawing shall be done with sawing equipment approved by the Engineer. Joints shall be sawed as soon as the saw can be operated without damaging the concrete. Saws shall be equipped with adequate guides, blade guards, and a method of controlling the depth of cut. Sawing shall be done wet and the joint must be cleaned, after having been sawed, by a jet of water under pressure. A standby saw in working condition with an adequate supply of blades shall be maintained at the site of the work during the sawing of contraction joints.

(e) Construction Joints. Construction joints shall be constructed as specified at the end of each day's work, and whenever necessary to suspend the work for a period of more than 30 minutes. In no case shall an emergency construction joint be placed closer than 10 feet to a parallel joint.

(f) Pressure Relief Joints. Pressure relief joints shall be located and constructed as designated in the plans.

**451.10 Consolidating and Finishing**. Concrete shall be placed in accordance with 511.08. Internal vibration shall be required for consolidating full width pavements. This type of consolidation is not mandatory for tapered sections and variable width sections of pavement. The method and equipment used for internal vibration shall be approved by the Engineer. An automatic cutoff is required to stop vibration when the equipment is stopped.

Retempering or the application of water to the surface of the concrete shall not be allowed.

The pavement shall be finished by an approved finishing machine operated over each section of pavement as many times and at such intervals as will produce the desired results. During the operation of the finishing machine, a uniform roll of concrete shall be maintained ahead of each screed for its entire length. Floating shall be accomplished by means of a cutting or smoothing float or floats suspended from and guided by a rigid frame riding on, and constantly in contact with, the side forms.

Small or irregular areas which are inaccessible to finishing equipment may be hand finished by methods approved by the Engineer.

The surface shall be continuously checked for trueness with ten foot straightedges.

Before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, shall be worked with an approved tool and rounded to the radius specified. Any tool marks left by the edging shall be eliminated by texturing the surface.

The pavement shall be textured to provide a surface satisfactory to the Engineer. The surface shall be textured by the use of a broom or artificial turf drag in the longitudinal direction, followed by an approved device that will produce a relatively uniform pattern of grooves in the transverse direction. The grooves shall be spaced at approximately 5/8-inch centers and shall be approximately 0.15 inches deep and 0.10 inches wide. Variation from the texturing requirements will be permitted only with the written permission of the Engineer. The curbing shall be finished in accordance with 455.03 (e).

**451.11 Curing.** Immediately after the finishing operations have been completed, and after the free water has disappeared, all exposed surfaces of the concrete shall be sealed by spraying thereon a uniform application of curing membrane in such a manner as to provide a continuous uniform film without marring the surface of the concrete. The material shall be applied with an approved mechanical sprayer. Wind protection to the spray fog shall be provided by an adequate shield. A minimum of one gallon of material shall be used for each 150 square feet of surface treated. Curing material shall be thoroughly agitated immediately prior to use.

On pavement with integral curb, or small and irregular areas which are inaccessible to the mechanical spray machine, the curing material may be applied by a hand spray.

As soon as the forms have been removed, any honeycomb areas shall be immediately corrected, and the edges of the pavement coated with the curing material. Any areas of pavement film that may have been damaged during the sawing shall be resprayed during this operation.

The above requirements for curing are minimum requirements only. Any concrete showing injury or damage due to inadequate curing shall be repaired or replaced by the Contractor at no additional cost to the City.

**451.12 Removing Forms**. Forms shall be removed in such a manner that no damage will occur to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in 451.11.

**451.13 Surface Smoothness**. After the final curing of the concrete, the surface shall be cleaned, and may be tested for smoothness by means of a surface testing machine which will test one or more lines on each side of the pavement as determined by the Engineer. All surface variations so indicated shall be corrected to within the specified tolerance in a manner that will provide the required texture specified in 451.10. Pavement surface variations, except as hereinafter stated, shall not exceed 1/8 inch in a 10 foot length of pavement. For ramp pavements and for those pavements with curvature greater than 8 degrees, or with grades exceeding 6 percent, the surface variation shall not exceed 1/4 inch in 10 feet.

Sections of pavement containing depressions which cannot be corrected by grinding shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

**451.14 Sealing Joints**. Joints shall be sealed before the pavement is opened to traffic or to use by construction equipment, and as soon after completion of the sawing as is feasible. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, using approved equipment, and the joint faces shall be clean and surface dry when the seal is applied.

Sawed and formed joints shall be filled with joint sealer conforming to 705.01. The joint sealer shall be placed with proper equipment to obtain a neat workmanlike joint free from excess and unsightly filler.

**451.15 Opening to Traffic**. The completed pavement may be used for traffic, including construction traffic, when 7 days have elapsed.

**451.16 Slip Form Placement**. With the written permission of the Engineer, the pavement may be constructed without the use of fixed forms and the following provisions shall apply:

(a) Grade. After the subbase has been placed and compacted to the required density, the areas on which the pavement is to be constructed and the areas which will support the paving machine shall be cut to the plan elevation by means of a properly designed machine. If the density of the base is disturbed by the grading operations, it shall be corrected by methods satisfactory to the Engineer before concrete is placed.

(b) Placing Concrete. The concrete shall be placed with an approved slipform paver or combination of pavers designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with the plans and specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed.

The concrete shall be held at a uniform consistency, having a slump of not more than 3 inches. The slipform paver shall be operated with as nearly a continuous forward movement as possible, and all operations of mixing, delivering and spreading concrete shall be coordinated as to provide uniform progress, with stopping and starting of the paver held to a minimum. If for any reason it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

The finish grade of the pavement shall be accurately controlled from a grade line pre-set parallel to the finish grade. Slip form paving equipment shall have controls that will

trace the grade line and automatically adjust the grade of the screeds or extension meters.

(c) Finishing. The surface smoothness and texture shall meet the requirements of 451.10 and 451.13. The edges of the pavement shall not vary more than 1/4 inch below the typical section.

(d) Curing. Curing shall be done in accordance with 451.11. The curing shall be applied at the appropriate time, and shall be applied uniformly and completely to all surfaces and edges of the pavement.

(e) Joints. All joints shall be constructed in accordance with 451.09.

**451.17 Pavement Thickness**. Thickness of concrete at any point, determined by the measurement of cores cut as hereinafter specified, shall not be more than 1/2 inch less than the specified thickness, nor shall the average thickness of the concrete, determined as hereinafter specified, be more than 0.2 inches less than the specified thickness. The length of the cores will be determined in accordance with AASHTO T 148.

The entire pavement shall be considered a unit for the purpose of coring. One core shall be taken at random for every 600 square yards of pavement or major fraction thereof; however, a minimum of three cores shall be taken from any pavement cored. Should any core show a deficiency in thickness of more than 1/2inch, additional cores shall be cut 5 feet, measured longitudinally, on each side of the location of the core deficient in thickness. If both these additional cores are within the 1/2 inch tolerance, no further special borings for this particular zone of deficiency shall be made. If either or both of the cores are outside the 1/2 inch tolerance, special borings shall be continued 25 feet and 50 feet, measured longitudinally from the location of the first core found to be deficient in thickness, and thence at 50 foot intervals longitudinally, until pavement thickness within the 1/2 inch tolerance is found in both directions or the end of the pavement is reached, thus establishing the longitudinal boundaries of the zone of deficiency, but in no case shall additional cores be cut longitudinally beyond the location of any boring in that lane at which the pavement thickness has been found to be within the 1/2 inch tolerance.

Where the separately poured width of pavement consists of two or more traffic lanes and a scheduled core shows a deficiency of more than 1/2 inch, an additional core or cores shall be cut to determine the extent of the zone of deficiency in a direction transverse to the center line. The additional core or cores shall be cut approximately in the center of the traffic lane or lanes. Where a transverse core or cores are within the 1/2 inch tolerance, the zone of deficiency shall be limited to the traffic lane or lanes found to have deficient thickness. However, where any of the transverse core or cores is outside the 1/2 inch tolerance, the zone of deficiency shall include all traffic lanes where such deficiency was found and the longitudinal boundaries for each deficient lane shall be determined as above.

When any core shows a deficiency of more than 1/2 inch, the area of the pavement for which payment shall be withheld shall be the sum of the areas found to be deficient as determined above. Deductions will be determined and applied to each separately poured width of pavement.

All thickness measurements which are more than 1/2 inch greater than the specified thickness shall be regarded as the specified thickness plus 1/2 inch.

The average thickness of concrete pavement shall be the mean thickness, in inches, of the cores taken from the pavement with the provision that wherever a total deduction occurs, the mean thickness of the two cores limiting the zone of deficiency longitudinally shall be used in lieu of the original core (in the zone) in the average thickness calculation. The other cores within a zone of deficiency shall be disregarded in this calculation.

Any widening less than five feet in width, or any pavement of less than 600 square yards in area, shall not be cored unless requested by the Engineer.

All core holes shall be filled by the Contractor with concrete of the same proportions and materials used in the pavement.

Price Adjustments. Where the average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than one inch, payment will be made at an adjusted price as specified in the following table:

	Concrete Pavement Deficiency
Deficiency in Thickness	Proportional Part
as Determined by Cores.	of Contract Price
0.0 to 0.2 inch	
0.3 inch to 0.5 inchR	2 atio <u>Average Thickness</u> Specified Thickness
Greater than 1.0 inch	

When the thickness of pavement is deficient by more than 1/2 but less than one inch and the judgment of the Engineer is that the area of such deficiency should not be removed and replaced, payment will be made at 1/2 of contract price.

**451.18 Method of Measurement**. The quantity under this item will be the number of square yards of concrete pavement completed and accepted in place. The width for measurements will be the width of the pavement shown on the typical cross section of the plans, plus additional widening where called for, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the center line of each street, roadway or ramp. Integral curb will be included in the measurements for concrete pavement. The quantities as adjusted for changes, errors and deviation in excess of allowable tolerances will be the method of measurement.

**451.19 Basis of Payment**. The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard, which price and payment shall be full compensation for furnishing and placing all materials, including reinforcing steel, dowels and joint materials; provided, however, that for pavement found deficient in thickness only the reduced price as determined in 451.17 shall be paid.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.

Payment for accepted quantities will be made at the contract price for:

 Item
 Unit
 Description

 451
 Square Yard
 \_\_\_\_\_\_\_inch Reinforced portland cement concrete pavement

## **ITEM 452 PLAIN PORTLAND CEMENT CONCRETE PAVEMENT**

## 452.01 Description 452.02 Method of Measurement 452.03 Basis of Payment

**452.01 Description**. This item shall consist of constructing a portland cement concrete pavement on prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer. This item shall conform to the same specifications and requirements prescribed in 451 except that fabricated steel reinforcement is not required.

Load transfer devices are required only at transverse expansion and construction joints.

Transverse construction joints shall be constructed in accordance with standard drawings. Longitudinal joints shall be constructed between lanes in accordance with 451.09(a).

All sawed or formed joints shall be sealed with joint filler conforming to 705.01 or 705.02.

**452.02 Method of Measurement**. The yardage under this item will be the number of square yards completed and accepted in place. The width for measurement will be the width of the pavement shown on the typical cross sections of the plans and additional widening where called for, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the center line of each street, roadway or ramp. Integral curb will be included in the measurements for concrete pavement. The quantities as adjusted for changes, errors, and deviations in excess of allowable tolerances will be the method of measurement.

**452.03 Basis of Payment**. The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard, which price and payment shall be full compensation for furnishing and placing all materials, including joints; provided, however, that for pavement found deficient in thickness only the reduced price as determined in 451.17 shall be paid.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
452	Square Yard	inch Plain portland cement concrete pavement

## **ITEM 453 APPROACH SLABS**

453.01 Description
453.02 Materials
453.03 Forms
453.04 Placing
453.05 Finishing
453.06 Side Curbs
453.07 Method of Measurement
453.08 Basis of Payment

**453.01 Description**. This item shall consist of constructing reinforced concrete approach slabs for bridges on the completed and accepted subgrade or subbase, according to the dimensions, lines and grades specified.

453.02 Materials. Materials shall be:

Concrete (Class C)	
Reinforcing steel	
Joint material	
Joint sealer	705.01 or 705.02

**453.03 Forms.** Side forms shall be of steel or wood, they shall be true and straight, and be rigidly held to line and grade, and shall at no time deviate more than 1/8 inch in 10 feet. They shall be cleaned and oiled each time after they are used. They shall not be removed within 24 hours after the concrete is placed.

**453.04 Placing**. The subgrade or subbase shall be thoroughly moistened immediately prior to placing the concrete. The concrete shall be placed as required under 451 or 511.

**453.05 Finishing**. If the approach slab is to serve as a base for a top course, the finishing, smoothness and curing shall conform to the requirements set forth under 305. If the approach slab is to serve as a wearing surface, the finishing, smoothness and curing shall conform to 451.

**453.06** Side Curbs. When the adjacent pavement is of a type requiring curbs, and the same type of pavement is to be carried on the approach slabs, side curbs shall be tapered the length of the approach slab from the bridge curb to the pavement curb and shall be constructed monolithic with the approach slab using the same proportioned concrete as specified for the approach slab. The finish of the curb shall conform to 455.

**453.07** Method of Measurement. The yardage measured will be the number of square yards complete in place.

**453.08 Basis of Payment**. Accepted quantities will be paid for at the contract unit price per square yard complete in place. This price shall include full compensation for all concrete, curbs, reinforcing steel, dowels, joints and other materials.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
453	Square Yard	inch Reinforced concrete approach slab

### **ITEM 454 CONCRETE BARRIER**

454.01 Description
454.02 Materials
454.03 Placing Concrete
454.04 Portable Concrete Barrier
454.05 Joints
454.06 Finish
454.07 Curing
454.08 Method of Measurement
454.09 Basis of Payment

**454.01 Description**. This item shall consist of furnishing and placing portland cement concrete barrier on the accepted, prepared subgrade, subbase course or existing pavement in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions shown on the plans.

This item shall include furnishing, placing, maintaining, and removal of portable concrete barrier.

This item also includes all inserts, sleeves, fittings, connectors, reinforcement, dowels, preformed filler, excavation, backfill and all incidentals necessary to complete the item.

**454.02** Materials. Materials shall be:

Concrete (Class C)	
Reinforcing steel and wire fabric	
Curing materials 705.05, 705.06 or 7	705.07(Type II, Class B)
Preformed filler	
Forms	
Dowel bars	. 709.01, 709.03, 709.05
Precast concrete	
Steel	

**454.03 Placing Concrete**. This item may be cast-in-place, precast, or slipformed. If slipformed, concrete may be placed with a self-propelled machine. The proper density and cross section shall be obtained by forcing the concrete through a mold of the proper cross section. Where a track is used, the track on which the machine operates shall be set and held to the exact line and grade given by the Engineer. The concrete shall be of such consistency that it can be molded into the desired shape and then will remain as placed, without slumping of the vertical face.

**454.04 Portable Concrete Barrier**. The individual sections shall be not less than 10 feet in length and shall be positively joined by either a connecting pin or a tongue and groove joint. Portable concrete barrier may be slipformed in place without joints, or with grooved or sawed joints to facilitate removal, if the barrier is to be utilized at only one location on the project. Barrier sections which have been damaged during handling or by traffic during the life of the project shall be repaired or replaced as directed by the Engineer. Repair or replacement of sections will not be measured for payment.

**454.05 Joints**. Joints for cast-in-place or slipformed barriers shall be constructed of the type, dimensions, and at the locations specified.

(a) Contraction Joints. Unsealed contraction joints shall be constructed by sawing, by metal inserts inside the forms, by the use of a grooving tool or by full width 3/4 inch preformed joint filler 705.03. The joints formed by sawing, tooling or forming by inserts shall be a minimum of 1/8 inch wide and 1-1/2 inches deep.

(b) Expansion Joints. Expansion joints shall be constructed at the centerline of and around each bridge pier column and on either side of each sign support foundation by use of 3/4 inch preformed joint filler 705.03.

**454.06** Finish. Immediately following the removal of fixed forms or construction by the slipformed method, the surface of the barrier shall be checked with a straightedge, and any irregularities of more than 1/4 inch in 10 feet shall be corrected. The barrier surface shall receive such additional finishing as necessary to present a smooth or lightly textured finish. The surface shall be free of any honeycomb, broken corners or edges, and surface voids larger than 1/4 inch in

diameter. Any surface which is not satisfactory to the Engineer as to color, texture and smoothness shall be corrected in accordance with 511.15.

**454.07 Curing**. Immediately after the free water has disappeared on surfaces not protected by forms, and immediately after the removal of forms, all exposed surfaces of the concrete shall be sealed by spraying thereon a uniform application of white curing compound 705.07. This shall be applied in such a manner as to provide a continuous film without marring the surface of the concrete. The material shall be applied with an approved mechanical sprayer. For small areas, other acceptable methods may be used. Wind protection to the spray fog shall be provided for by an adequate shield. For rate of application and other precautions necessary in application of this compound, see 511.14 Method (b).

Curing of precast sections may also be performed in accordance with the requirements of 515.06. Radiant heated forms may also be used for curing if approved by the Engineer.

When the foundation portion of the barrier is placed first so that the top part will be doweled to it, the foundation shall be cured in accordance with 511.14 Method (a) or (b). Method (a) may be used for initial cure of short length barrier leave-outs., however, before the curing is completed for leave-outs, material meeting 705.07, Type II Class B shall be applied at the normal rate.

**454.08** Method of Measurement. The quantity measured shall be the number of linear feet along the centerline of the top of the barrier, including all transitions, end terminals and bridge pier sections as specified complete in place.

**454.09 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>	
454	Linear Foot	Concrete barrier	
454	Linear Foot	Portable concrete barrier,	

## **ITEM 455 CURBING**

- 455.01 Description
- 455.02 Materials
- 455.03 Concrete Curbing
- 455.04 Concrete Combination Curb and Gutter
- 455.05 Method of Measurement
- 455.06 Basis of Payment

**455.01 Description**. This item shall consist of furnishing and constructing curb and combination curb and gutter of the specified materials and types, in reasonably close conformity with the lines, grades and cross sections shown on the plans or established by the Engineer. This item shall also include necessary excavation and backfill, furnishing and installing joint materials, and the disposal of surplus excavation and discarded materials in accordance with 203. All removal and restoration related to curb reconstruction shall be included in this item.

**455.02 Materials.** Materials shall be:

Concrete, Class C	
Bituminous joint sealers	705.01 or 705.02
Expansion joint material	
Reinforcing steel	

**455.03 Concrete Curbing.** (a) Forms and joints. Curb forms shall be approved metal forms. They shall be securely braced and held to line and grade specified. The inner surface of the forms shall be clean and coated with a suitable oil immediately before the concrete is placed.

All curb not constructed integral with the base or pavement shall have 1/4 inch contraction joints constructed at 10 foot intervals or as directed. The joint may be constructed with the use of metal separator plates or sawed in accordance with 451. The depth of sawcut joints shall be no less than 2" for combination curb and gutter, and 4" for 6" x 18" curb. The bottom of the saw kerf shall slope to the pavement from the curb. Where expansion joints occur in the abutting pavement, they shall be provided for by separation of the curb section being placed with 1 inch 705.03 preformed joint filler. One-half inch expansion joints shall be provided at the points of curvature, points of tangency, at inlet approaches and at no greater than 300 foot intervals.

When the curb is integral with the base or pavement, joints of the type used in the pavement shall be constructed in the curb. The joints shall be spaced identically with the joints in the base or pavement.

Curb forms shall be left in place for such length of time that the removal of forms does not crack, shatter, allow to slump or otherwise injure the concrete.

Where the curbs built under this item are to later serve as a support for finishing machine in the placing of a surface course, the alignment of the supporting edges shall be such that the distance between the curbs shall nowhere vary more than 1/2 inch from that specified.

Approved flexible forms of steel or wood shall be used for construction of circular curb where the radius is 100 feet, or less.

(b) Placing. The concrete shall be placed in accordance with 511.08. Internal vibrators shall be used to consolidate the concrete.

Concrete for curb which is to be integral with the concrete base or pavement shall be placed while the base or pavement concrete is plastic.

(c) Curb Cuts. The top of each curb shall be depressed for driveways such that the back of curb is  $1\frac{1}{2}$  inches above the surface of the pavement or gutter and the face of the curb is 1 inch above the surface of the pavement or gutter. Top of curb ramps shall be flush with the surface of pavement or gutter and shall be sloped as directed.

(d) Finishing. The top of the curb shall be floated in such a manner as to thoroughly compact the concrete and produce a smooth and even surface. The addition of extra mortar to secure this result will not be permitted. The upper edge of the face of curb shall be rounded, by the use of a tool especially designed for the purpose, to a radius of 3 inches. All other edges shall be finished to a 1/4 inch radius. The face of the curb shall be rubbed with a float immediately after removing the forms. Unnecessary tool marks shall be eliminated. The finished surface shall be free of irregularities and waves and shall be uniform in texture as finished with light brooming. In case of curb reconstruction on improved streets, face of the curb shall be finished to a depth of 6" minimum.

(e) Protection. Concrete curb, and combination curb and gutter shall be cured in accordance with 451, except that membrane cure shall be applied at a rate of not less than 1 gallon per 200 square feet of surface. Cold weather protection shall be as per 451.07.

**455.04 Combination Curb and Gutter**. Combination curb and gutter shall be in accordance with 455.03 except that:

Contraction joints shall be provided at intervals of 10 feet unless otherwise directed by the Engineer.

At inlets, approach slabs, or other locations where a transition is required, the curb and gutter shall be shaped as directed.

Four-inch subbase shall be placed and compacted in accordance with Item 310 and payment shall be included in the price bid for Item 455 Combination Curb and Gutter.

**455.05** Method of Measurement. The footage measured will be the actual number of linear feet of curb or combination curb and gutter complete in place, measured along the front face of the curb section, whether the curbing is laid on a straight line or on a curve.

No distinction will be made between curbing laid in a straight line and curbing laid on a curve.

**455.06 Basis of Payment**. The accepted quantities of specific items of curb and combination curb and gutter will be paid for at the contract price. The unit price shall include all removal and restoration related to the curb reconstruction.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
455	Linear Foot	Curb, Type
455	Linear Foot	Combination Curb and Gutter
455	Lineal Foot	Combination Curb and Gutter, Modified
455	Linear Foot	4" Rolled Curb and Gutter

### ITEM 456 SIDEWALKS, DRIVEWAYS AND STEPS

- 456.01 Description
- 456.02 Materials
- 456.03 Concrete Walks, Driveways and Driveway Aprons
- 456.04 Concrete Steps
- 456.05 Curb Ramps
- 456.06 Sidewalk Relaid
- 456.07 Method of Measurement
- 456.08 Basis of Payment

**456.01 Description**. This item shall consist of constructing sidewalks, driveways, driveway aprons, curb ramps, and steps of specified materials in reasonably close conformity with lines, grades and dimensions shown on the plans or established by the Engineer. All removal and restoration related to construction of the items listed herein shall also be included in this item.

456.02 Materials. Materials shall be:

Concrete (Class C)	499 and 511
Expansion joint material	
Reinforcing steel	

**456.03 Concrete Walks, Driveways and Driveway Aprons**. (a) Excavation shall be made to the required depth and to a width that will permit the installation of forms. Excavation to the finished surface of the sidewalk, driveway or apron shall be included under 203. Embankment to the top of subgrade shall be included under 203. The entire subgrade shall be uniformly compacted to a surface conforming to the plans or as directed. The Contractor shall provide and use a
template, riding on the forms, for checking the subgrade before the concrete is placed. A subbase course, if specified in the plans, shall be as required in 310.

(b) Forms shall be of metal, unless otherwise permitted by the Engineer, and shall extend for the full depth of the concrete and be of sufficient strength to resist the pressure of the concrete without deflection. Forms shall be kept clean and shall be oiled just before placing the concrete.

Unless otherwise shown on the plans or ordered by the Engineer, forms shall be set so that the back edge of the walk will be on the property line, at the designated grade, and the walk will have a uniform cross slope of 1/4 inch per foot of width toward the street center line.

Steel plates, 1/8 inch thick, shall be used to divide the walk for its full width and thickness into blocks five or six feet in length or as directed by the Engineer. In lieu of using divider plates, the walks may be saw cut to a minimum depth of 2 inches. Sawing shall be done as soon as practicable but no later than 24 hours after the concrete is placed. Driveway aprons shall be divided in a similar manner. If the driveway apron and sidewalk are placed integrally, joints in the sidewalk shall be in line with the edges and joints of the apron, and one of the two joints in line with the edge of the apron shall be an expansion joint. A longitudinal joint in line with the front edge of the walk shall be sawed between the sidewalk and apron.

All covers of shut-off boxes, manhole or coal hole covers, valves, platforms or area covers, and other similar fixtures, shall be adjusted to the grade of the completed walk prior to pouring the concrete.

Where the sidewalk concrete surrounds posts, poles, fire hydrants, gratings, castings, and the like, the concrete immediately adjacent to such objects shall be separated from the remaining concrete by means of 1/2 inch expansion joints extending through the full depth of the sidewalk concrete. In general, these joints shall be placed about 6 inches from poles, hydrants, etc., and arranged in the form of squares or rectangles or as directed by the Engineer.

(c) Placing and Finishing. The subgrade shall be moistened thoroughly, immediately prior to placing concrete. The concrete shall be deposited in a single layer. It shall be struck off with a template and smoothed with a float and a uniform broom finish applied. No plastering will be permitted. All outside edges and joints shall be edged with a 1/4 inch radius edging tool. Premolded expansion material 1/2 inch thick, extending the full depth of the walk, shall be installed between the new concrete and existing curbs, drives, aprons, walks, any fixed structure and at intervals of approximately 30 feet.

All concrete walks shall have the name of the Contractor or person constructing the walk, together with the year the walk is constructed, stamped in the surface of the walk in front of each lot. When single blocks of walk are constructed, they shall be separated from the existing walk by means of at least one expansion joint 1/2 inch in thickness. All such isolated blocks shall be stamped with the Contractor's name.

Where drain pipes cross underneath sidewalks, the walk shall be marked near the edge with a small circle, not less than 1 inch in diameter, impressed into the concrete.

(d) Concrete shall be cured as required in 451 except that membrane cure shall be applied at a rate of not less than 1 gallon per 200 square feet of surface. Cold weather protection shall be in accordance with 451.07.

**456.04 Concrete Steps**. (a) Excavation and forms shall conform to 456.03 (a) and (b) where applicable.

(b) Placing and finishing shall be in accordance with 511 except that treads of steps shall be finished to produce a sandy texture.

(c) Slopes of step treads shall be 1/4 inch per foot toward the next lower step.

(d) Curing shall be in accordance with 511.

(e) Hand railing, when specified, shall be in accordance with pertinent provisions of 517.

**456.05 Curb Ramps**. Excavation, forming, placing and finishing and curing shall conform to 456.03. The final surface texture shall be obtained by coarse brooming or other method approved by the Engineer. This item includes furnishing and installing approved detectable warnings, unless paid for under a separate item. All curb ramps shall conform to all requirements of the American Disabilities Act (ADA) and the City of Akron Standard Construction Drawings.

**456.06** Sidewalk Relaid. Existing concrete or flagstone sidewalk slabs that are suitable for relaying will be designated on the plans or by the Engineer. Slabs that are to be relaid shall be carefully removed, and a new bed of cushion sand spread and tamped to such elevation as is necessary to bring the relaid walk to proper grade. Then the slab shall be placed upon the new bed and tamped to line and grade, care being exercised not to break the slab. Any slabs broken by the Contractor while being relaid shall be replaced with new concrete sidewalk at the price bid for relaying. If the Contractor so elects, he may, at the price bid for relaying, provide new concrete sidewalks, constructed as specified above, in lieu of relaying the existing slabs.

**456.07 Method of Measurement**. Walks, aprons, driveway reconstruction and sidewalk will be measured by the square foot of finished surface complete in place. Steps will be measured by the linear foot, along the front edge of each tread. Where steps are constructed with integral walls, each tread will be considered to extend from out to out of such walls.

Curb ramps in concrete walk will be measured as the number of each complete and shall include the cost of any additional materials, grading, forming and finishing not included in the walk which is measured through the curb ramp area. New curbs required for curb ramps shall be constructed and paid for in accordance with Item 455 Curbing.

**456.08 Basis of Payment**. The accepted quantities of specific items will be paid for at the contract prices designated for each pay item listed. Excavation, backfill, base course material, reinforcing steel, hand railing, expansion joint material and other related miscellaneous items will not be paid for separately, but the cost thereof shall be included in the cost of the item of which they are a part.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
456	Square Foot	Concrete walk, inches thick
456	Square Foot	Sidewalk relaid
456	Each	Curb ramps
456	Linear Foot	Concrete steps
456	Square Foot	Concrete Driveway Reconstruction, inches thick
456	Square Foot	Concrete aprons, inches thick

### **ITEM 457 CONCRETE MEDIAN AND TRAFFIC ISLAND**

457.01 Description457.02 General457.03 Method of Measurement457.04 Basis of Payment

**457.01 Description**. This item shall consist of medians and islands composed of portland cement concrete constructed on the accepted, prepared subgrade, subbase or the completed and accepted base course or old pavement.

**457.02 General**. Materials and other requirements shall be the same as 451 except as follows:

- (a) Membrane cure shall be applied at a rate of not less than 1 gallon per 200 square feet of surface.
- (b) Medians may also be constructed by machine as provided in 454.03.

**457.03** Method of Measurement. The quantity measured shall be the number of square yards or the number of cubic yards as specified complete in place.

**457.04 Basis of Payment**. Accepted quantities will be paid for at the contract unit price per square yard or per cubic yard as specified. These prices shall be full compensation for all concrete, joints, dowels and other material necessary for completion of the items.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
457	Square Yard or Cubic Yard	Concrete traffic island
457	Square Yard or Cubic Yard	Concrete median

### **ITEM 458 TRAFFIC DIVIDERS**

458.01 Description
458.02 Materials
458.03 Construction
458.04 Method of Measurement
458.05 Basis of Payment

**458.01 Description**. This item shall consist of furnishing traffic dividers of the kind and size specified and installing such dividers at the locations specified.

**458.02 Materials**. Cement shall be white portland cement conforming to 701.01, 701.04, or 701.05. In addition, it shall be white without tint and shall have a minimum luminous (daylight) reflectance of 75.

Fine aggregate shall meet the grading and physical property requirements of 703.02 except as hereinafter noted.

Coarse aggregate shall be No. 8, except as hereinafter noted.

Modification of aggregate sizes within the above gradings may be made providing that the concrete produced will possess flexural strength and durability at least equal to that of concrete produced of the grading specified above.

The fine and coarse aggregates shall be silica or marble. Under no circumstances may different sizes from the same source or different sources be mixed to obtain a soundness loss within the specified limits.

The fine and coarse aggregates shall be combined in the proportion of 30 to 45 percent by weight of fine aggregate. Within these limits the proportions shall be regulated so as to provide a workable mix.

The minimum cement factor shall be 750 pounds per cubic yard of concrete. The maximum water-cement ratio shall be 0.45. The maximum allowable slump shall be 1 inch. The plastic concrete shall contain 5 to 8 percent entrained air.

**458.03 Construction**. When the traffic dividers are to be placed in bituminous concrete, they shall not be placed until the bituminous concrete surface has been completed. The opening remaining between the bituminous concrete and the traffic dividers shall be filled with 1:2 cement mortar or 705.01 or 705.02 joint sealer.

When the traffic dividers are to be placed in portland cement concrete, the openings into which the traffic dividers are to be set shall be formed at the time the portland cement concrete pavement is being placed by a method acceptable to the Engineer. The opening remaining between the portland cement concrete pavement and the traffic dividers shall be filled with 1:2 cement mortar or 705.01 or 705.02 joint sealer.

After the traffic dividers have been set in the pavement, the lifting holes shall be filled to within 3/4 inch of the surface with dry sand and sealed with 705.01 or 705.02 joint sealer.

Throughout the work, the Contractor shall keep the traffic dividers free of any material tending to deface them.

**458.04 Method of Measurement**. The number of traffic dividers measured will be the actual number of traffic dividers furnished and installed as specified.

**458.05 Basis of Payment**. The number of traffic dividers measured will be paid for at the contract unit price per each complete in place. This price shall constitute full compensation for furnishing, preparing and installing traffic dividers as specified.

Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription458EachTraffic dividers

### **ITEM 459 CORE HOLES IN WALK**

- 459.01 Description
- 459.02 Construction Method
- 459.03 Measurement
- 459.04 Basis of Payment

**459.01 Description**. This item shall consist of providing circular holes in walk at locations designated on the plan, or as directed by the Engineer.

**459.02** Construction Method. The holes of size and location as specified on plan shall be provided through the walk by drilling, using a method approved by the Engineer. The workmanship must be of a high quality and the walk must not be injured.

**459.03 Measurement**. The quantity of core holes complete to be paid shall be the actual number of holes through the walk, satisfactorily completed and accepted.

**459.04 Basis of Payment**. Payment for accepted quantities complete in place shall be made at the contract price for:

ItemUnitDescription459EachCore Holes in Walk, \_\_\_\_ inch

### **ITEM 460 BRICK WALK**

- 460.01 Description 460.02 Materials
- 460.03 Execution
- 460.04 Method of Measurement
- 460.05 Basis of Payment

**460.01 Description**. This item shall consist of furnishing the necessary labor, material and equipment required to install bricks on a prepared base in areas shown on the plans or as directed by the Engineer.

**460.02 Materials**. Bricks shall be new beveled edge paving bricks (4"x2<sup>1</sup>/4"x8" nominal size). Brick manufacturer and color shall be as shown on Standard Construction Drawing No. LA-1. If blending into existing brick walk, materials shall match existing as directed by the Engineer. New bricks shall be in accordance with ASTM C-902 Type 1, Class SX. Bricks shall be manufactured by extrusion, not by dry-stamping.

The base course material shall be class "C" concrete meeting the requirements of 499.03.

The aggregate for cushion and joint filler shall be concrete sand per 703.02.

**460.03 Execution**. Installation of the bricks shall not start until the construction of adjacent sidewalk and curb has been completed. The Contractor

### 460.04

shall correct any and all deficiencies in the subgrade as necessary in a manner acceptable to the Engineer.

The subgrade shall be tamped or rolled to secure a firm foundation. The concrete base shall then be placed three inches thick, and screeded to the proper depth and elevation so that after the concrete sand cushion and bricks are placed and compacted, the bricks shall meet adjacent elevations of surrounding concrete walk and curb.

After the concrete base is cured the concrete sand shall be spread and leveled at 1/2"-1" thickness.

The bricks shall be laid in straight courses to form a "running bond" pattern, as shown on the drawings or as directed by the Engineer, hand tight, with a smooth finished surface. All objectionable bricks shall be removed and replaced with acceptable bricks. The bricks shall be brought to firm bearing and finished grade with the adjacent curb and sidewalk by means of a rubber mallet and wood blocks. Driving or ramming of the bricks shall not be permitted. A maximum of 1/8 inch shall be permitted for whole or cut brick joints. Concrete sand shall be swept over the brick to fill all joints, and the area saturated by fine spraying with water.

The brick surface shall not vary more than 1/8" inch in ten (10) feet and shall not be more than 1/16 inch above or below the adjacent curb or sidewalk.

Brick Walk Relaid shall consist of installing or reinstalling bricks on an existing base.

Broken bricks, unused brick pieces, sand, cement and other debris shall be removed from the site at the end of each workday.

**460.04 Method of Measurement**. The quantity to be paid shall be the number of square feet of brick walk installed and accepted, as determined from the Engineer's final measurements.

**460.05 Basis of Payment**. Payment for completed work will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
460	Square Foot	Brick Walk
460	Square Foot	Brick Walk Relaid

This price shall include compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including all excavation, concrete base, concrete sand cushion and joint filler, and bricks.

## **ITEM 461 BRICK PAVEMENT**

- 461.01 Description
- 461.02 Materials
- 461.03 Execution
- 461.04 Method of Measurement
- 461.05 Basis of Payment

**461.01 Description**. This item shall consist of furnishing the necessary labor, material and equipment required to construct or reconstruct brick pavement on a prepared base in areas shown on the plans or as directed by the Engineer. Unless paid for separately, this item shall also include the removal of any existing pavement as necessary to complete the work or as directed by the Engineer.

**461.02 Materials**. Bricks shall be standard paving bricks (4" x 4" x 8" nominal size), which have been salvaged from old brick streets, or new bricks acquired by the Contractor, as noted below. For brick pavement reconstruction, the Contractor shall reuse as much of the existing brick as possible. Replacement bricks may be obtained from the City at no cost to the Contractor. Old paving bricks are stockpiled at the Municipal Services Center, 1420 Triplett Boulevard, Akron, Ohio. The contractor shall contact the Public Works Bureau (330 375-2834) to make arrangements to pick up the bricks. If necessary, the Contractor shall clean the bricks prior to use.

If new bricks are required to complete the work, the manufacturer of the new bricks will be as designated on the plans or as directed by the Engineer. New bricks shall be in accordance with ASTM C-1272 Type F, color to match that of the existing or salvaged bricks, and shall be of the same nominal size (4" x 4" x 8"). New bricks supplied by the Contractor shall be manufactured by the extrusion process, not by dry stamping.

The base course material shall be class "C" concrete meeting the requirements of 499.03. For reconstructed brick pavement, the concrete base shall be the same thickness as the adjoining concrete base, with a minimum thickness of six inches. Concrete base for new brick pavement shall be 6 inches thick unless otherwise specified on the plans.

The aggregate for cushion and joint filler shall be concrete sand per 703.02.

**461.03 Execution**. The Contractor shall correct any and all deficiencies in the subgrade as necessary, in a manner acceptable to the Engineer. The subgrade shall be compacted to secure a firm foundation. The concrete base shall then be placed and screeded to the proper depth and elevation so that after the cushion material and paving bricks are placed and compacted, the bricks shall meet adjacent elevations of surrounding brick pavement or proposed elevations shown on the plans. After the

concrete base is cured the cushion material shall be spread and leveled at the same thickness as the adjoining material.

The bricks shall be laid in straight courses to form a "running bond" pattern, or as directed by the Engineer, hand tight, with a smooth finished surface. All objectionable bricks shall be removed and replaced with acceptable bricks. The bricks shall be brought to firm bearing and finished grade by means of a rubber mallet and wood blocks. Driving or ramming of the bricks shall not be permitted. A maximum of 1/8 inch shall be permitted for whole or cut brick joints. Concrete sand shall be swept over the bricks to fill all joints and the area saturated by fine spraying with water. The brick surface shall not vary more than 1/8 inch in ten feet.

Unused whole bricks shall be returned by the Contractor to the stockpile at 1420 Triplett Boulevard. Broken bricks, unused brick pieces, sand, and other debris shall be removed from the site.

**461.04 Method of Measurement.** The quantity to be paid shall be the number of square yards of brick pavement installed and accepted, as determined from the Engineer's final measurements.

**461.05 Basis of Payment**. Payment for completed work will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
461	Square Yard	Brick Pavement (Salvaged Bricks)
461	Square Yard	Brick Pavement (New Bricks)
461	Square Yard	Brick Pavement Reconstructed (Salvaged Bricks)
461	Square Yard	Brick Pavement Reconstructed (New Bricks)

This price shall include compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including all excavation, concrete base, cushion material, paving bricks and joint filler.

## **ITEM 464 HORIZONTAL SAWING OF CURB**

464.01	Description
464.02	Method
464.03	Method of Measurement
464.04	<b>Basis of Payment</b>

**464.01 Description**. This item shall consist of sawcutting existing curb horizontally to conform to lines and/or dimensions of proposed driveway aprons and curb ramps. Removed material shall be disposed of and the area cleaned of all debris.

**464.02 Method**. Work shall be performed using an industrial duty wet masonry saw designed to cut horizontally, inclined and sloped.

The finish of the horizontal sawed curb shall be an even plane surface slightly sloped toward the pavement, as directed by the Engineer. At the ends of the horizontal saw cut, an inclined saw cut shall be made to match the incline of the curb ramp or apron. The intersection of the saw cuts shall be mechanically ground to a smooth radius.

**464.03 Method of Measurement**. The quantity measured will be the actual number of linear feet of curb cut in place, measured along the front face of the curb, whether straight or curved.

**464.04 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

 Item
 Unit
 Description

 464
 Linear Feet
 Horizontal sawing of curb

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete this work as specified.

## **ITEM 499 CONCRETE - GENERAL**

- 499.01 Description
- 499.02 Materials
- 499.03 Proportioning
- 499.04 Equipment
- 499.05 Handling, Measuring and Batching Materials
- 499.06 Mixing and Delivering
- 499.07 Sampling and Testing
- 499.08 Concrete Which Fails to Meet Specifications

**499.01 Description**. This item shall consist of proportioning, mixing and transporting concrete.

499.02 Materials. Materials shall be:

Fine aggregate	703.02
Coarse aggregate	703.02
Portland cement701.01, 701.04 and	701.05
Air entraining admixture	705.10
Chemical admixture for concrete	705.12

### 499.03

The brands or kinds of all concrete materials for any one item may be changed only by permission of the Engineer.

Water used in concrete shall be free from sewage, oil, acid, strong alkalis or vegetable matter and also shall be free from clay and loam. Water which is potable is satisfactory for use in concrete.

**499.03 Proportioning**. Proportioning shall be based on predetermined cement content. Except as otherwise provided herein, each cubic yard of concrete shall contain the specified weight of cement as determined by the yield test. The water-cement ratio shall not exceed the maximum specified. Below this limit the quantity of water shall be adjusted to meet the slump requirements.

Concrete shall contain 6, plus or minus 2, percent of entrained air.

Slump shall be maintained within the range shown as nominal slump in the following table. No concrete shall be used in the work that has a slump greater than that shown as maximum in the table. When the slump is found to exceed the limit of nominal slump but is within the maximum limit, occasional loads of concrete may be used, provided an immediate adjustment is made in the mixture to reduce the slump of succeeding loads to within the nominal range shown.

Type of Work	Nom. Slump <u>Inches</u>	Max. Slump <u>Inches</u>
Concrete Pavement (305, 451, 452, 453, 615)	1-3	4
Structural concrete (511, 610, 622 excluding		
superstructure concrete)	1-4	4
Superstructure Concrete 511	2-4	4
Non-reinforced concrete		
(454, 455, 456, 457, 458, 551, 562, 563, 601, 602)	1-3	4

The contractor may, with the prior approval of the Engineer, add an approved type F or type G high-range, water-reducing admixture provided the following criteria are met.

- (a) The Engineer must be present and approve the addition of the admixture on a load-by-load basis. Failure to obtain approval of the Engineer will result in the rejection of the load.
- (b) The admixture shall be supplied by the ready-mix supplier providing concrete for the project.

- (c) The slump of the concrete prior to the addition of the admixture is three inches or less and does not exceed six inches after the addition of the admixture.
- (d) The addition of the admixture shall take place before a third of the load has been discharged. At no time shall admixture be added to a load containing less than four cubic yards.
- (e) The air content of the concrete mixture shall be maintained within the acceptable range after the addition of the admixture.
- (f) The yield of the concrete mixture shall be maintained at  $27\pm 0.5$  C.F./C.Y.

Failure to maintain acceptable mixture properties as determined by the Materials Testing Laboratory may result in the suspension of the use of these admixtures.

Tests on the plastic concrete for pavement shall be made at the paving site or at a location designated by the Engineer. Tests for structure concrete shall be made at the site of the work at the time the concrete is being placed.

The weights of fine and coarse aggregate shall be determined by the Engineer from the weights given in the Concrete Table, not exceeding the maximum water-cement ratio shown and the range in slump stated. If high-early strength concrete is specified, the Contractor may use high-early strength cement (per 701.05), additional cement, approved chemical admixture or a combination of these materials to achieve a modulus of rupture of 600 pounds per square inch in three days or less. If high-early-strength concrete is not specified, but is desirable to expedite the work, the Contractor may use, at his own expense, high-early-strength cements, additional cement, approved chemical admixtures, or a combination of these materials with the approval of the Engineer. Do not waive concrete curing periods specified for the item of work in which concrete is used.

The weights specified in the Concrete Table were calculated for aggregates of the following bulk specific gravities: natural sand and gravel 2.62, limestone sand 2.68, limestone 2.65, slag 2.30. For aggregates of specific gravities differing more than plus or minus 0.02 from these, the weights in the table shall be corrected as indicated in paragraph (c) of this section.

Gravel

1320

# CONCRETE TABLE Quantities Per Cubic Yard Dry Aggregates

Type Of Course Aggregate	Fine Aggregate (lb.)	Coarse Aggregate (lb.)	Total (lb.)	Cement Content (lb.)	Water Cement Ratio Maximum
		CLASS C (Usin	ng No. 57 Siz	ze)	
	(min. 2	28 days compress	sive strength,	4000 psi)	
Limestone	1285	1630	2915	600	0.50
Slag	1350	1360	2710	600	0.50
		CLASS F (Usin	ng No. 57 Siz	ze)	
	(min. 2	28 days compress	sive strength,	3000 psi)	
Limestone	1345	1730	3075	500	0.50
Slag	1380	1470	2850	500	0.50
		CLASS S (Usin	ng No. 57 Siz	e)	
	(min. 2	28 days compress	sive strength,	4500 psi)	
Limestone	1260	1530	2790	715	0.44
Slag	1280	1370	2650	715	0.44
	CL	ASS C (Using N	Jo. 7. 78. or 8	8 Size)	
	Provide	concrete with a	n air content	of $8\% + 2\%$	
	(min. 2	28 days compress	sive strength,	4000 psi)	
Limestone	1380	1410	2790	600	0.50

Calcium Chloride (CaCl<sub>2</sub>) as an admixture will not be permitted. The Contractor may, with prior approval of the Engineer, add an approved Type C or Type E non-chloride set accelerating admixture provided the requirements of 499.03 paragraph four, items (a) through (f) are met. All initial water, called for in the design, must be added at the plant. The addition of the admixture is not construed as substitute for cold weather protection, but as an addition to it.

2780

600

0.50

1460

At any time during the construction period, the relative weights of fine and coarse aggregate as determined from the above table may be varied by the Engineer in order to insure a workable mix within the slump range and to control the yield. However, the total weight of aggregate per cubic yard shall not be changed except as provided in the preceding paragraph or for the following conditions or both.

(a) For batch weights, the weights determined as described above shall be corrected to compensate for moisture contained in the aggregates at the time of use.

(b) If it is found impossible to prepare concrete of the proper consistency without exceeding the maximum water-cement ratio specified, a water reducing admixture conforming to requirements of 705.12 shall be used or the cement content shall be increased. However, the Contractor shall not be compensated for the admixture or additional cement which may be required by reason of such adjustment.

(c) If, during the progress of the work, the specific gravity of one or both of the aggregates changes, the batch weight shall be adjusted to conform to the new specific gravity.

(d) Unit weight determinations shall be made and the yield shall be calculated in accordance with the method on file with the Engineer. Based on these determinations, the batch weights will be adjusted when necessary. However, the specified cement content shall be maintained and the maximum water-cement ratio shall not be exceeded.

(e) The amount of mixing water shall be adjusted for the moisture contained in the aggregate and for the moisture which they will absorb, in order to determine the amount of water to be added at the mixer.

(f) When the temperature of concrete, at the time of placement, is expected to exceed 75°F, an approved water reducing admixture meeting the requirements of 705.12, Type A or Type D, shall be added at the plant and mixed in accordance with the manufacturer's recommendations. The admixture shall be compatible with the air entraining admixture used. The specified cement content shall be maintained. The cost of the admixture shall be included in the unit price of the item requiring the concrete. Proposed admixture shall be submitted to the Engineer for approval prior to start of construction.

Concrete Class MS. This mixture is a moderate-setting portland cement concrete for accelerated strength development. The rigid replacement may be opened to traffic after 24 hours provided test beams have attained a modulus of rupture of 400 psi. The minimum cement content shall be 800 pounds per cubic yard and the maximum water-cement ratio shall be 0.43.

The proportioning of the concrete materials to meet the requirements of each class of rigid replacement concrete specified shall be the responsibility of the contractor. The entrained air content shall be  $6\pm$  two percent. Slump shall meet the requirements of 499.03. No water shall be added on site, the slump may be adjusted with the approval of the engineer by the addition of an approved type F or type G high-range water reducer (superplastisizer). Failure to obtain the engineer's approval will result in the rejection of the load.

If high-early strength concrete is specified, the Contractor may use high-early strength cement, additional cement, approved chemical admixture or a combination

### 499.04

of these materials to achieve a modulus of rupture of 600 pounds per square inch in three days or less.

**499.04 Equipment**. Equipment shall be as follows:

(a) Batching plants. Each plant shall be constructed and operated so that no intermingling of materials occurs prior to batching. The plant shall have weighing mechanisms which provide either a visible means of checking weights or a printed record. Dispensing mechanisms for water and admixtures shall have a visible means of checking quantities or shall produce a printed record.

Weighing mechanisms used for cement and aggregates shall weigh to an accuracy such that the weight indicated on the scale or printed ticket is within plus or minus 0.5 percent of the correct weight. Devices for weighing or metering water shall measure to an accuracy of plus or minus 1.0 percent throughout the range used.

All weighing and metering devices shall have been checked and their accuracy attested to within the 12 month period immediately prior to their use. This service may be performed by the Division of Weights and Measures or a scale servicing company.

Ten 50-pound standard test weights shall be readily available for testing and weighing devices at the batch plant. These weights and all others used in testing the weighing devices shall be sealed every 3 years by the Ohio Department of Agriculture.

Weighing and dispensing devices shall be tested as often as the Engineer may deem necessary to assure their continued accuracy.

(b) Mixers. Mixers may be stationary mixers (central-mix) or truck mixers (transit mix). Agitators may be truck mixers or agitators. Each mixer shall have attached in a prominent place the manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Central-mix plants shall be approved types capable of producing thoroughly mixed and uniform concrete within the specified mixing period, and of discharging the mixture without segregation. The mixer shall be equipped with an approved timing device which automatically prevents the discharge of the batch before it has been mixed the specified minimum amount of time.

Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mix concrete, shall conform to paragraphs 8.1, 8.2, 8.3, 9.2, 9.4 and 9.5 of AASHTO M 157.

Truck mixers shall be equipped with mechanically or electrically actuated counters by which the number of revolutions of the drum or blades may readily be verified.

When a truck mixer is used for complete mixing, each batch of concrete shall be mixed for not less than seventy revolutions of the drum or blades at the rate of rotation designated on the metal plate on the mixer as mixing speed.

Mixers and agitators shall be examined or weighed routinely as frequently as necessary to detect changes in condition due to accumulation of hardened concrete or mortar and examined to detect wear of blades. When such changes are extensive enough to affect the mixer performance, the mixer or agitators shall not be used unless the condition is corrected.

**499.05 Handling, Measuring and Batching Materials**. Aggregates from different sources and of different gradings shall not be stockpiled together. Aggregates that have become segregated or mixed with earth or foreign material shall be reworked or cleaned as directed by the Engineer, or rejected. Coarse aggregate shall be maintained with a uniform moisture content.

The fine aggregate and each size of coarse aggregate shall be separately weighed in the respective amounts set by the Engineer as outlined in 499.03. Separate weighing devices shall be used for weighing the cement.

Batching shall be so conducted as to result in the weights of each material required within a tolerance of plus or minus 1.0 percent for cement and plus or minus 2.0 percent for aggregates. Water shall be measured by weight or volume to within a tolerance of plus or minus 1.0 percent. Admixtures shall be dispensed to within plus or minus 3.0 percent of the desired amount.

Methods and equipment for adding air-entraining agents or other admixtures into the batch, when required, shall be approved by the Engineer.

**499.06** Mixing and Delivering. The concrete may be mixed in a central mix plant or in truck mixers. The mixer shall be of an approved type.

Concrete that is mixed completely in a central mix plant and transported to the point of delivery either in a truck agitator or in a truck mixer operating at agitating speed shall conform to the following: The mixing time shall be counted from the time all of the solid materials are in the drum. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates and all water shall be in the drum by the end of the first one/fourth of the specified mixing time. The acceptable mixing time for mixers having capacities of  $1 \text{ yd}^3$  (0.76 m<sup>3</sup>) or less shall be not less than 1 minute. For mixers of greater capacity, this minimum shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

### 499.06

Concrete shall be mixed and delivered in accordance with 499.04 (b). The Contractor shall furnish to the City with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped or written information concerning said concrete as follows:

name of ready-mix batch plant serial number of ticket date truck number name of purchaser name and location of job specific class or designation of concrete amount of concrete in cubic yards type, brand and amount of cement batch weight of fine aggregate batch weight and size of coarse aggregate total mixing water added by producer water added by receiver of concrete and initialed type and brand and amount of admixtures time of loading or first mixing of cement and aggregates, imprinted by an automatic time clock

The concrete shall be delivered to the site of the work and discharge shall be completed within one hour after the combining of the water and the cement. If an approved set-retarding or a water-reducing and set-retarding admixture is used at the Contractor's expense, discharge shall be completed within 90 minutes after the combining of the water and the cement. This time extension shall not apply to 511 superstructure concrete.

Mixers shall be operated at a drum speed as shown on the manufacturer's name plate on the approved mixer. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity, as shown on the manufacturer's standard rating plate on the mixer.

Retempering concrete by adding water will not be permitted. When concrete is delivered in transit mixers or agitators, additional water within the limits specified may, with the approval of the Engineer, be added and a minimum of 30 revolutions of the drum at mixing speed performed to adjust the slump and to regenerate the specified air content throughout the batch, provided all of the following criteria are met.

(a) The Engineer must be present and approve the addition of the water on a load-by-load basis. Failure to obtain approval of the Engineer will result in the rejection of the load and removal, at no cost to the City, of all concrete placed from the rejected load.

(b) The slump of the concrete prior to the addition of water is three inches or less and does not exceed the requirements of 499.03 after the addition of water.

(c) The addition of water shall take place before no more than one cubic yard of the load has been discharged.

Admixtures for accelerating the set will be permitted only when provided for in the contract, or with the written permission of the Engineer.

After discharged into the work, ensure that the temperature of all concrete does not exceed  $90^{\circ}$  F.

**499.07** Sampling and Testing. The Contractor shall afford the Engineer all reasonable access, without charge, for the procurement of samples of fresh concrete to determine conformance of it to these specifications.

Slump and air-content tests shall be made at the time of placement as often as is deemed necessary by the Engineer and always when strength specimens are made. If the slump or air-content falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed the requirements of the specifications.

Fresh unit weight and yield tests may be made at the time of placement as is deemed necessary by the Engineer.

For a strength test 3 or more standard test specimens (6" x 12" cylinders) shall be made.

Strength tests as well as slump, air content, fresh unit weight and yield tests shall be generally made with a frequency of not less than one test for each 150 C.Y. per class of concrete placed or one test per day per class of concrete if less than 150 C.Y. is delivered.

Methods of sampling and testing concrete shall be in accordance with the following ASTM methods.

Sampling Fresh Concrete - Method C 172 Slump - Test Method C 143 Air Content - Test Methods C 138, C 173 or C 231 Yield, Weight per Cubic Foot - Test Method C 138 Compression Test Specimens - Method C 31 Compression Tests - Test Method C 39 Flexural Strength of Concrete - Test Method C 78

The testing laboratory performing tests of concrete shall meet the requirements of ASTM Recommended Practice E 329.

**499.08 Concrete Which Fails To Meet Specifications.** Concrete which fails to meet the specified slump or air content requirements shall be rejected and removed from the job site at no cost to the City. Concrete which fails to meet the specified strength requirement shall be removed and replaced at no cost to the City, or at the option of the Engineer, may be left in place and paid for at reduced unit prices determined as follows:

- A. For pavement (Items 451,452, and 453), curbing (Item 455) sidewalks, driveways and steps (Item 456) and patching concrete structures (Item 519), the unit price paid for all concrete represented by the failed sample shall be the bid price for the respective item of work times the square of the ratio of the average 28 day compressive strength achieved to the specified minimum 28 day compressive strength.
- B. For items of work such as piling, pile caps for sewers, and concrete for structures, a reduction shall be imposed as follows:

For each cubic yard of concrete represented by the failed sample, a reduction of \$200 times the quantity one minus the square of the ratio of the average 28 day compressive strength achieved to the specified minimum 28 day compressive strength.

# **500 STRUCTURES**

# **ITEM 501 STRUCTURES-GENERAL**

- 501.01 Description
- 501.02 Verification of Dimensions
- **501.03** Foundation Information
- 501.04 Approval of Fabricator
- 501.05 Shop Drawings
- 501.06 Approval of Construction Plans
- 501.07 Test Reports
- 501.08 Utilities
- 501.09 Erection Stresses
- 501.10 Traffic

**501.01 Description**. Structures shall be built as indicated on the plans, in accordance with the specifications for the various items which constitute the completed structure, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

The Contractor shall so plan and carry on his work, including fabrication, erection, and construction, that the structure as a whole and all its component parts will function as contemplated in the design.

**501.02 Verification of Dimensions**. The Contractor shall verify all dimensions established by the Engineer and satisfy himself as to the correctness thereof and the mutual agreement of parts.

**501.03 Foundation Information**. The City assumes no responsibility for the accuracy of soundings, test borings or rock elevation shown on the plans, even though this information is the result of field investigations.

**501.04 Approval of Fabricator**. Before any steel, other metal, or prestressed concrete members requiring fabrication are ordered by the Contractor, the fabricator or fabricators shall be approved by the Engineer. Request for such approvals shall be made by the Contractor in writing on or before the date of the preconstruction conference.

Fabricators of structural steel for structures furnished under 513, exclusive of bridge bearings, roadway expansion joints, and secondary and detail material as defined in 513.02, shall be certified in accordance with the requirements of the American Institute of Steel Construction (AISC) Quality Certification Program in the appropriate category.

Certification under AISC Category I is limited to simple and multiple span rolled beam bridges which require no heat curving or butt welded sections.

Approval will be given only to those Fabricators who will perform all fabrication in plants located within the continental limits of the United States.

**501.05** Shop Drawings. Structural steel and other metal items, prestressed concrete members, precast concrete structural elements which are to be assembled, laminated elastomeric bearings, joint sealing devices and other similar items requiring either shop or field fabrication shall be detailed on shop drawings by the Contractor in accordance with AASHTO "Standard Specifications for Highway Bridges" and the Ohio "Supplement" to the AASHTO specifications in effect on the date of advertisement for bids.

The Contractor shall submit to the Engineer, for review and approval, three copies of these drawings, unless additional copies are requested. All drawings shall show detailer's and checker's initials as an indication that details have been checked for accuracy. Fabrication shall not begin until written approval of the submitted drawings has been received from the Engineer. Following approval of the drawings, four complete sets shall be submitted to the Engineer unless additional copies are requested.

The prints shall be made from tracings, neatly and accurately drawn on sheets 22 or 24 inches wide and 36 inches long.

Drawings used for fabrication shall indicate the date of approval by the City. After all fabrication is completed, the Fabricator shall furnish a 35 millimeter microfilm copy of each shop drawing mounted in a 3-1/4 by 4-3/8 inch aperture card. The card shall be imprinted along the top edge with the City bridge and project number, details shown on the drawing, and drawing number in the order listed.

**501.06 Approval of Construction Plans**. The following plans shall be approved by the Engineer and by any involved railway companies before the work may begin. For such approval, three copies of the plans, plus an additional five copies for each involved railway company, shall be submitted. The plans shall be prepared by a registered professional engineer and shall bear his signature and P.E. number or his P.E. seal. Two copies of the design computations shall be submitted with the plans.

(a) Plans for sheeting and bracing of excavation adjacent to railroad tracks.

(b) Plans of falsework for cast-in-place concrete bridges over 20 feet in span. These plans shall be submitted at least 15 days before the construction of the falsework, and approval must be obtained prior to placing superstructure material.

(c) Plans for the proposed erection and handling procedure for (1) multiple span plate girder bridges, (2) rolled beam bridges where the length of any fabricated beam exceeds 80 feet, where fabricated sections contain bend point or horizontal curvature where cross girders are involved or where there is a field splice on each span, (3) trusses, (4) arches, and (5) structures carrying railway traffic. These plans shall be submitted at least 30 days before material handling is to begin, and handling or erecting shall not begin before approval is obtained. The drawings for the proposed procedure shall include the complete framing plan showing each girder or beam section by "piece mark," sequence of erection, load capacity of erection equipment to be utilized, method of lifting members, splicing procedures and methods for obtaining structure stability in the initial piece or pieces erected and the partially completed structure.

Equipment used for erection shall also be used for unloading and any interim handling.

(d) Plans for permanent or temporary attachments other than those shown or permitted by Contract Plans made by welding to main structural members.

Approval of the above construction plans does not relieve the Contractor of responsibility for the behavior of the temporary structures and procedures proposed.

**501.07 Test Reports**. Certified test data for all structural steel, except bar stock enumerated in 513.03, steel piles, cast steel, aluminum, bronze and sheet lead to be supplied shall be furnished the Engineer showing compliance with the requirements of 711. Certified test data shall be furnished for new sheet piling. Acceptance of used sheet piling shall be governed by the requirements of 504.02. All test data shall be accompanied by copies of mill shipping notices or invoices showing the quantity and size of material being certified. Materials will not be accepted for erection until the test data have been approved by the Engineer.

Structural steel and other metals produced in countries other than the United States may be used providing each heat is sampled and tested prior to use by an approved domestic U.S.A. laboratory and shown to comply with the requirements of 711. Such testing shall be performed at no additional cost to the City.

Certified test data showing compliance with 711.08 shall be submitted to the Engineer.

The certified test data required above shall be submitted in single copy for each structure, except where the structure carries railway traffic and then one additional copy shall be submitted for each railway company involved.

**501.08 Utilities**. When appurtenances for gas, steam, water or electric lines, car tracks or other utilities are to be installed on a new structure, the Contractor shall cooperate with the utility company or agency, in their installation of these utilities, after the installation and method of installation have been approved by the Engineer.

**501.09 Erection Stresses.** No part of the structure shall be subjected to unit stresses that exceed by more than one-third the allowable unit stresses, as given in AASHTO "Standard Specifications for Highway Bridges" due to erection and construction methods, or to the use or movement of erection or construction equipment onto or across the uncompleted or completed structure.

When equipment having a gross weight in excess of 40,000 pounds is to be placed on the structure and used for erection purposes, structural analysis calculations showing the stresses produced by the equipment and associated erection loads shall be submitted to the Engineer for review and approval.

**501.10 Traffic**. Traffic, including the movement of construction equipment, shall be restricted on concrete structures according to 511.14.

### **ITEM 502 TEMPORARY STRUCTURE**

502.01 Description
502.02 General
502.03 Maintenance
502.04 Removal
502.05 Basis of Payment

**502.01 Description**. This item shall consist of preparing plans, providing, maintaining and subsequently removing one or more temporary structures in reasonably close conformity with the plans, special provisions and proposal and with the requirements hereinafter set forth.

**502.02 General.** The temporary structure shall have an adequate waterway opening, but generally not less than 75 percent of the effective waterway opening of the proposed structure may be designed to provide for a five-year frequency flood as a minimum. The Contractor shall be responsible, however, for any damages caused by upstream flooding due to insufficient temporary structure size or the accumulation of debris or sediment in the channel. A clear roadway width of at least 23 feet face to face of guardrails shall be provided. Provisions shall be made for pedestrian traffic where the existing structure or approaches or both have sidewalks. Such provision shall consist of at least one sidewalk not less than 4 feet wide and shall include adequate connections to existing walks.

The temporary structure shall be designed for a loading of HS20-44 at unit stresses not to exceed 136.5 percent of those specified by pertinent sections of AASHTO "Standard Specifications for Highway Bridges."

Three copies of the Contractor's plans for the proposed temporary structure shall be submitted to the Engineer at least 15 days before its scheduled construction and such construction shall not begin until after approval has been received. The plans shall be prepared by a registered Professional Engineer and shall bear his signature and registration number.

Piling, when required, shall be driven to sufficient penetration to carry the superimposed loads in accordance with 507, but not less than 12 tons per pile.

If the plans state that the existing superstructure may be used in lieu of new construction, it need not be altered to meet either the above width or strength requirements, but it shall be moved or dismantled and re-erected with sufficient care to avoid any reduction of capacity. If such superstructure has been restricted by posting to loads less than permitted by statute, the posting signs shall be moved to the temporary road, unless the superstructure is strengthened to a legal load capacity. If the Contractor plans to use the existing superstructure on the temporary road, he shall notify the Engineer at least 3 days in advance of the time when it will be moved in order to permit the City to establish a detour. The bridge shall be completed in not more than 48 hours after traffic has been routed over the detour.

**502.03 Maintenance**. The Contractor shall maintain all portions of the temporary structure including lighting in good condition with respect to both safety and smoothness for travel as long as it is needed for maintenance of traffic. The channel and waterway opening shall also be satisfactorily maintained. The lump sum temporary structure item shall be considered as including maintenance.

**502.04 Removal**. When the temporary structure is no longer needed, it shall become the property of the Contractor and shall be removed from the site by him according to 202.

**502.05** Basis of Payment. The erection, maintenance and subsequent removal of the temporary structure will be paid for at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
502	Lump Sum	Temporary structure

### **ITEM 503 EXCAVATION FOR STRUCTURES**

- 503.01 Description
- 503.02 Classification
- 503.03 Cofferdams, Cribs and Sheeting
- 503.04 Protection of Excavation
- 503.05 Footings in Rock
- 503.06 Approval of Foundations
- 503.07 Culvert Foundations
- 503.08 Additional Excavation
- 503.09 Disposal of Excavated Material
- 503.10 Backfill

### 503.11 Method of Measurement 503.12 Basis of Payment

**503.01 Description**. This item shall consist of designing cofferdams and shoring, excavating all materials not removed under other items that must be removed to enable construction of bridges, foundations for box culverts and other structures. Included in this item are (a) constructing, maintaining and subsequently removing cofferdams and shoring, (b) dewatering and backfilling the excavation, (c) protecting the excavation against collapse, and (d) disposing of materials not required or suitable for backfill.

**503.02** Classification. Excavation is classified as (a) unclassified excavation, (b) unclassified excavation including rock (or shale), and (c) rock (or shale) excavation.

**503.03** Cofferdams, Cribs and Sheeting. This item shall include the preparation of a plan, construction, maintenance and subsequent removal of all cofferdams, cribs, sheeting, shoring, bracing or other materials necessary to safely support the sides of excavations, trenches, embankments, adjacent buildings, tracks or other premises, and all dewatering necessary to complete required construction.

Wales and crossbraces shall, if practicable, clear the top of the footings by at least 1 foot. If this is not practicable, such bracing shall be of structural steel and shall be left in place. The ends of such structural members shall be burned off flush with the surface of the concrete unless the ends would be exposed to view when the structure is completed. Ends so exposed shall be boxed back at least 6 inches from the face of the concrete and shall be burned off at least 3 inches back of the concrete face. The resulting holes shall be completely filled with concrete.

Where water is not encountered, sheeting may be placed at plan dimension of footing and used as forms for footing concrete. This sheeting shall be left in place at least to top of footing or shall be properly separated from the footing concrete so that it may be removed without damage to the concrete.

Where water is encountered and cofferdams are necessary, they shall be practically watertight before any excavation is made below water level. Provisions shall be made outside the footing or trench to drain, collect and remove water. When concrete is being placed, the excavation shall be kept dewatered until concrete is above prevailing water level. Footing concrete shall be effectively protected from erosion. If a concrete seal is used to stop the flow upward from the bottom of a cofferdam, it shall be placed below the planned footing and it shall be considered as a part of the cofferdam. No concrete yardage will be allowed for a seal unless it is specifically called for on the plans.

**503.04 Protection of Excavation**. The sides of all excavations shall be cut so as to prevent caving or the excavation shall be protected from caving and the material below the bottom of footings shall not be disturbed. Blasting shall be done

in a manner that will avoid damage to the material which supports the structure vertically or laterally and subsequent slides that will damage the structure, road or adjacent property. Blasting shall conform to Section 203.04(c). Where the material below the bottom of footings not supported by piles has been disturbed, it shall be removed and the entire space filled with concrete at the Contractor's expense. Under footings supported on piles, the over-excavated or disturbed volumes shall be replaced and compacted as directed. If backfilling is necessary to correct caving or slides, it shall be according to 503.10.

All excavation adjacent to railroad tracks shall be subject to the supervision of the involved railway company. Sufficient bracing shall be provided to insure the proper support of roadbed and tracks.

**503.05 Footings in Rock.** Where rock or shale excavation is a separate pay item, the portion of the excavation into rock or shale below the top of footing shall be filled with concrete. Where rock or shale is removed as part of unclassified excavation, and the footing is designed to be keyed into the bedrock, the excavation into bedrock the minimum specified depth of keying shall be confined within the area bounded by the outer edge of the footing. Excavation outside these limits and within and below the keyed depth shall be filled with concrete.

**503.06 Approval of Foundations**. The Contractor shall notify the Engineer when the excavation will be completed to the depth shown on the plans, and no footings shall be placed until the Engineer has approved the subfoundation.

**503.07 Culvert Foundations**. Box culverts may be placed directly on solid rock, if rock exists for the full length of the culvert; but boulders, unstable material, and rock over a portion of the length shall be removed and replaced with suitable compacted material for a depth determined by the Engineer, but in no case less than 6 inches below the bottom of the culvert. Rock and boulders shall be removed for a width sufficient for placing and proper compaction of the backfill. Unstable material shall be removed on each side of the culvert for a width generally equal to the span of the culvert, but not less than 2 feet. Payment for this work shall be made according to 503.08.

**503.08** Additional Excavation. The elevations shown on the plans for the bottoms of footings shall be considered as approximate. When excavation below plan elevation for footings is required, the 3 feet immediately below the plan elevation within the lateral limits defined by 503.11 (3) shall be paid for at the unit price bid for the class of excavation.

Where cofferdams are a separate pay item, the lump sum price shall be considered as including any extra cost involved for cofferdams for additional depth up to 3 feet below plan elevation. Excavation deeper than 3 feet below plan elevation and the additional cofferdams necessitated by this excavation may be provided for as extra work, as described in 109.04.

**503.09** Disposal of Excavated Material. Excavated material shall be disposed of in accordance with 202.03. Other suitable excavation material shall be used for backfill. Material which is not needed or not suitable for backfill shall be disposed of in accordance with 203.05.

**503.10 Backfill**. Backfill under this item shall be considered as all replaced excavation and new embankment adjacent to structures. Backfill shall be of materials meeting the requirements of 203.08, and shall be constructed according to 203 except as modified in this section.

No backfill shall be placed against any structural elements until they have been approved by the Engineer.

Soil backfill in bridge abutment areas and around culverts shall be compacted according to 203.12. Elsewhere, the required compaction of soil shall be 95 percent of the maximum laboratory dry weight.

Backfill in front of abutments and around piers shall be carried to ground lines shown on the plans.

All structural foundation units shall be backfilled as soon as practicable after the required conditions of 503.10 are met to avoid the ponding of surface water and the accumulation of debris. Backfill in front of abutments, piers, wing walls and retaining walls shall be made simultaneously with the backfill behind them.

Backfill against a waterproofed surface shall be placed carefully to avoid damage to the waterproofing material.

Mechanical tampers or approved compactors shall be used to compact all backfill and embankment within four feet of each side of a culvert, and heavy compaction equipment shall not be operated in this area or over the culvert until it is covered to the greater depth of 2 feet or one-fourth the span of the culvert with compacted fill. The backfill shall be placed in 4 inch lifts (loose depth). For multiple span culverts the span shall be assumed to be the longer individual span.

Lightweight dozers and graders may be operated over culverts having 1 foot of compacted cover, but heavy earth moving equipment shall require 2 feet of cover. Any

additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the City.

If the Contractor elects to construct an embankment in accordance with 203 before placing the culvert, the additional excavation and backfill shall be performed at no cost to the City.

**503.11 Method of Measurement**. After the requirements of 201, 202 and 203 have been met, the cubic yards of excavation shall be measured as a solid:

(1) Bounded on the bottom, by the bottom plane of the footing, crossbeam, or wall.

(2) Bounded on the top:

- (a) In cut sections, by the surface of the remaining ground.
- (b) In fill sections:

Where excavation is performed prior to embankment, by the surface of the original ground. Where excavation is performed after embankment, by the surface of the embankment.

- (3) Bounded on the sides:
  - (a) For unclassified excavation, 1 foot outside the outer edge of the footing, crossbeam, or wall.
  - (b) For rock or shale excavation when "rock excavation" is a contract item, by the outer edge of the footing or wall.
  - (c) For rock or shale excavation when the rock or shale is removed as part of unclassified excavation including rock or shale, above the minimum specified depth of keying the same as (a) above; for the remainder of the excavation, the same as (b) above.
  - (d) For unstable material under culverts, the limits of removal as specified.

Abutment excavation quantities include removal of material above the bench (if any), in front of the vertical plane described in (3) (a) above, and by the finished slope of the cut or embankment.

For keys below footings, the number of cubic yards shall be the volume of key as shown on the plans.

Culvert excavation and backfill between the surface of the original ground, the flow line of the culvert, and 1:1 slopes from the outer face of the culvert shall be included with 203 quantities. The remaining culvert excavation and backfill shall be governed by this item.

**503.12 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
503	Lump Sum	Cofferdams, cribs and sheeting

### 504.01

503 Cubic Yard Unclassified excavation	
503 Cubic Yard Unclassified excavation including rock	
503 Cubic Yard Unclassified excavation including shale	
503 Cubic Yard Unclassified excavation including rock an	d/or shale
503 Cubic Yard Rock excavation	
503 Cubic Yard Shale excavation	

Unless cofferdams, cribs and sheeting are separately itemized, they are included with the contract unit price for excavation.

## **ITEM 504 SHEET PILING**

504.01 Description
504.02 Materials
504.03 Driving
504.04 Method of Measurement
504.05 Basis of Payment

**504.01 Description**. This item shall consist of furnishing and driving steel or wood sheet piling to be left in place, or temporary steel or wood sheet piling driven and subsequently removed, including the furnishing and installing of all necessary anchors, braces, walers, headers or other attachments to structures.

**504.02** Materials. Sheet piling shall conform to the requirements of 711.03 or 711.26. Used steel sheet piling in good condition which meets project requirements may be used if inspected and approved by the Engineer.

**504.03 Driving**. Sheet piling left in place shall be driven to the penetration or tip elevation called for on the plans, or as directed by the Engineer. Temporary sheet piling, when specified, shall be driven to the depth or penetration as deemed necessary by the contractor for the protection of the work.

**504.04 Method of Measurement**. The quantity of sheet piling left in place shall be the number of square feet complete in place measured in the plane of the face of the sheeting bounded by A-1, B-1 and C as follows:

- (A) Bounded on the top:
  - (1) By the elevations or dimensions shown on the plan or ordered or approved by the Engineer.
  - (2) When specified for protection of the work by a line 2 feet below proposed finish grade if not under pavement, or 2 feet below bottom of proposed or existing pavement.
- (B) Bounded on the bottom:

- (1) By the elevations, dimensions or penetration shown on the plan or ordered or approved by the Engineer.
- (2) By the elevation of the bottom of the trench or excavation.
- (C) Length shall be the actual length installed or as shown on the plan, whichever is less.

The quantity of Temporary sheet piling shall be the number of square feet, installed and removed, measured in the plane of the face of the sheeting bounded by A-2, B-2 and C above. The quantity of temporary sheet piling below the bottom of the trench or excavation will not be measured for payment.

When temporary sheet piling is not a separate pay item the work shall be performed but the cost thereof shall be included in the item requiring the sheet piling.

If two sets of sheet piling are used on one wall no payment shall be made for the overlap.

**504.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
504	Square Foot	Steel sheet piling left in place (minimum section modulus ofin. <sup>3</sup> per foot of wall)
504	Square Foot	Temporary sheet piling
504	Square Foot	Wood sheet piling left in place

# **ITEM 505 TEST PILE**

505.01 Description505.02 Materials505.03 General Procedure505.04 Basis of Payment

**505.01 Description**. This item shall consist of furnishing and driving a test pile at a structure to obtain information for the Contractor's use in determining the approximate length of piles necessary to meet the requirements for specified bearing capacity.

This item shall include moving the pile driving equipment to and from the site.

**505.02** Materials. The test pile shall be of the type and size specified by the plans for the bearing piles.

**505.03 General Procedure**. The test pile shall be driven in accordance with the provisions of 507, and if practicable it shall be driven at a location which will permit it to be used as a bearing pile. if it is not used as a bearing pile, it shall be cut off or removed at the option of the Contractor.

If cut off, it shall be at least 3 feet below the finished ground line or 2 feet below the bottom of footing.

Any pile driven subsequently to the test pile for the purpose of determining the probable lengths of bearing piles shall be driven as a bearing pile and will be paid for at the contract unit price bid per linear foot for Item 507.

**505.04 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
505	Lump Sum	Test pile

# **ITEM 506 STATIC LOAD TEST**

506.01	Description
506.02	General
506.03	Application of Load
506.04	<b>Basis of Payment</b>

**506.01 Description**. This item shall consist of the application of a test load to a driven pile and the furnishing of instruments and facilities for obtaining load-settlement data of the pile.

**506.02** General. The use of the first pile load test and its location shall be determined by the Engineer. One or more subsequent test loads, if provided in the proposal, shall be applied if and where directed by the Engineer.

The hammer selected for driving the test loaded pile shall be used for driving all piles represented by the load test pile. If the Contractor subsequently finds it necessary to use a different size and type of hammer, the Engineer will determine if an additional test load is necessary; any such additional test load shall be completed at no additional cost to the City.

When anchor piles are used in the test procedures, they shall be located not closer than 4 feet center to center from the load test pile. If possible, the anchor piles should be parallel to the axis of the load test pile. Battered piles may be used as anchor piles provided the horizontal forces in the anchor system are balanced and primary bending stresses are not induced in the piles by the test load. Bearing piles meeting these requirements may be used as anchor piles. After the test has been completed, anchor piles other than bearing piles shall be removed or cut off at least 2 feet below the bottom of the footing or 3 feet below the finished surface of the ground.

The Contractor shall furnish dependable gages and devices for determining the load applied. He shall also furnish the Engineer with a recent verification of the calibration of the gages or devices by a reliable agency equipped to do the testing.

The Contractor shall supply adequate facilities for making load and settlement readings 24 hours per day.

The tested pile shall be substantially vertical and the load should be applied to the pile at a point as near the ground surface as possible to avoid column buckling of the pile.

If a cast-in-place reinforced concrete pile is to be tested and the shell provides all the steel required by 507.06, the shell shall be tested without concrete filling, unless otherwise directed by the Engineer. The test-loading will not be considered satisfactory if the pile fails internally during the test-loading due to improper installation or procedure by the Contractor.

**506.03** Application of Load. The load shall be applied not earlier than 72 hours after both the pile to be tested and the anchor piles have been driven.

The test load shall be concentrically applied by such a method that the test load acting on the pile at any time may be definitely determined and controlled.

The initial loading shall be approximately 4/5 of the capacity R determined according to the pertinent capacity formula in 507.05 or as directed. Subsequent loading shall be increments approximately 1/5 R, and the first of these increments shall be applied 1 hour after all measurable settlement due to the initial loading has ceased. The second such increment shall be applied 2 hours after the measurable settlement due to the first increment has ceased. Subsequent load increments shall be applied after measurable settlement due to the previous increment has ceased and after a time lapse in hours corresponding to the sequence number of the load increment. "Measurable settlement," is defined as 0.01 inch or more in a 20 minute time interval.

All settlement readings will be recorded by the Engineer or as noted on the plans.

The application of load will be considered complete when the "yield point" is reached. The "yield point" is defined as where the additional amount of settlement exceeds 0.02 inch per ton for the load increment applied.

If the yield point is reached before the total applied load exceeds 3 times the plan design load, an additional increment of load shall be applied to assure that the failure has been established. If the amount of settlement per increment is repeated or increased, the application of load will be considered completed, but if not, the application of load increments will be continued until the yield point is reached or until a total load of 4 times the plan design load is applied. The safe bearing value Q shall be considered as 50 percent of the yield capacity.

When the yield point has not been reached after the last required increment of load has been applied, the application of the total load shall be continued for not less than 1 hour after all measurable settlement has ceased.

All instrumentation shall remain in place for three hours after the pile is unloaded in order to obtain settlement recovery measurements.

If it is necessary to remove and reapply the load, it shall be reapplied utilizing the same procedures used to apply the initial loads except that the load increments shall be applied 15 minutes after all measurable settlement has ceased.

**506.04 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
506	Lump Sum	Static load test
506	Each	Subsequent static load test

## **ITEM 507 BEARING PILES**

- 507.01 Description
- 507.02 General
- 507.03 Materials
- 507.04 Driving of Piles
- 507.05 Determination of Capacity
- 507.06 Cast-in-Place Reinforced Concrete Piles
- 507.07 Steel Piles
- 507.08 Timber Piles
- 507.09 Splices
- 507.10 Defective Piles
- 507.11 Painting of Piles
- 507.12 Prebored Holes
- 507.13 Method of Measurement
- 507.14 Basis of Payment

**507.01 Description**. This item shall consist of furnishing and driving bearing piles of the type and size specified. The piles shall be driven at the locations and to the elevations shown on the plans or as otherwise approved by the Engineer.

**507.02** General. The Contractor shall be responsible for the selection of the piles and the pile lengths which will meet all requirements of the plans and specifications. Estimated pile lengths shown on the plans are approximate, having been determined from the subsurface investigation.

Concrete (Class C)	511
Reinforcing steel	509
Chemical admixture for concrete	705.12, Type F
Steel piles	711.01 or 711.03
Timber	
Steel pile points	711.01 or 711.07
Prime paint	
Finish paint	

507.03 Materials. Materials shall conform to the following:

**507.04 Driving of Piles**. The piles shall be driven until they have at least the bearing capacity called for on the plans. The bearing capacity furnished should preferably not exceed the required capacity by more than 15 percent unless a greater capacity is attained in meeting the requirement for minimum penetration.

The penetration of each pile generally shall be at least 80 percent of the penetration as determined from the estimated average length indicated on the plans. If it appears that appreciable overdriving will be necessary to attain this minimum length of penetration, this situation shall be promptly reported to the Engineer. In such cases, the final penetration, driving requirements, right of substitution of another pile type for the specified type, and the use of prebored holes will be determined by the Engineer after further study of the conditions. Any additional costs due to such adjustments shall be borne by the Contractor.

If embankment material makes it difficult to obtain adequate penetration for the abutment piles, the use of prebored holes at the Contractor's expense will be permitted.

All piles raised during the process of driving adjacent piles shall be driven down again.

The size or type of hammer shall be selected to suit the conditions that will be encountered and shall be submitted to the Engineer for approval prior to use. If the size of hammer used is found to be unsatisfactory, corrective measures shall be used as required to produce satisfactory results. When a pile test load is performed, the provisions of the second paragraph of 506.02 shall apply.

### 507.05

The energy of the hammer shall not be less than 7000 foot-pounds per blow. The ram of the steam, air-operated or diesel hammer shall weigh not less than 1500 pounds.

The ram of a drop hammer shall have a minimum weight of 3000 pounds, except for driving temporary piles a 2000 pound minimum weight is acceptable provided that the constant used in the capacity formula of 507.05 is 0.5 instead of 0.3 as indicated. The height of fall for drop hammers shall not exceed 7 feet.

When the outside rows of bearing piles are not driven accurately, the size of the footing shall, if necessary, be increased at the Contractor's expense so that the minimum thickness of concrete between any pile and the edge of the footing will be at least 75 percent of that shown on the plan.

Driving leads shall be used and shall be securely anchored. A cap device with sliding jaws shall be used to engage the leads to guide the pile and maintain its alignment with the stroke of the hammer. The travel of the hammer shall be accurately aligned with the axis of the pile.

The cap shall be adequately cushioned to avoid damage from driving to the top of the pile. The cap and pile top shall be shaped to distribute the hammer blow uniformly to the top surface of the pile.

A follower shall not be used without the permission of the Engineer, but when approved for use, an allowance shall be made for the increased energy loss.

When a pile test load is required, piles other than the load test pile and anchor piles shall not be driven until after the test loading has been completed and the required depth of penetration has been determined.

Water jets shall not be used without the permission of the Engineer. When water jets are authorized, the number and placement of the jets, the volume and pressure of the water, the depth of penetration without jetting, and any other factor that has a significant effect on the bearing capacity of the driven pile will be subject to such authorization.

Piles which become damaged during driving shall be replaced or repaired before driving is continued.

After being driven, the piles shall be cut off at the elevation and angle specified on the plans.

**507.05 Determination of Capacity**. The bearing capacity (R) of a driven pile (considered as a single isolated pile) shall be determined by means of the following capacity formula, unless this formula is modified as a result of a test load:

For a drop hammer: R = 2DWH

For a single-acting, differential-acting or double-acting steam (or air-operated) hammer, or a diesel hammer:

$$R = \frac{2DF}{S+0.1} \qquad B = \frac{12}{\frac{2DF}{R} - 0.1}$$

In which:

- R = Safe bearing value, in pounds (corresponding with the design load capacity per pile called for on the plans). The above formulas contain a safety factor of 2. The piles will be driven to a yield capacity that is two times the design load capacity. When a 506 or 523 test is performed, the yield load capacity that is found will be divided by 2 to determine the design load capacity.
- $D^2 = \frac{(1 UG)^2}{1 + G^2}$  (applies only in case of battered piles)
- B = Blows per foot
- W = Weight of striking parts of hammer, in pounds
- H = Height of fall of striking parts, in feet
- F = WH for single-acting steam hammer, in ft-lbs.
- F = Approved rated energy of hammer for a differential- acting or double-acting steam or air-operated hammer, or a diesel hammer, in ft-lbs.
- S = Penetration, in inches per blow (generally determined from the rate of penetration for the last several inches of penetration)
- U = Coefficient of friction, which is estimated at 0.05 for double acting, differential-acting and diesel, 0.1 for single-acting, and 0.2 for drop hammers.
- G = Rate of batter (1/3, 1/4, etc.)
- Q = Safe bearing capacity as determined by test load in pounds (1/2 the yield capacity).

When pile driving is resumed after an interruption and the rate of penetration is appreciably less than before the interruption, the value of "S" shall not be considered satisfactory for use in the capacity formula until after several feet of
penetration. When driving has been interrupted for an appreciable length of time, the required additional length of penetration after driving is resumed shall preferably be determined from the penetration of adjacent piles for which no such interruption occurred.

If the bearing capacity of a driven pile is checked by test-loading according to 506 or 523 and is found to be different than the formula capacity, the formula shall be multiplied by the ratio Q/R. The formula thus modified shall then be used for determining the bearing capacity of the bearing piles of the same type and size which penetrate for nearly the same depth into substantially the same kind of soils. Further formula adjustment may be necessary if pile driving conditions change from those which were found at the test pile.

**507.06** Cast-in-Place Reinforced Concrete Piles. Cast-in- place reinforced concrete piles shall conform to one of the types described below. The diameter shall be measured as follows:

- (a) Plain cylindrical casing, the outside diameter.
- (b) Cylindrical casings with vertical fluting, the diameter of a circle circumscribing the outermost points or ridges.
- (c) Cylindrical casing with circumferential corrugations, the average of the outside diameters measured at the bottom and top of the corrugations or continuously welded helical corrugations with diameters measured at tops of the corrugations.
- (d) Tapered piles, the top diameter as determined in (a), (b), or (c), but the point shall not be less than 8 inches.
- (e) Step-tapered piles, the top diameter as determined by (a), (b), or (c) and the diameter of any section shall be not less than that of a pile tapered uniformly from 8 inches diameter at point to the top.

Pile casings described in (1) or (2) below shall be water tight after being driven and shall have shoes or points which do not project more than 1/4 inch outside the vertical surface of the casing.

(1) Cast-in-place reinforced concrete piles having casings that remain in the ground, but which are not designed to resist axial and bending stresses, shall have vertical and lateral reinforcing steel as follows:

(a) When the piles are in an embankment or within the embankment height distance from the toe of the slope, the amount of longitudinal (vertical) reinforcement for the upper segment shall be determined from the formula:

$$A = 0.05d (1+.04L)$$

In which A = minimum cross-sectional area, in square inches of steel required.

- L = length of pile in feet (based on the expected length as per test pile).
- d = diameter in inches as called for on the plans.

The reinforcement specified for the upper segment of the pile shall extend not less than 10 feet below the existing or finished ground surface, whichever is lower, except that the reinforced portion shall never be less than one half the pile length. The lower half or remainder of the pile shall have not less than one-half the formula amount.

The longitudinal steel shall be uniformly spaced around the perimeter and not less than 4 nor more than 8 bars of equal size shall be used.

Lateral reinforcing, consisting of hoops or spirals, shall surround the vertical reinforcement. The total weight of lateral steel shall be not less than one-fourth the required weight of longitudinal steel and it shall be uniformly spaced along the pile not farther apart than the top diameter. The lateral steel shall be securely fastened to the vertical bars and shall be placed and secured to maintain a clear distance of between 1-3/4 and 2 inches from the surface of the concrete.

(b) When the piles are not in an embankment, or not within the embankment height distance from the toe of the slope, only the upper segment shall be reinforced and the amount shall be as specified in (a).

(2) Cast-in-place piles having casings that remain in the ground and which are designed to resist axial and bending stresses shall have a net cross-sectional area of metal equal to or greater than "A" according to the above formula. The cross-sectional area of the casing shall be determined at the one-fourth point nearest the butt and 1/16 inch of wall thickness shall be deducted for anticipated corrosion loss. Any deficiency in area shall be supplied as longitudinal and lateral reinforcing which shall be placed as directed in (1) above.

The Contractor shall have available a suitable light for the inspection of the interior of a driven casing for its entire length.

The tops of driven casings shall be covered until the concrete is placed. Any accumulated water or other foreign matter in a driven casing shall be removed before placing the concrete. No concrete shall be placed until all piles within a radius of 15 feet have been driven, or the driving within a 15 foot radius shall be discontinued until the concrete has been placed and has set at least seven days. Concrete for cast-in- place piles need not be vibrated, but care shall be taken in placing concrete to prevent the formation of voids. Concrete for cast-in-place piles shall contain a superplasticizing admixture meeting the requirements of 705.12, Type F. After the superplasticizer has been added the slump range shall be 6 to 8 inches.

**507.07 Steel Piles**. Steel piles will consist of structural steel shapes of the kind and size specified.

**507.08 Timber Piles**. Timber piles shall be of sufficient length to permit the removal of broomed or split portions caused by driving, and they shall be symmetrically trimmed to a right truncated cone at the tip. When steel shoes or points are specified, the tip of the pile shall be carefully shaped so that the steel shoe or point will fit snugly and symmetrically.

Timber piles shall be handled and stored in a manner as to avoid warping.

When creosoted piles are specified, they shall comply with 521.03 and 712.06.

**507.09** Splices. Splices in steel casings and structural shapes shall be avoided to the fullest practicable extent, especially where exposed to view. Splices in timber piles will not be permitted.

Pile casings and structural shapes may be spliced to obtain the required length either before driving or after a segment has been driven, but if the latter procedure is used, the splice shall be made at least three feet above the ground to permit observation of the splice while subject to the forces of driving. The segments shall be aligned to make the axes of all segments common.

Structural shapes shall be spliced by butt welds made in accordance with 513.17, except that temporary extension bars are not required. If a steel casing is to remain in the ground and is to be considered as pile reinforcement, the section shall be spliced by welding in a manner that will provide sufficient strength to conform with reinforcing requirements.

**507.10 Defective Piles.** A pile will be considered defective if it is damaged to an extent that the strength of its section is reduced by more than 20 percent, or if its location differs from the specified location by more than the top diameter for piles that will be entirely underground or by more than one-fourth the top diameter for piles which project above the ground. Piles which project above the ground will also be considered defective if the top cannot be drawn to the specified location.

Defective piles shall be replaced or if practicable they shall be either repaired or a substitute pile shall be driven beside the damaged one. The off-location limits do not apply to the substitute pile.

If a defective pile is withdrawn, the hole remaining in the ground shall be filled with sand. If a defective pile is left in place under a footing and a replacement is driven beside it, the defective pile shall be cut off slightly above the bottom of the footing. A defective pile that is left in place but not under a footing, shall be cut off at least 3 feet below ground level. Defective casings left in place shall be completely filled with concrete. **507.11 Painting of Piles**. The exposed portion of steel piles and casing of cast-in-place concrete piles shall be thoroughly cleaned and painted with two prime coats and one finish coat applied according to 514.

**507.12 Prebored Holes**. Prebored holes shall be as shown on the plans. The diameter of auger may vary as follows: (1) for round piles, from 2 inches less to 4 inches more than the diameter of piles, (2) for steel H-piles, from 6 inches less to 2 inches more than the diagonal dimension of piles, but shall be such as to produce satisfactory pile driving results.

Voids between the pile and the prebored material shall be backfilled with granular material satisfactory to the Engineer.

**507.13** Method of Measurement. The total length of all non-defective bearing piles accepted for payment shall be the lengths in feet measured along the axis of each pile from the bottom of each pile to the elevation of cutoff. Steel points (or shoes) shall not be included with the measured length of piles for payment.

If the test pile is used as a bearing pile payment will be made according to 505, lump sum only.

The length of prebored holes shall be measured in feet from the surface of ground at the time of boring to the bottom of the hole.

**507.14 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	Description
507	Linear Foot	Steel piles, HP x
507	Linear Foot	inch Cast-in-place reinforced concrete piles
507	Linear Foot	Timber piles, creosoted
507	Linear Foot	Timber piles, untreated
507	Linear Foot	Prebored holes
507	Each	Steel shoes (or points)

# **ITEM 508 FALSEWORK AND FORMS**

508.01 Description 508.02 Forms 508.03 Oiling Forms 508.04 Payment

**508.01 Description.** Falsework shall be substantial and rigid and shall not unduly obstruct any waterway, highway or railway. Intermediate supports shall be

#### 508.01

arranged to produce in the completed structure the camber necessary for conformance with the plan profile of the roadway. The maximum deflection "d", in inches, in the longitudinal falsework members at the edges of the concrete deck shall not exceed 1/2 inch or the amount obtained by the following formula, whichever is greater.

d = (S+100) / 1000, in which S is the distance between supports in inches.

For transverse falsework members, and for longitudinal falsework members other than those near the edges of the deck, the permissible deflection obtained from the above formula may be increased 75 percent. If unusual requirements for spanning an existing road or channel or restrictions due to vertical clearance exist, a falsework with an excessive deflection may be approved by the Engineer.

Camber shall be built into the falsework to compensate for falsework deflection, dead load deflection, and deck surface profile.

The Contractor shall remove and replace, at his own expense, any part of the structure made unsatisfactory by settlement or form deformation.

Falsework for arches shall be so constructed that it may be released gradually.

Falsework construction shall be removed before final acceptance of the structure. Falsework piling shall be cut off or pulled. If piles are cut off, they shall be cut at least 3 feet below the slope line, riprap line or bed of stream.

For all bridges over 20 foot span whose main supporting members are cast-in-place concrete, falsework plans must be submitted and approved according to 501.06.

When a thickened edge is shown on the plans, it may be developed by sloping the bottom of the slab for a minimum of 9 feet from the edge, in lieu of the section shown. This modification is at the Contractor's option and additional concrete required shall be furnished at no cost to the City.

Falsework for structures shall remain in place until the concrete has met the requirements of 511.14.

Spandrel walls, decks or arches, sidewalks and curbs, or any superimposed concrete to be completed after the main supporting member or the deck is constructed shall not be placed until the falsework for the main supporting member has been removed or released.

For continuous concrete slab or beam superstructures, the concrete shall not be placed on any span until the falsework and forms are complete for the adjacent spans. The falsework shall not be released or removed from any span until the concrete in adjacent spans has been placed a sufficient length of time to meet all requirements for the removal of falsework as set forth above.

**508.02** Forms. All concrete shall be placed in proper forms. The use of the unprotected side of the excavation, instead of forms, will not be permitted, except as indicated in 503.05 for rock or hard shale excavation. For dry excavation described under 503.03, the sheeting may be used as forms for footings.

The forms shall be substantial, unyielding and mortar tight, and shall be so designed that the finished concrete will conform to the proper dimensions and contours. Forms for exposed surfaces shall be made of approved material requiring a minimum number of joints or dressed lumber of uniform thickness using a form liner of an approved type. Forms and form liners are to be used in a manner to reduce to a minimum the joints showing on the finished surface. Joints shall be arranged to coincide with any rustication grooves shown on the plans. Forms shall be properly braced or tied together with approved form ties so arranged that when forms are removed, no metal will be within 2 inches of an exposed surface of the finished structure. An approved insert shall be used in connection with all ties in the region of exposed surfaces. No material except metal, and precast mortar blocks placed in accordance with 509.09, shall be permitted to remain in the concrete.

For concrete decks separated by an open median, the falsework and forms for each deck shall be independent of the adjacent structure.

Temporary openings shall be provided at the base of column and wall forms and in the bottom of all narrow, deep members where necessary to facilitate cleaning or inspection immediately before depositing concrete.

All exposed edges shall be beveled 3/4 inch with a triangular strip built into the forms.

Where rustication is used, the molding shall be fastened to the forms in such a manner that the molding will remain in the concrete when the forms are removed. Molding for rustication shall be surfaced on all sides. This molding shall not be removed until the concrete has set sufficiently so that the edges of the concrete will not be damaged.

If weep holes through abutments or retaining walls are called for on the plans or are required to provide outlets for backfill drainage, they shall be formed in such a manner as to obtain a smooth circular opening and straight gradient through the wall. They shall be not less than 3 nor more than 4 inches in diameter, with a gradient of 1 inch per foot, spaced not closer than 6 foot nor more than 10 foot centers and placed so that the bottom of weep holes, at face of wall, is approximately 6 inches above ground line or low water elevation. **508.03 Oiling Forms**. The inside of forms shall be coated with non-staining mineral oil or other approved material, prior to placing the reinforcing steel.

**508.04 Payment**. Falsework and forms will not be paid for separately, but their cost shall be included for payment in the price bid for the item for which they are used.

# **ITEM 509 REINFORCING STEEL**

509.01 Description
509.02 Materials
509.03 Care of Materials
509.04 Method of Placing
509.05 Bending
509.06 Shop Assembled Units
509.07 Approval of Placing
509.08 Splicing
509.09 Supports
509.10 Method of Measurement
509.11 Basis of Payment

**509.01 Description**. This item shall consist of furnishing and placing in concrete, reinforcing steel of the quality, type, size and quantity designated, including steel dowels.

**509.02** Materials. Reinforcing steel shall be deformed bars conforming to 709.01, 709.03, or 709.05. Spiral reinforcing steel shall conform to 709.01 or 709.08. Bar mats and wire fabric shall conform to 709.09, 709.10 or 709.12. Epoxy coated reinforcing steel shall conform to 709.13.

**509.03 Care of Materials**. All reinforcing steel when received on the work, prior to its use shall be stacked off the ground and shall be kept free from dirt, oil, grease, or avoidable rust. When placed in the concrete, it shall be clean and free from loose rust. All epoxy coated bars shall be handled per ASTM A775.

**509.04 Method of Placing**. Reinforcing steel shall be placed in the position shown on the plans and shall be securely held in this position during the concreting operation. At the Contractor's option, a portion not to exceed 25 percent of the upper longitudinal bars in a bridge deck slab may be placed beneath the upper transverse bars for support of the top mat. In no case shall reinforcing steel be driven or forced into the concrete after it has taken its initial set.

Welding on main reinforcing is prohibited. Fabrication of reinforcing bar cages for prestressed beams is permitted when done in a manner satisfactory to the Engineer.

The clearance between the reinforcing steel and the surface of the concrete shall be not less than:

- (a) 2-1/2 inches at the top surfaces of cast-in-place deck slabs and sidewalks.
- (b) 3 inches at the faces of footings placed against rock or earth rather than forms.
- (c) 1 inch at the bottom surface of a cast-in-place deck slab
- (d) 2 inches at all other surfaces
- (e) or as specified on the plan.

For epoxy coated reinforcing bars, plastic coated or epoxy coated bar supports and tie wires shall be employed to protect the coating from physical damage during placement and to prevent electrical coupling between mats.

Bars shall be carefully handled and installed so that patching at the job site will be kept to a minimum. It is not expected that the coated bars, when in final position ready for concrete placement, will be completely free of damaged areas. However, numerous nicks and scrapes which expose the steel will not be allowed, regardless of the stage when they occur subsequent to coating in the plant. All damage defined as significant damage shall be patched. At the discretion of the Engineer, numerous areas of damage not defined as significant damage shall also be patched. The latter type of patching can be avoided by careful observance of the requirements of Section 509.03.

Significant damage is defined as any opening in the coating which exposes the steel and which exceeds the following sizes:

An area of 0.05 square inch (approximately 1/4" square or 1/4" diameter or equivalent).

An area of 0.012 square inch (approximately 1/8" square or 1/8" diameter) if the opening is within 1/4" of another opening of the same or larger size.

6 inches in length, regardless of area.

An aggregate area of 0.07 square inch in any one foot length. For example, three areas each 3/16" diameter equals 0.08 square inch would require patching.

Where repair is required, the damaged areas shall be cleaned, repaired and adequate cure time allowed before placing concrete. The installation shall be considered approved when patching has been done as outlined above.

Where reinforcing bar cages for prestressed concrete beams are fabricated by tack welding, the areas damaged by the tack welding shall be patched as outlined above.

**509.05 Bending**. Reinforcing steel shall be carefully shaped to the pertinent dimensions shown on the plans and in the Standard Bends table. Reinforcing steel showing transverse cracks shall not be used.

	В	AR			Bend		Bend	135	• Stirrup Bend
Bar No.	Nom. Diam. In.	Area Sq. In.	Wgt. lb/LF	D	А	D	А	D	А
3	.375	0.11	0.376	2-1/4	5	2-1/4	6	1-1/2	5
4	.500	0.20	0.668	3	6	3	8	2	6-1/2
5	.625	0.31	1.043	3-3/4	7	3-3/4	10	2-1/2	8
6	.750	0.44	1.502	4-1/2	8	4-1/2	12	4-1/2	11
7	.875	0.60	2.044	5-1/4	10	5-1/4	14	5-1/4	12-1/2
8	1.000	0.79	2.670	6	11	6	16	6	14-1/2
9	1.128	1.00	3.400	9-1/2	15	9-1/2	19		
10	1.270	1.27	4.303	10-3/4	17	10-3/4	22		
11	1.410	1.56	5.313	12	19	12	24		
14	1.693	2.25	7.65	18-1/4	27	18-1/4	31		
18	2.257	4.00	13.60	24	36	24	41		

**STANDARD BENDS** 

# **Tolerances:**

For diameter of bends, "D", the tolerance is plus or minus the diameter of the bar.

For straight bars the tolerance is plus or minus one inch.

For out to out dimensions of bent bars the tolerance is plus or minus 1/2 inch for No. 7 bars or smaller and one inch plus or minus for No. 8 bars or larger.

For truss bars the tolerance for height is minus 1/2 inch, with no allowance for increased height.

No weight allowances will be made for tolerances.

**509.06** Shop Assembled Units. The use of unit frames or shop assembled reinforcing steel where practicable is recommended.

**509.07 Approval of Placing**. Reinforcing steel shall be in place and approved by the Engineer before any concrete is placed.

**509.08 Splicing**. Splices of reinforcement shall be made only as specified or determined by the Engineer.

Welded wire fabric shall be spliced by lapping 12".

Spiral reinforcement shall be spliced by lapping 1-1/2 turns. A material sample of spirals up to 30 inches long, if taken from an end of the spiral, need not be replaced. Welded wire fabric shall be spliced 12".

Number 14 and 18 bars shall be spliced with approved mechanical connectors. Mechanical connectors shall be capable of developing 125 percent of the yield strength of the bars connected.

Bars used to replace random samples shall be lapped as follows:

<u>Bar Size</u>	Lap Length
4	1'-4"
5	1'-8"
6	2'-0"
7	2'-6"
8	3'-3"
9	4'-2"
10	5'-3"
11	6'-5"

**509.09** Supports. Precast mortar blocks or metal supports, of adequate strength, of the proper depth and in sufficient number shall be used for supporting the bars in slabs, beams or girders. Where metal supports are used, the portion at and near the surface of the concrete shall be stainless steel, plastic tipped galvanized steel, or epoxy coated or plastic coated steel. Metal supports shall have a shape that is easily enveloped by the concrete.

If mortar blocks are used, they shall be made from the same materials and of the same proportions of sand and cement as that of the concrete in which they are to be embedded. They shall not be used where they will be exposed to view. They shall be cast and properly cured for at least seven days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to the reinforcing steel.

**509.10** Method of Measurement. The number of pounds of reinforcing steel shall be the actual number of pounds of the various sizes incorporated in the

#### 509.11

concrete as shown on the plans, completed and accepted. The number of pounds shall be determined from the number, length and weight of the bars as shown on the steel list of the plans, based on the weight per linear foot shown in the table, with deductions for bars not used and additions for extra bars used as directed by the Engineer. The weight of coated reinforcing steel shall be based on the weight of uncoated steel.

**509.11 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
509	Pound	Reinforcing steel
509	Pound	Epoxy coated reinforcing steel

Where epoxy coated reinforcing steel is specified for prestressed concrete members, the cost of epoxy coating shall be included with Item 515 for payment.

# **ITEM 510 DOWEL HOLES**

- 510.01 Description
- 510.02 Method of Construction

510.03 Basis of Payment

**510.01 Description.** This item shall consist of the drilling of holes into concrete or masonry and the furnishing and placing of grout into the holes. The furnishing and placing of steel for dowels is included with 509 Reinforcing Steel.

**510.02** Method of Construction. The holes shall be drilled at the location and to the depth shown on the plans and shall be approximately 1/2 inch larger in diameter than the dowel bars. The holes shall be partially filled with an approved non-shrink grout 701.11 and the bars shall be forced into the holes the specified depth, spreading the grout mortar around the bar and solidly filling the hole. The bar and the filler shall be held in place until the filler has taken its initial set.

**510.03 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
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# **ITEM 511 CONCRETE FOR STRUCTURES**

511.01 Description 511.02 Materials

- 511.03 Proportions
- 511.04 Concrete Test Specimens
- 511.05 High-Early-Strength Concrete
- 511.06 Mixing of Concrete
- 511.07 Slump
- 511.08 Placing Concrete
- 511.09 Construction Joints
- 511.10 Emergency
- 511.11 Depositing Concrete Under Water
- 511.12 Depositing, Protecting and Curing Concrete During Cold Weather
- 511.13 Removal of Forms
- 511.14 Curing and Loading
- 511.15 Surface Finish
- 511.16 Roadway Finish
- 511.17 Sidewalk Finish
- 511.18 ODOT Class HP Concrete Testing
- 511.19 Method of Measurement
- 511.20 Basis of Payment

**511.01 Description.** This item shall consist of furnishing and placing portland cement concrete in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions shown on the plans. Falsework and forms shall be in accordance with 508.

For prestressed concrete see 515.

**511.02 Materials.** Materials shall conform to 499.02 except as follows:

Aggregate; all concrete above the ground line in a given substructure unit or all concrete for any given superstructure shall be made of aggregates of the same kinds and colors, except upon the written permission of the Engineer. Gravel for coarse aggregate may only be used where specifically noted on the plans or with written permission of the Engineer.

Portland Cement; only one brand, grade or kind shall be used in any given substructure unit above the ground line or given superstructure except by written permission of the Engineer.

Curing materials; 705.05, 705.06 (White Opaque), 705.07 Type 1 or ID, or 705.08 Type I or II, Class 2.

Joint filler; 1/4 inch gray sponge 711.28, or preformed filler 705.03.

Seals; preformed elastomeric compression joints seals, 705.11.

Chemical admixture; 705.12 Type A, B, or D.

**511.03 Proportions.** Concrete for structures shall be proportioned according to 499.03, using Class C or Class S as specified.

The proportioning is based on developing a minimum compressive strength at 28 days of 4000 pounds per square inch for Class C and 4500 pounds per square inch for Class S concrete.

**511.04** Concrete Test Specimens. On structures over 20 foot span, test cylinders will be made from each 200 cubic yards, or fraction thereof, of concrete that is incorporated each day in the work. On structures of 20 foot span or less, cylinders will be made for each 50 cubic yards of concrete.

**511.05 High-Early-Strength Concrete.** The use of high- early-strength concrete shall be in accordance with 499.03. Curing and loading shall be in accordance with 511.14.

**511.06** Mixing of Concrete. Mixing shall be according to 499.06 except that the discharge time for placing superstructure concrete shall be limited to 60 minutes, after the combining of cement and water.

When mixed, all concrete shall have a temperature of not more than 90°F, and the concrete shall be maintained below this temperature until deposited in the work.

When an air temperature at  $60^{\circ}$ F or higher prevails at the time of placing concrete in a bridge superstructure (over 20 foot span), the Contractor shall add an approved chemical admixture (705.12 Type B or D) to the concrete.

**511.07 Slump.** Concrete shall have a slump such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel, but individual particles of coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand.

The slump of concrete shall be in accordance with 499.03. The slump shall be determined according to ASTM C 143.

**511.08 Placing Concrete.** Submit to the Engineer a description of proposed placing procedures and notify the Engineer at least 24 hours in advance of placing concrete.

Place superstructure concrete when the ambient air temperature is 85 °F (30 °C) or less and not predicted to go above 85 °F (30 °C) during the concrete placement; and when evaporation rates, determined according to Figure 1 in ACI 308, do not exceed the following:

Class	Evaporation Rate
S.	0.2 pound per square foot per hour $(1.0 \text{ kg/m}^2/\text{hour})$ .

Determine and document the ambient air temperature, concrete temperature, deck surface temperature, relative humidity, and wind velocity, subject to verification by the Engineer. Measure data required in Figure 1 from within 10 feet (3 m) of the area where the superstructure concrete is placed.

Figure 1 does not apply to substructure items and poured parapets. Figure 1 applies to slip-formed parapets.

To meet favorable atmospheric conditions, may require the Contractor to place concrete at night. At least 24 hours before placing concrete at night, submit a lighting plan for the work area to the Engineer. Obtain the Engineer's approval of the lighting plan before placing the concrete. Direct lights so that approaching traffic is not affected or distracted.

Before placing a concrete deck on continuous steel beams or girders, complete all of the main beam or girder splices at least two piers beyond the pier or piers supporting the concrete.

Before placing concrete for backwalls above the approach slab seat with steel expansion joints, backfill the abutments to within 2-foot (0.6 m) of the bridge seat elevation, place superstructure concrete in the adjacent span, and either erect structural steel or prestressed concrete beams. Use the steel expansion joint as a template for the top of the backwall. If temporary bolts are used to support the backwall portion of an expansion device during the placing of the backwall concrete, remove the bolts after the concrete has taken its initial set and before a change in temperature causes superstructure movement sufficient to damage the backwall.

Before placing concrete, assure the Engineer of an adequate and uniform source of supply of concrete to allow proper placing and finishing, and of the availability of coverings to protect the concrete from rain.

Do not add or apply water to the concrete after it has left the truck and before applying curing materials according to 511.14.

Before placing concrete, thoroughly clean all forms and structural steel that contact the concrete and ensure that the space to be occupied by the concrete is free of laitance, silt, dirt, shavings, sawdust, loose and built-up rust, and other debris.

Deposit concrete using methods that ensure reinforcing steel is completely enveloped in concrete mortar and that allow inspection of concrete enveloping the reinforcing steel. Use a method or device to convey the concrete from the mixer to the work that prevents coarse aggregate separating from the mortar. If depositing concrete in shallow members, such as slabs, place it with as short a vertical drop as possible. Place the concrete over a section to maintain a practically horizontal surface. If using a chute, slope the chute to allow concrete to flow without segregation. Place concrete as near as possible to its final position.

#### 511.08

Drop concrete into the forms with a free-fall distance of 5 feet (1.5 m) or less. As necessary, use drop chutes to limit the free fall to 5 feet (1.5 m) and to ensure the delivery ends as vertical as possible.

Place concrete in structures using vibration. Furnish and use sufficient vibration equipment of the type and size approved by the Engineer to properly compact the concrete immediately after it is placed in the forms. The vibrators shall generally be of a type that is applied directly to the concrete and have a frequency of at least 4500 impulses per minute. If the concrete is inaccessible for this method of vibration, apply the vibrators to the outside of the forms.

Do not move concrete using a vibrator. Vibrate freshly deposited concrete at the point deposited. Slowly insert and withdraw the vibrators vertically into the concrete until the concrete is thoroughly compacted but not segregated. During vibration, do not disturb partially hardened concrete.

As necessary, spade along form surfaces, in corners, and in locations impossible to reach with vibrators to ensure smooth surfaces and dense concrete. Closely observe the results obtained on the first concrete placed, and, if necessary, modify the mix according to this specifications to secure the best results.



**511.09** Construction Joints. When construction joints are shown on the plans, all concrete between consecutive joints shall be placed in a continuous operation. Concrete shall not be placed against the side of any joint for at least 12 hours, or as required by 511.14.

Approval of the Engineer must be obtained for placing any construction joint not shown on the plans or permitted by 511.08 and 511.16.

The planes on which a day's work is to terminate shall be predetermined before depositing of concrete begins. They shall in general be perpendicular to the lines of principal stress and in regions of small shear. Horizontal joints will not be permitted in concrete girders and beams. Slabs acting with concrete beams or girders shall be deposited continuously with them unless composite construction is specified.

All construction joints shall be made with bulkheads provided with keys which clear all exposed surfaces approximately one-third the thickness of the joint.

Horizontal joints in piers, abutments and retaining walls generally shall be avoided and when they are used, shall not be located within 2 feet of the normal water level.

Construction joints, not shown on the plans and above ordinary low water, in abutments and retaining walls that retain earth fills shall be waterproofed on the back with a 36 inch strip of Type B waterproofing according to 512 at the Contractor's expense.

Joints in cantilevered members shall not be permitted unless approved by the Engineer in writing.

Horizontal construction joints shall have the surface of the concrete below the joint dampened immediately prior to placing adjoining concrete.

Horizontal construction joints between bridge slabs and superimposed curbs, parapets, sidewalks and median strips, shall be placed and protected the same as the remainder of the slab. They shall be cured in accordance with 511.14. If method (b) is used, the membrane shall be removed prior to placing the concrete on the second side of the joint.

Care shall be exercised to avoid disturbing the bond of curb reinforcing steel protruding from the concrete. If the curb areas are used by workmen when placing the deck concrete, the reinforcing steel shall be tied and/or braced to prevent its movement.

Where walls or columns support slabs or beams, the concrete in the vertical member shall be deposited up to the bottom of the supported member and a period of at least 2 hours shall elapse for settlement before placing concrete in the horizontal member.

**511.10 Emergency.** When the work is unexpectedly interrupted by breakdowns, storms or other causes, and the concrete as placed would produce an improper construction joint, the Contractor shall rearrange the freshly deposited concrete, to provide a suitable construction joint. When such a joint occurs at a section on which there is shearing stress, he shall provide an adequate mechanical bond across the joint by forming a key, inserting reinforcing steel or by some other means satisfactory to the Engineer, which will prevent a plane of weakness.

**511.11 Depositing Concrete Under Water.** No concrete except for cofferdam seals shall be deposited under water, unless by special permission of the Engineer. If such permission is granted, care shall be exercised to prevent the formation of laitance. Concrete shall not be deposited until any laitance, which may have formed on concrete previously placed, has been removed. Pumping shall be discontinued while depositing foundation concrete if it results in a flow of water inside of forms. If concrete other than cofferdam seals is deposited under water, the proportion of cement used shall be increased at least 10 percent at no extra expense to the City, to compensate for losses due to water. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket or other approved method and shall not be disturbed after being deposited.

**511.12** Depositing, Protecting and Curing Concrete During Cold Weather. When an atmospheric temperature of 32°F or less exists at the time concrete is placed, or is predicted by weather forecasts to occur during the curing period, the following procedures shall apply.

The water or aggregate or both shall be heated as necessary to make the temperature of the concrete not less than  $50^{\circ}$ F or more than  $70^{\circ}$ F when placed.

Concrete shall not be placed in contact with materials having a temperature of less than 32°F. If necessary, the forms, reinforcing steel and foundation materials shall be heated before the concrete is placed.

The concrete shall be protected from freezing, and specified temperatures for curing shall be maintained by a heated enclosure, insulated forms or by either of these used in combination with flooding, except that insulation alone may not be used to protect and cure deck slabs less than 10 inches thick.

The concrete shall be cured by maintaining the surface temperature between  $50^{\circ}$ F and  $100^{\circ}$ F for a period of not less than five days except as modified below for concrete flooded with water. At the end of this curing period, the temperature shall be reduced at a rate not to exceed  $20^{\circ}$ F in 24 hours until it is within  $20^{\circ}$ F of atmospheric temperature.

Removal of falsework and opening to traffic shall be not earlier than specified by 511.14.

(a) When a heated enclosure is used. The enclosure and heating devices shall be as nearly complete before any concrete is placed as the placing will permit. Throughout the entire concreting operation, the completion of enclosures and the application of heat shall follow the placing of concrete as closely as possible.

Heat may be supplied by any method which will maintain the required temperature continuously with a reasonable degree of uniformity in all parts of the enclosure without discoloring the concrete. If dry heat, other than free steam, is used with method (a) curing, all exposed concrete shall be covered with two thicknesses of burlap as soon after placing the concrete as it can be done without marring the surface. The burlap shall be wetted and kept continuously wet and shall not be removed during the heating period, except as required for rubbing. Wood forms without liners, left in place more than two days after the placing of concrete, shall be thoroughly wet at least once each day for the remainder of the heating period. If forms are removed during the heating period, the concrete shall be thoroughly drenched with water and covered with burlap as noted above for the remainder of the heating period.

Enclosures shall be strong and wind proof, and provide adequate space to allow free circulation of air around the forms and deposited concrete.

An operator shall be in active charge 24 hours each day and adequate fire protection equipment shall be accessible at all times during the period of heating.

(b) When insulation is used. Sufficient recording thermometers shall be furnished and installed by the Contractor in such a manner that the surface temperature of the concrete may be readily determined. Whenever the surface temperature, as indicated by the thermometer readings, approaches 100°F, the forms or insulation shall be loosened or otherwise vented to keep the surface temperature within the specified limits. If the thermometer readings indicate that the minimum required temperature is not being maintained, the structure shall be promptly enclosed and heated as provided above or flooded as specified below.

The insulating material shall be wind and water resistant. Precautions shall be taken at edges and corners to insure that such points of extreme exposure are adequately protected. The top surface of the concrete shall be protected by a tarpaulin, or other approved waterproof cover, placed over the insulation.

(c) When the concrete is to be flooded with water. The concrete may be flooded as soon as it can be done without damaging it. Flooding water shall be heated to a temperature of not less than 50°F nor more than 100°F. The heated flood water may be discontinued after 48 hours if the concrete remains flooded to a depth of 1 foot above its highest elevation for at least the subsequent 120 hour period.

**511.13 Removal of Forms.** In order to facilitate finishing, forms on vertical surfaces which are to receive a rubbed surface finish shall be removed as soon as the concrete has hardened sufficiently that it will not be damaged.

**511.14 Curing and Loading.** Concrete for structures shall be cured, have the falsework removed, and be opened to traffic in not less time than is specified by the following table:

Curing	Any	7
Removing	Over 10'	14
Falsework	10' or less and all pier caps	7
Traffic	Any	14

(a) Span in this circumstance is defined as the horizontal distance between faces of the supporting elements when measured parallel to the primary reinforcement.

When the temperature of the air surrounding the concrete is above and maintained above  $32^{\circ}F$  and below  $50^{\circ}F$  and the provisions of 511.12 are not in force, the duration of the cure and the time specified above for removing falsework and opening to traffic shall be extended one day for each day the temperature of the air surrounding the concrete is above  $32^{\circ}F$  but below  $50^{\circ}F$ .

All superstructure concrete and all other concrete which is to be overlaid with concrete or sealed shall be cured in accordance with Method (a) Water Curing. All other concrete shall be cured either by Method (a) Water Curing or Method (b) Waterproof Membrane Curing; however, if Method (b) is used on construction joints or areas to be waterproofed, the membrane shall be removed as specified in 511.09.

Compression rings are not to be installed on pier columns or similar items of construction for the purpose of supporting falsework or subsequent construction until after a 72 hour curing period.

No load shall be applied or other work conducted that will damage new concrete or interfere with its curing. Where work is necessary on new concrete to complete a structure, such as building forms on a footing, workmen and materials shall be kept off such concrete until such time as it will not be damaged by the work in progress, but in no case shall the elapsed time between placing the concrete and working on it be less than 36 hours. No work that will interfere with the curing shall be done on concrete placed during cold weather, unless insulating material to retain the heat in the mix is placed during periods in the day when the presence of workmen will not interfere with the normal curing procedure. When this is done, the normal protection shall be resumed immediately after work is suspended. Proper curing shall have preference and, if necessary, workmen shall be kept off so that the concrete may be thoroughly wetted and kept wet until the curing is completed.

Method (a) Water Curing. All surfaces not covered by forms shall be protected with two thicknesses of wet burlap which have been spot stitched, wet jute felt cotton mats or wet cotton mats, as soon after placing the concrete as it can be done without marring the surface, and kept wet by the continuous application of water for a period of not less than 7 days. Formed surfaces shall, after the removal of forms, be cured in like manner for the remainder of the curing period, with the entire surface of the concrete being thoroughly drenched with water and covered immediately after forms are removed. Portions of the covering material may be removed temporarily and continuous sprinkling stopped when and as necessitated by any required finishing operation.

In lieu of continuous sprinkling, wet burlap covered with white polyethylene sheeting or plastic coated burlap blankets 705.06 may be used. They shall be placed wet with the burlap side against the concrete. Adjoining plastic coated blankets or polyethylene sheets used to cover wet burlap shall be lapped sufficiently and held securely in place at laps and edges so that a positive moisture seal is provided. White polyethylene sheeting or plastic coated blankets containing holes or tears shall be covered with an additional covering of sheeting or blankets as directed.

If the curing is not started before the surface of the concrete begins to dry, the surface of the concrete shall be given a fog spray of water. Additional applications of a fog spray shall be applied as needed until curing material is in place.

Method (b) Membrane Curing. Immediately after the free water has disappeared on surfaces not protected by forms, and immediately after the removal of forms, if such are removed before the end of the 7 day curing period, the concrete shall be sealed by spraying, as a fine mist, a uniform application of the curing material 705.07, Type 1 or 1D, in such manner as to provide a continuous uniform water impermeable film without marring the surface of the concrete.

The membrane curing shall be applied in one or more separate coats at the rate of no less than 1 gallon per 200 square feet of surface. To insure that the proper amount of the curing material is applied, the number of gallons of curing material in the spray container shall be noted and the correct square footage for that gallonage laid off so that the area of concrete surface to be covered will be such that the approved application rate will be secured. Curing material shall be thoroughly agitated immediately previous to use. If the film is broken or damaged at any time during the specified curing period, the area or areas affected shall be given a complete duplicate treatment of the curing material applied at the same rate as the first treatment.

Unless adequate precautions are taken to protect the surface of the membrane; workmen, materials and equipment shall be kept off the membrane for the duration of the curing period.

**511.15** Surface Finish. Immediately after the removal of forms, all cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be cleaned, dampened and completely filled, pointed or trued with a mortar of the same proportions as used in the concrete being finished.

On all exposed surfaces, all fins and irregular projections shall be removed with a stone or power grinder, care being taken to avoid contrasting surface textures. Sufficient white cement shall be substituted for the regular cement in the filling of holes and other corrective work to produce finished patches of the same color as the surrounding concrete. Exposed surfaces which are not satisfactory to the Engineer because of excessive patching and/or other corrective work, shall be grout cleaned or rubbed as required by the Engineer. Other contiguous exposed surfaces on the structure shall be finished in a similar manner to the extent required to produce a uniform appearance.

Grout Cleaning. Where grout cleaning is called for on the plans or required by the Engineer because of unsatisfactory appearance, the surface, after wetting, shall be uniformly covered with a grout consisting of one part cement to 1-1/2 parts fine sand, 703.03 and sufficient water to produce a consistency of thick paint. White portland cement and a bonding agent shall be used for all or part of the cement in the grout, as directed by the Engineer, to give the color required to match the concrete. The grout shall be uniformly applied with brushes or a spray gun, and all air bubbles and holes shall be completely filled. Immediately after the application of the grout, the surface shall be vigorously scoured with a cork or other suitable float. While the grout is still plastic, the surface shall be finished with a sponge rubber or other suitable float removing all excess grout. This finishing shall be done at the time when grout will not be pulled from the holes or depressions. After being allowed to thoroughly dry, the surface shall be vigorously rubbed with dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing, and the entire cleaning operations of any area must be completed on the day it is started. If any dark spots or streaks remain after this operation, they shall be removed with a fine-grained silicon carbide stone, but the rubbing shall not be sufficient to change the texture of the surface. Unless otherwise directed by the Engineer, grout cleaning shall be delayed until the final clean up of the project.

Rubbed Finish. Forms shall be removed, if possible, within two days after concrete is placed. Corrections shall be made as outlined above. Rubbing of concrete shall be started as soon as the conditions will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of two hours. Sufficient time shall have elapsed before wetting down to allow the mortar used in painting insert holes and defects to be thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse silicon carbide stone until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been attained. The paste produced by rubbing shall be left in place at this time. No additional material other than water shall be applied to the surface. After all concrete above the surface being finished has been placed, the final finish shall be obtained by rubbing with a fine silicon carbide stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform in color. Any surfaces which have been given a rubbed finish shall be protected from subsequent construction operations. Any surfaces not protected, shall be cleaned and again rubbed if necessary to secure a uniform and satisfactory surface.

No extra payment will be made for any type of surface finish, the cost being considered as included in the price bid for concrete.

**511.16 Roadway Finish.** Concrete deck slabs shall be finished in accordance with the requirements of 451.10 and 451.13, except that construction joints shall not be edged, and a strip of surface 9 to 12 inches wide adjacent to curbs (and barriers) shall not be grooved. The requirement for use of a finishing machine may be waived by the Engineer for small bridges where their use is impractical.

The finishing machine shall be self-propelled and shall be approved by the Engineer. It preferably shall be of sufficient size to finish the full width of the decks between curbs, but not less than the projected width of the approach pavement, except for slab bridges. For slab bridges, a longitudinal construction joint may be placed in the slab on the center line of the approach pavement, or as shown on the plans; and each side placed and finished separately. The wheels of the finishing machine shall run on temporary riding rails adequately supported on structural steel or falsework. If such rails are placed within the roadway area, they shall be elevated a sufficient distance above the slab to permit the simultaneous finishing by hand of any portions not finished by the machine. Any rail supports which extend through the roadway area of the slab shall be made and installed in such manner as to permit their removal to at least 2 inches below the top of the slab. Holes formed by the removal of such supports shall be filled during the final finishing of the slab. The concrete shall be delivered and distributed at a uniform and adequate rate ahead of the finishing machine by suitable mechanical equipment.

Bridge decks that are to be waterproofed with a membrane shall be given a burlap drag finish.

**511.17 Sidewalk Finish.** The concrete shall be struck off after placing with a template and finished in accordance with 456.03.

**511.18 ODOT Class HP Concrete Testing.** If included as a separate pay item, perform the following tests on the concrete.

**A. Rapid Chlorine Permeability Tests.** Perform test according to AASHTO T 277. Take a minimum of three tests for decks containing less than 100 cubic yards (75m<sup>3</sup>) of superstructure concrete. For all other decks, take six tests. Test deck superstructure concrete samples obtained from the actual concrete used.

Provide the Engineer with results of rapid chlorine permeability tests at 28, 56, and 90 days.

**B.** Drying Shrinkage Tests. Perform test according to ASTM C 157 and at the frequency specified for rapid chlorine permeability tests.

Provide the Engineer with drying shrinkage tests at 4, 7, 14, 28, 56 and 90 days.

**C.** Heat of Hydration Testing. Perform testing to determine the potential for length change due to thermal expansion and contraction. Immediately after placing the deck, install three thermometers into the fresh concrete at a location that is accessible for readings and representative of the overall deck pour. Locate the thermometer bulbs at 1 inch (25 mm) below the surface of the concrete, at approximately mid-slab, and at I inch (25 mm) above the bottom of the deck form. Leave the thermometers in place throughout the testing time. The Contractor may lubricate and place the thermometers in a thin plastic sheath to facilitate eventual removal.

Test Intervals	Time
2 Hours	First 12 hours
3 Hours	Second 12 hours
4 Hours	Second day
8 Hours	Third thru fifth day

Record temperatures at the following intervals:

Record the ambient air temperatures when taking concrete temperatures. Ensure that all testing is performed by a testing laboratory regularly inspected by the Cement and Concrete Reference Libraries (CCRL). Furnish a copy of the last CCRL inspection report to the Engineer before the test slab pour.

If the Contractor uses ODOT HP 1 or 2 for parapets or substructures, perform three additional chloride permeability and shrinkage drying tests for the parapets or substructure concrete. If used for parapets, perform a heat of hydration test as described above with one thermometer located a 1 inch (25 mm) below the top of the parapet and a second thermometer located 19 inches (500 mm) below the top of the parapet, approximately midway between the front and back faces of the Engineer will not require additional testing for units constructed with the same concrete mix option as the deck.

Tabulate test results on the attached form and forward the form to the City of Akron Testing Lab no later than 10 days following the completion of the tests.

After removing the thermometers, drill out and fill the holes as approved by the Engineer.

**511.19** Method of Measurement. The yardage shall be the number of cubic yards determined by calculations from plan dimensions, in place, completed and accepted.

No deduction will be made for the volume of the reinforcing steel, conduits or structural steel other than beam flanges embedded in deck slabs. No deduction will be made for the volume of any embedded piles. 511.20

Superstructure concrete includes the concrete in deflective parapets not having a metallic railing.

**511.20 Basis of Payment.** Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
511	Cubic Yard	Class concrete,
511	Lump Sum	ODOT Class HP Concrete Testing

# **ITEM 512 TREATING CONCRETE**

- 512.01 Description
  512.02 Materials
  512.03 Sealing of Concrete Surfaces
  512.04 Sealing Concrete Bridge Decks with HMWM Resin
  512.05 Soluble Reactive Silicate (SRS) Concrete Treatment
  512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin
  512.07 Sealing Cracks by Epoxy Injection
  512.08 Waterproofing
  512.09 Method of Measurement
- 512.10 Basis of Payment

**512.01 Description.** This work consists of sealing and treating concrete surfaces, sealing cracks in concrete, and applying waterproofing to structures.

# 512.02 Materials. Furnish materials conforming to:

Asphalt cement	
Asphalt primer for	
waterproofing	
HMWM Resin	
Epoxy-Urethane Sealer	
Non-epoxy Sealer	
Soluble Reactive Silicate(SRS)	
Gravity Fed Resin	
Epoxy injection Materials	
Sand	.703 with the following exceptions:

Maximum moisture content of 0.5 of the percent of absorption when treated according to California Test 226.

Grading:

SIEVE SIZE	% PASSING MAX.
No. 4 (4.5mm)	100
No. 8 (2.36mm)	90 - 100
No. 20 (850µm)	5 -15
No. 50 (300µm)	0 - 5

Emulsified asphalt primer,	702.04 (MS-2, SS-1)
Asphalt for waterproofing	
Hot applied joint sealer	
Type 3 membrane primer	
Waterproofing fabric	
Sheet Type 2 membrane waterproofing	
Sheet Type 3 membrane waterproofing	

**512.03** Sealing of Concrete Surfaces This work consists of applying an approved sealer on existing and new concrete surface areas after the concrete is cured and repairs completed and cured. Apply the sealer to locations described in the plans. Apply the sealer listed in the pay item description. Choose a type of sealer if no sealer is listed in the pay item description.

**A. Equipment.** Use application equipment recommended by the sealer manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are clean, free of foreign matter, oil residue and water.

**B.** Mixing. Mix the sealer according to the manufacturer's recommended procedures. Furnish the Engineer with the manufacturer's application instructions. Don't mix or apply the sealer until the manufacturer's written recommendations are supplied to the Engineer. Mix materials to a uniform consistency and maintain during application.

**C.** Storage. Store all sealer components in tightly sealed containers, in a dry location, and as recommended by the manufacturer. Deliver unopened drums or containers of the sealer or sealer components to the job site with the manufacturer's numbered seal intact.

**D.** Surface Condition. Apply sealers to surfaces which are dry, free from dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials. Repair any structurally unsound surfaces, weak sections or spalled areas before applying any sealer.

Air dry concrete surfaces for at least five (5) days after completion of required curing. Air dry any cavities which require grout filling and curing for five days. Do not apply sealer until the air drying is complete.

Seal accelerated cured precast concrete after it has attained the required 28 day strength and after any cavities which require grout filling have been filled, cured and air-dried for five days.

**E.** Surface Preparation. Remove dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials from surfaces to be sealed. Use chemicals or other cleaning compounds if removal requires their use but only use products approved by the sealer manufacturer. Furnish the Engineer

### 512.03

documentation of the sealer manufacturer's approval. Apply the sealer within 48 hours of surface preparation.

Install suitable traps, filters, drip pans and other separation devices in the cleaning equipment so oil and other foreign material isn't deposited on the surface.

Use the following cleaning methods depending on the surface type:

New water cured exposed concrete surfaces:

- Water blast at 7,000 psi (48 MPa) minimum

Exposed surfaces of new prestressed concrete box beams:

- Clean with high pressure hot water or steam jenny, or
- Water blast at 7,000 psi (48 MPa) minimum, or

- Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surfaces and opened pores

## Existing concrete surfaces:

- Water blast at 7,000 psi (48 MPa) minimum, or

- Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores.

# F. Application and Coverage.

Do not apply sealer if rain is anticipated within 2 hours after application. Clearly mark where the sealer application stops if not continuous.

### 1. Epoxy - Urethane sealers.

Apply each coat of the Epoxy-urethane sealer at the coverage rate specified on the Office of Materials Management's approved list. If no application rate is listed, apply each coat at 120 square feet per gallon (2.9 square meter/liter).

Only apply sealer when the surface temperature is  $50^{\circ}$  F ( $10^{\circ}$  C) or above

Apply with a brush, squeegee, roller or spraying equipment and as recommended by the manufacturer.

Apply one coat of epoxy and one coat of the urethane top coat. Time between coats shall meet the manufacturer's recommendation. Use epoxy and urethane from the same manufacturer. Achieve specified coverage regardless of the number of passes per coat.

Tint so the final color is Federal Color Standard No. 17778 - Light Neutral. Pigment content shall be limited so as not to reduce sealing effectiveness of the second coat. Refer to the plans for colors for specific projects.

Sags and runs are not acceptable in the sealer.

For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard (0.8 kg/m<sup>2</sup>) of silica sand into the surface of the second coat to produce a non-skid surface satisfactory to the Engineer.

#### 2. Non-epoxy sealer.

Apply the sealer according to the manufacturer's recommended mode of application and under the observation of the Engineer.

Coverage:

Surfaces subject to abrasive wear (bridge decks, bridge deck shoulders and sidewalks); Minimum, one gallon (3.875 liter) of sealer for each 100 square feet (9.0 square meter);

Curbs, vertical surfaces of beams and deck slabs subject to direct roadway drainage; Minimum, one gallon (3.875 liter) for each 125 square feet (11.5 square meter)

Other surfaces (for example, parapets, abutments, pier caps and median dividers) 3. Minimum, one gallon (3.875 liter) for each 150 square feet (14.0 square meter)

Apply sealer on surfaces in a one-pass operation at the required coverage. Acceptable applications saturate a horizontal surface and take a few seconds before completely penetrating. Broom in the sealer if recommended by the manufacturer.

Vertical surface sealer spraying will create runs. Acceptable applications of penetrating sealer developing 6 to 12 inch (150 to 300 mm) runs below the spray pattern. Apply additional passes in 10 to 15 minutes if coverage rate is not achieved with first pass. Apply sealers with brush or roller if recommended by the manufacturer.

After 10 to 15 minutes, squeegee off excess material on smooth finished or dense concretes where the required coverage is not absorbed.

For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard ( $0.8 \text{ kg/m}^2$ ) of silica sand into the sealer application to produce a non-skid surface satisfactory to the Engineer.

Tint clear non-epoxy sealers with a vanishing dye that will not damage the concrete.

Don't apply sealer if the ambient temperature is below  $40^{\circ}$  F (5° C) or will fall below  $32^{\circ}$  F (0° C) within 12 hours after application.

**G.** Test Site/Application. Apply sealer to measured coverage areas, both on a horizontal and vertical surfaces, and on different concrete types, demonstrating:

The project's visual effects for the epoxy/urethane sealer application at the required coverage rate.

Visually, the absorption necessary to achieve the specified coverage rate for the nonepoxy sealer. Use at least ½ gallon (2 liter) of sealer, following the manufacturer's recommended method of application, for the total of the test surfaces.

Apply to the deck, safety curb or sidewalk for the horizontal test surfaces and use an abutment parapet or pier face for the vertical test surface so different textures are tested.

**H. Appearance.** Epoxy/Urethane sealers. Uniform appearance and the final color shall visually match the test section. Re-coating, removal and re-application or other methods recommended by the manufacturer will be required to correct final appearance. Non Epoxy Sealers. The sealer shall result in a uniform appearance.

**I. Traffic.** Allow traffic on deck shoulder areas after 12 hours of drying time for an epoxy/urethane sealer. Keep traffic off a non-epoxy sealer until the sealer appears totally dry.

**J.** Safety Precautions. Follow precautions defined on the manufacturer's MSDS. Provide the Engineer a copy of the MSDS sheet for information before any work commences.

**K.** Protection of Adjoining Surfaces and the Public. Protect the public during all operations, especially when applying sealer to the fascia or the underside portions of a bridge that spans an area used by the public.

During sealing, mask off, or use other means of protection, for surfaces not being sealed. Protect asphalt and mastic type surfaces from spillage and heavy overspray.

Do not apply sealers to joint sealants which have not cured according to the manufacturer's instructions. Joint sealants, traffic paints and asphalt overlays may be applied to the treated surfaces 48 hours after the sealer has been applied. Protect nearby steel, aluminum or glass surfaces when non-epoxy overspray could be deposited on those surfaces.

**L. Environmental Requirements.** Protect plants and vegetation from overspray by covering with drop cloths.

**512.04** Sealing Concrete Bridge Decks with HMWM Resin. This work shall consist of preparing and treating the concrete wearing surfaces of bridge deck with a penetrating sealer in accordance with these specifications, in reasonably close conformity with the plans and the manufacturer's recommendation and as directed by the Engineer.

**A.** Limitations. Do not perform this work during the period beginning November 1st and ending March 31st.

**B.** Surface Preparation. Remove roadway dirt and debris from the area of the deck to be treated. Sweep, sandblast, then with the use of a manual or power broom sweep and blow with compressed air so that the surfaces to which the sealer is to be applied is dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, driers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surface prior to application of the sealer. Remove existing pavement markings according to 621.20. Remove all traces of asphalt or petroleum products and concrete curing seals by abrasive blasting prior to air sweeping.

**C. Installation**. Provide a compatible promoter/initiator system capable of providing the same physical qualities of the hardened resin as if promoted/initiated with 2% cobalt naphthanate (6%) and 2% cumene hydroperoxide. Store materials at 65-80° F (18-27° C). Provide a system that has a resin gel time of not less than 40 minutes to not more than  $1\frac{1}{2}$  hours at the time and temperature of application.

Adjust the gel time to compensate for the change in temperature throughout the day. The temperature of the surfaces to be treated may range from 50° F ( $10^{\circ}$  C) to  $120^{\circ}$  F ( $49^{\circ}$  C). Arrange to have a technical representative on site to provide mixing proportions equipment suitability, and safety advice. Any conflict between these provisions and representative's advice shall be resolved at the job site. The technical representative shall remain at the job site until such time as he and the Engineer agree that the Contractor is qualified in all aspects of the application of the sealer.

Do not allow the promoter and initiator, if supplied separate from the resin, to contact each other directly. Do not store containers of promoter or initiators together in a manner that will allow leakage or spillage from one to contact the containers or materials of the other.

Machine application of the resin may be performed by using a two-part resin system utilizing a promoted resin for one part and an initiated resin for the other part. This two-part resin system may be combined at a spray bar through positive displacement atomization of the resin. Do not use compressed air to produce the spray. Use appropriate cleaning and flushing of equipment, tools, etc., with an appropriate solvent, as approved by the Engineer, in such a manner to minimize personal and environmental hazards. Advise workman that the resin will soften gum rubber soles, and a face-mask should be used to protect from accidental splashes. Clothing and leather saturated with resin will harden and become useless.

Prior to resin application the surface to be treated shall be visibly dry and its temperature between 50° F (10° C) and 120° F (49° C). Do not apply the resin within 24 hours after a rain or when rain is forecast within 12 hours or when the ambient air temperature is below 50° F (10° C). Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100 square feet per gallon ( $2.45m^2/L$ ). The exact rate shall be determined by the Engineer prior to commencing full-scale deck treatment operations.

Before using the material submit to the Director copies of the manufacturer certified test data showing that the material complies with the qualitative and quantitative requirements of this specification. The test data shall be developed by an independent approved testing laboratory, and shall include the brand name of the material, name of manufacturer, number of the lot tested and date of manufacture. When the material has been approved by the Director, further testing by the manufacturer will not be required unless the formulation of manufacturing process has been changed, in which case new certified test results will be required. The manufacturer shall certify that the formulation is the same as that for which data has been submitted. The state reserves the right to sample and test delivered lots for compliance.

Flood the deck surfaces resin, allowing penetration into the concrete and filling of all cracks. Limit the initiated mix of promoted resin to 5 gallons (19L) at a time for manual application. A significant increase in viscosity shall be cause for rejection. Apply the treatment within 5 minutes after complete mixing. Redistrubute excess material by squeegee or brooms within 10 minutes after application.

Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire treated area of the bridge deck by mechanical means to affect a uniform coverage of 0.80 to 1.2 pounds per square yard (0.43 kg/m<sup>2</sup> to 0.65 kg/m<sup>2</sup>). The sand shall be uniformly graded aggregate conforming to the quality requirements of 703 and shall conform to the following limits for grading:

Sieve Size	% Passing Max.
No. 4 (4.75mm)	100
No. 8 (2.36mm)	90-100
No. 20 (850µm)	5-15
No. 50 (300µm)	0-5

It is the intention of the specification to allow the use of commercially available blast sands applied by a common lawn broadcast type seeder/spreader. Place sand between 10 to 15 minutes behind the resin spreading front and before any jelling of the resin occurs. If the surface contains large deep cracks, the low-viscosity liquid could run completely through the concrete slab. Apply a second coat in these areas after the first coat has started to cure.

Before the monomer hardens, fill imperfections or spalls with standing liquid with commercial quality concrete or sandblast sand, and finished to a uniform surface. The sand shall have a maximum moisture content of 0.5 of the percent of absorption when tested in accordance to a California Test 226.

Do not permit traffic and equipment on the tested deck until it is tack free and a minimum of 6 hours have elapsed since treatment and the sand cover adheres sufficiently to resist brushing by hand. Protect the treatment from moisture for not less than 4 hours after placement.

**512.05** Soluble Reactive Silicate (SRS) Concrete Treatment This item consist of the necessary labor, materials and equipment to prepare and treat portland cement concrete surfaces with a reactive silicate sealer meeting these specifications.

**A. Equipment.** Use application equipment that is recommended by the manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are thoroughly clean, free of foreign matter, oil residue and water prior to applying the treatment.

**B.** Cleaning and Surface Preparation. Insure that surfaces which are to be treated meet the approved product's requirements for surface condition. Do not begin sealing until all concrete repairs have been completed and cured. Furnish the Engineer with written instructions for surface preparation requirements and have a representative of the manufacturer present to assure the surface condition meets their requirements.

At a minimum, thoroughly clean the surface to remove dust, dirt, oil, wax, curing components, efflorescence, latence, coatings and other foreign materials. Obtain the approval of the manufacturer or its representative before the use of chemicals and other cleaning compounds to facilitate the removal of these foreign materials. Apply the treatment within 48 hours following surface preparation.

Fit cleaning equipment with suitable traps, filters, drip pans and other devices to prevent oil and other foreign material from being deposited on the surface.

**C.** Test Application. Treat a measured test coverage area on horizontal and vertical surfaces of the different components of the structure to be treated for the purpose of demonstrating the desired physical and visual effect of an application or of obtaining a visual illustration of the absorption necessary to achieve the specified coverage rate prior to final application. In the latter case, use at least ½ gallon (2

## 512.06

liter) of treatment following the manufacturer's recommended method of application for the total of the test surfaces. Locate horizontal test surfaces on the deck and on the safety curb or sidewalk and locate vertical test surfaces on an abutment parapet and pier face so that the different textures are displayed.

**D. Application.** Apply the concrete treatment to concrete surfaces as designated on the plans. Apply the SRS by thoroughly saturating the concrete surfaces at an application rate specified by the manufacturer.

Apply the SRS when the concrete surface temperature is above  $35^{\circ}$  F (2° C). Use a surface thermometer on the concrete to establish the temperature of the concrete if the air temperature at the time of application is  $45^{\circ}$  F (7° C) or below.

Spread the SRS from puddles to dry areas.

If unable to complete the entire application continuously, note and clearly mark the location where the application was stopped.

**E. Protection of Adjoining Surfaces and the Public.**, Protect by masking off or by other means adjoining surfaces of the structure which are not to be sealed when applying a treatment. Make provision to protect the public when treating the fascia of a bridge and/or portions of the underside of the deck of a bridge that spans an area used by the public.

Protect asphalt and mastic type surfaces from spillage and heavy overspray. Do not apply joint sealants, traffic paints and asphalt overlays to the treated surfaces until 48 hours after the treatment has been applied. Cover adjoining and nearby surfaces of aluminum or glass where there is a possibility of the treatment being deposited on the surfaces.

Protect plants and vegetation from overspray by covering with drop cloths. Follow precautions as indicated on the manufacturer's MSDS.

**F.** Opening to Traffic. Only allow traffic on a deck after a treated area does not track.

**512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin.** This work shall consist of preparing and treating the concrete bridge deck with a gravity-fed crack welding system in accordance with these specifications in reasonably close conformity with the plans and the manufacturer's recommendations and as directed by the Engineer.

**A.** Limitations. Do not perform this work during the period beginning November 1st and ending March 31st.

Prior to resin application insure that the surface to be treated is visibly dry with a temperature between  $40^{\circ}$  F ( $4^{\circ}$  C) and  $100^{\circ}$  F ( $38^{\circ}$  C). Do not apply the resin within

24 hours after a rain, during rain, when rain is forecast within 12 hours or when the ambient air temperature is below  $40^{\circ}$  F (4° C).

**B.** Surface Preparation. First remove roadway dirt and debris from the area to be treated. Sweep abrasive blasted surfaces to which the sealer is to be applied, then manual or power broom swept and blown with compressed air so that they are dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Use a high pressure water blast followed by an air blast if particles are highly embedded in the cracks, to clean cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, dryers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surfaces prior to application of the sealer. Remove existing pavement marking according to section 641.10 of the ODOT CMS. Remove all traces of asphalt or petroleum products and concrete curing by the abrasive blasting prior to air sweeping.

**C. Application.** Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100-150 square feet per gallon  $(2.45 \text{m}^2/\text{L}-3.68 \text{m}^2/\text{L})$ . The Engineer will determine the exact rate but will not exceed 150 square feet per gallon  $(3.68 \text{m}^2/\text{L})$ . Flood the area to be sealed with resin. Allow the resin to penetrate into the concrete and fill all cracks. Mix the resin to a limit of 5 gallons (191) at a time for manual application. Reject resin with a significant increase in viscosity. Redistribute excess material by a squeegee within 10 minutes after application. Front and back movement with the squeegee is recommended over cracks and patch perimeters to enhance penetration. Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire sealed area of the bridge deck by mechanical means to effect a uniform coverage of 1 pound (0.45kg) per 2-3 square foot (0.1858-0.2787 square meter).

Protect the treatment from moisture for not less than 6 hours after placement.

**D. Traffic.** Do not permit traffic on the treated deck until the resin is tack free, a minimum of 6 hours has elapsed since treatment, and the sand cover adheres sufficiently to resist brushing off by hand.

**512.07** Sealing Cracks by Epoxy Injection. This specification covers the repair of dry, moist or wet cracks or fractures that are 2 to 100 mils (50 to 2500 micrometers) in thickness in reinforced concrete members. The repair is by means of an epoxy injection system. This system shall consist of a paste epoxy used to seal the surface cracks and an injection epoxy used under low pressure, 200 psi (1400kPa) max., to penetrate and fill the cracks and bond the crack surfaces together. Material for each epoxy shall consist of a two-component modified resin bonding system. The unmodified resin shall be known as Component A and the hardener as Component B.

Arrange to have a manufacturer's representative at the job site to familiarize him and the Engineer with the epoxy materials, application procedures and recommended pressure practice. This representative shall direct at least one complete crack or area injection and be assured prior to his departure from the project that the personnel are adequately informed to satisfactorily perform the remaining repairs.

Furnish the Engineer a copy of the manufacturer's comprehensive preparation, mixing and application instructions which have been developed especially for use with the proposed epoxy injection system. Ensure that any significant changes to these instructions which are recommended by the representative for an unanticipated situation have been approved by the Engineer prior to the adoption of such changes.

Clean concrete surfaces adjacent to the cracks to be sealed only to the extent necessary to achieve an adequate bond with the paste epoxy, and only by procedures which will not cause abrasive grits or concrete dust to penetrate the cracks. Do not permit the use of solvents or thinners in cracks or on bonding surfaces.

Install injection ports or tees in cracks to be injected. Space injection ports or tees at 6 to 12 inches (150 to 300 mm) vertically and 6 to 18 inches (150 to 450 mm) horizontally but in no case closer together than the thickness of the concrete member if full depth penetration is desired unless otherwise specified or directed. Set ports or tees in dust free holes made either with vacuum drills or chipping hammers. Seal all surface cracks in the area to be repaired, after injection ports or tees have been inserted into the holes, with paste epoxy between ports to ensure retention of the pressure injected epoxy within the confines of the member. The Department will allow an alternative procedure of sealing the cracks before the injection holes have been made. Limit the application of paste epoxy to clean and dry surfaces. Limit substrate temperatures to not less than  $45^{\circ}$  F(7° C) during epoxy applications.

Begin the epoxy injection at the bottom of the fractured area and progress upward using a port or tee filling sequence that will ensure the filling of the lowermost injection ports or tees first.

Establish injection procedures and the depths and spacings of holes at injection ports or tees. Use epoxy with flow characteristics and injection pressure that ensure no further damage will be done to the member being repaired. Ensure that the epoxy will first fill the innermost portion of the cracked concrete and that the potential for creating voids within the crack or epoxy will be minimized.

Remove the injection ports or tees flush with the concrete surface after the fractured area has been filled and the epoxy has partially cured (24 hours at ambient temperature not less than 60° F (16° C), otherwise not less than 48 hours). Roughen the surfaces of the repaired areas to achieve uniform surface texture. Remove any injection epoxy runs or spills from concrete surfaces.

Obtain two 4-inch (100 mm) diameter core samples in the first 100 linear feet (30 m) of crack repaired and one core for each 100 linear feet (30 m) thereafter. Take the

core samples from locations determined by the Engineer and for the full crack depth. Cores will be visibly examined by the Engineer to determine the extent of epoxy penetration. Repair the core holes in the concrete with material specified in 705.21.

# 512.08 Waterproofing

**General.** Apply an even and uniform coating of asphalt materials using brushes, squeegees, or spray equipment.

If using spray equipment, provide portable power pressure type spraying equipment capable of being moved to the location of the waterproofing operation.

Protect concrete surfaces not covered with waterproofing from overspray, spilling, or otherwise marring of the surface with the asphalt materials.

Ensure that the edge of any exposed application is sharply defined true to line with a uniform exposure.

# **Preparation of Surface.**

Asphalt Materials: Remove concrete projections. Using wire brushes and clear water, remove dirt and the outside film of cement. Before applying asphalt materials, ensure that the concrete is clean and dry and the concrete temperature is at least  $40^{\circ}$  F ( $4^{\circ}$  C).

Membranes: Remove protrusions from the concrete. Sweep off dirt and dust, and blow the concrete clean. Fill joints or cracks greater than 3/8 inch (10 mm) wide with portland cement mortar. In addition to the above, remove oil and grease from surfaces for Type 3 membranes using water and a detergent designed to remove oil and grease from concrete. Flush residual detergent from the surface. Do not allow traffic on the cleaned surface.

**Primer Coat.** Apply the primer coat at the rate of 0.10 to 0.15 gallon (0.50 to 0.70 L) of asphalt material per square yard (square meter).

For primer coats applied between June 1 and September 1, use asphalt primer for waterproofing or emulsified asphalt primer conforming to 512.02.

For primer coats applied between September 1 and June 1, use asphalt primer for waterproofing conforming to 512.02.

If practical, apply asphalt emulsion using spray equipment.

If subjected to traffic, spread sand on the primer coat for protection. Broom off excess sand before applying asphalt waterproofing.

**Type A Waterproofing.** This type of waterproofing consists of one primer coat and at least two coats of asphalt material conforming to 702.06 to provide a total of at
least 1 gallon (5 L) of asphalt per square yard (m<sup>2</sup>) on flat areas and at least 1/2 gallon per square yard (3 L/m<sup>2</sup>) on vertical or sloping surfaces. Start applying the waterproofing at the lowest point, and progress to a higher elevation. Uniformly cover the surface except apply more asphalt in corners and over construction joints. Apply the asphalt material at a temperature from 250° to 350° F (121° to 177° C).

**Type B Waterproofing.** This type of waterproofing consists of one primer coat, three coats of asphalt material conforming to 702.06, and two layers of waterproofing fabric conforming to 711.24 applied as follows:

1. On a clean, dry, and well-primed surface, apply a thorough coating of asphalt at a temperature from  $250^{\circ}$  to  $350^{\circ}$  F ( $121^{\circ}$  to  $177^{\circ}$  C).

2. Apply the coating at a rate of at least 1/3 gallon per square yard (1.5  $L/m^2$ ) of surface.

3. While the asphalt is hot enough to penetrate the fabric, lay the fabric according to the following:

a. Surfaces Wider than Normal Fabric Strip. For the first strip, lay a half-width [normally 18 inches (0.5 m) wide] strip of fabric. For the second strip use a full-width strip of fabric, and lap the entire width of the first strip. Lap each succeeding strip 2 inches (50 mm) more than half its full width. Lap the fabric strips in the direction of water flow.

b. Surfaces with Same Width as Fabric Strip. For the first strip, lay a full-width strip. For the second strip, lay another full-width strip, covering the first.

Lay each strip without wrinkles, folds, or pockets. Thoroughly coat the strip with asphalt for the full width of the lap before laying the succeeding strip. Each application shall entirely conceal the texture of the fabric.

4. Apply a final coat of asphalt to provide a thorough covering for the fabric.

5.For all three coats, use a total of at least 1 gallon (5 L) of asphalt waterproofing material per square vard ( $m^2$ ).

Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

**Type D Waterproofing.** This type of waterproofing consists of one primer coat, one layer of waterproofing fabric conforming to 711.24 over joints, three coats of asphalt material conforming to 702.06, and two shingled plies of asphalt saturated waterproofing fabric conforming to 711.24.

Prime the surface to be waterproofed and allow the primer to dry. Fill joints and irregularities in the surface with asphalt cement. Lay a layer of fabric extending at

least 9 inches (230 mm) on both sides of all joints. Leave the underside of this layer unbonded to the concrete surface.

Apply the asphalt at a temperature from  $250^{\circ}$  to  $350^{\circ}$  F ( $121^{\circ}$  to  $177^{\circ}$  C) and conceal the texture of each layer of fabric with the asphalt. Use at least 1/3 gallon (1.5 L) of asphalt per square yard ( $m^2$ ) of surface for each application. Begin applying the asphalt and fabric at the low side or sides of the surface, and proceed toward the apex or high side so that water runs over and not against or along the laps of the fabric. Lay the fabric without wrinkles, folds, or pockets. Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

Start applying waterproofing by mopping asphalt on a surface slightly wider than half the width of the fabric strip. Immediately lay a half-width strip of the fabric onto the asphalt. Mop asphalt on this strip and an adjacent surface slightly wider than half the width of the fabric, and lay a full width of fabric that entirely covers the first strip. Mop asphalt on the second half of this second strip and an adjacent concrete surface and lay a third strip of fabric that laps the first strip at least 2 inches (50 mm). Continue this process of applying asphalt and laying fabric until the entire surface is covered and each strip of fabric laps the next to last strip already placed by at least 2 inches (50 mm). Finish laying fabric with a partial-width strip and mop the entire surface with asphalt.

**Type 2 Membrane Waterproofing.** This type of waterproofing consists of a rubberized asphalt and peel-and-stick waterproofing membrane 711.25. If the ambient temperature is below 50° F (10° C), use a manufacturer recommended primer coat for vertical surface application. After installing the primer coat, if required, remove the membrane's release liner and place the adhesive side on the prepared concrete surface. Lay the membrane smooth and free of wrinkles. Lap joints in membranes by at least 1 inch (25 mm). Store membrane materials indoors at temperatures not to exceed  $120^{\circ}$  F (49° C).

For precast concrete three- and four-sided structures, install Type 2 membrane on the exterior vertical and exterior top horizontal surfaces.

**Type 3 Membrane Waterproofing.** This type of waterproofing consists of a primer coat conforming to 705.04 and a waterproofing membrane consisting of a high density asphalt mastic between two layers of polymeric fabric conforming to 711.29.

Keep membrane and primer materials dry before installation.

Heat the membrane primer in an oil primer heated, double-jacket kettle. Use a kettle that is clean and free of other materials with any obvious buildup scraped out. The Contractor may use a single-jacket kettle if the primer is capable of being heated in direct fire to the application temperature. Heat primers within the manufacturer's recommended temperatures.

## 512.09

On bridges with curbs, apply the primer and membrane 3 inches (75 mm) up the curb face. On prestressed box beam bridges with no approach slab, apply the primer and membrane 6 inches (150 mm) over the ends of the beams. On prestressed and slab bridges with approach slabs, apply the primer 2 feet (600 mm) out onto the approach slab.

If the plans require a Type 3 membrane on the top exterior surface of precast concrete three- or four-sided structures, apply the primer and membrane to overlay the vertical exterior sides of the structure by 12 inches (300 mm).

Apply primer no further than 5 feet (1.5 m) in front of the membrane using a squeegee to fill all voids and imperfections. Apply membrane from the low to the high side of the surface. Apply an extra bead of primer at the edge of the membrane. Lap joints in membranes by at least 3 inches (75 mm). After installing the membrane over the entire surface, seal joints in the membrane by applying primer and smoothing with a V-squeegee.

**512.09 Method of Measurement.** The Engineer will measure Waterproofing, of the type specified, by the number of square yards (square meters) or on a lump sum basis.

The Engineer will measure the sealing of concrete surfaces, sealing of concrete bridge decks with HMWM resin and treating concrete bridge decks with SRS as the actual area in square yards (square meters ) of surfaces treated.

The Engineer will measure the actual length in linear feet (meters) of crack repaired by epoxy injection.

**512.10 Basis of Payment.** The Engineer will pay for accepted quantities at the contract prices as follows:

The Engineer will consider the cost for the obtaining and repairing the two cores used by the Engineer to determine the extent of the epoxy penetration as incidental to the work of repairing the concrete by epoxy injection.

<u>Item</u>	<u>Unit</u>	<b>Description</b>
512	Square yards	Sealing of concrete surfaces
512	Square yards	Sealing of concrete surfaces (non-epoxy)
512	Square yards	Sealing of concrete surfaces (epoxy urethane)
512	Square yards	Sealing of concrete bridge decks with HMWM resin
512	Square yards	Treating concrete bridge decks with SRS
512	Square yards	Treating concrete bridge decks with Gravity-Fed
		Resin
512	Linear feet	Concrete repair by epoxy injection
512	Square Yard	Type A Waterproofing
	or Lump Sum	

512	Square Yard	Type B Waterproofing
	Lump Sum	
512	or Square Yard	Type D Waterproofing
	Lump Sum	
512	or Square Yard	Type 2 Waterproofing
	Lump Sum	
512	Square Yard	Type 3 Waterproofing
	or Lump Sum	

# **ITEM 513 STRUCTURAL STEEL**

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**513.01 Description**. This item shall consist of preparing shop drawings, and furnishing, fabricating, nondestructive testing, cleaning, shop painting, galvanizing, and erecting of all structural steel, and other structural metals, as specified. It shall also include any work required to move existing steel structures to the plan location,

#### 513.02

to make necessary repairs and alterations, and to connect or join new with old construction.

**513.02 General**. 501 includes general information pertaining to structural steel fabrication and erection. Shop painting shall conform to 514.

Shop drawings required under 501.05 shall show details, dimensions, size of materials, match mark diagrams for field connections, and other information necessary for the complete fabrication and erection of the metal work. These drawings shall also show a diagram identifying, by some unique mark, each area of a welded splice to be covered by a single radiograph.

The shop drawings for all multiple span beam and girder bridges shall include an overall layout with dimensions showing the relative unloaded vertical and horizontal position of beam or girder segments with respect to a full length base or work line; camber and horizontal curvature of the beams or girders and the effect of deck surface profile shall be accounted for in this relationship. Required offsets for horizontal curvature shall be shown for each 10 feet of length.

Shop drawings shall specifically identify each piece of steel as to grade (ASTM designation). Pieces made of different grades of steel shall not be given the same assembling or erecting mark, even though they may be of identical dimensions and detail.

When changes on submitted drawings are requested by the Engineer and the Contractor makes changes in addition to those expressly requested, the next copy of prints submitted shall identify the additional changes with some suitable marking.

Deviation from the contract plans or approved shop drawings will not be permitted without the written order or consent of the Engineer. Requests for such deviation or change shall be submitted in writing. For changes in location or addition or elimination of splices, approval shall be obtained prior to ordering material. After approval by the Engineer, such plans shall be taken as supplemental to, but in no sense a substitute for, the original plan.

After shop drawings have been approved, the Fabricator shall furnish three complete copies of shop bills showing the weight of individual pieces, computed in accordance with 513.26 for approval of pay weights.

All steel fabrication including the shop coat of paint shall be performed in a structural steel fabricating shop having adequate size, equipment, heating and lighting facilities and experienced personnel to satisfactorily perform all necessary operations. Areas where flame cutting, air carbon-arc gouging, welding, cleaning and painting are performed shall be kept dry. The required air temperature levels shall be maintained while these operations are in progress. Shop assembly of large pieces for fit-up of field connections may be performed outdoors. The shop shall at all times provide an adequate number of supervisory and inspection personnel to

control the work properly and to assure satisfactory materials and workmanship. These provisions will not apply to steel requiring fabrication at the site in the repair, alteration or extension of an existing structure.

Where work consists of repairing and extending or altering existing structures the Contractor shall make such measurements of the original construction as may be required to join accurately old and new work. Shop drawings, when required, shall include these measurements. Measurements which may appear upon contract plans to indicate the extent and nature of such repair or extension shall not relieve the Contractor of this responsibility.

Fabricated material shall not be shipped from the shop without prior inspection unless such inspection is waived by the Engineer.

Shop inspection or approval of shop drawings by the Engineer shall not relieve the Contractor of responsibility for erroneous or inconsistent dimensions, notations, omissions or other errors. All parts forming a structure shall be built in accordance with approved drawings.

The Fabricator shall notify the Engineer at least two weeks in advance of the beginning of shop fabrication, and furnish a tentative fabrication schedule for the work. Notification of schedule changes shall be made as soon as practicable.

The Fabricator shall provide office accommodations having a minimum floor area of 120 square feet and a minimum ceiling height of 7 feet. This office shall be equipped with adequate working and storage facilities, lighting and electrical outlets. It shall have provisions for heating to a temperature of not less than 68°F and be adequately ventilated and maintained. It shall also contain a telephone with direct access to an outside trunk line which shall be for the exclusive use of the inspector.

The Fabricator shall cooperate fully with the inspector, in his inspection of the work in progress. This shall include the storage of members completed during the inspector's absence, in such a manner, that he can completely and safely inspect the finished work, unless such inspection has been waived.

In subsequent sections where the terms "Main," "Secondary," or "Detail" are used, it shall be understood that reference has been made as follows: "Main" refers to material, members and fasteners that are primarily stressed by live load and structure weight; "Secondary" refers to material, members and fasteners that do not directly support live load or main members; "Detail" refers to material, members and fasteners that are essentially nonstressed.

Where steel stamps are used for identification purposes, they shall be of the "mini-stress" or "stressless" type.

**513.03** Material. Structural steel and other structure metals shall conform to 711, except that steel bar stock utilized for end dams and scuppers may be any weldable grade of low or mild carbon steel available commercially.

Welded stud shear connectors shall be in accordance with 513.18.

Steel plates for main and secondary members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile or compressive stresses.

**513.04 Material Control**. Each piece of Steel to be fabricated shall be properly identified for the Engineer.

The issuance of cutting instructions by the Fabricator to the shop shall be by cross-referencing of the assembly marks shown on the shop drawings with the corresponding item covered on the mill purchase order. The Fabricator's system of assembly-marking individual pieces of steel and the issuance of cutting instructions shall be such as to provide a direct reference to the appropriate mill test report.

The Fabricator may furnish from stock, material that he can identify by heat number and mill test report.

Any excess material placed in stock for later use shall be marked with the mill test report number and the ASTM A 6 specification identification color code, if any, when separated from the full-size piece furnished by the supplier.

During fabrication, each piece of steel shall show clearly and legibly its specification identification color code and heat number.

Individually marked pieces of steel which are used in furnished size, or reduced from furnished size only by end or edge trim, that does not disturb the heat number or color code or leave any usable piece, may be used without further color coding provided that the heat number and color code remains legible.

Pieces of steel which are to be cut to smaller size pieces shall, before cutting, be legibly marked with the ASTM A 6 specification identification color code and heat number.

Individual pieces of steel which are furnished in tagged lifts or bundles shall be marked with the ASTM A 6 specification identification color code and heat number immediately upon being removed from the bundle or lift.

Pieces of steel which will be subject to fabricating operations such as blast cleaning, galvanizing, heating for forming, or other operations which might obliterate paint color code and heat number marking, shall be marked with steel stamps or by a substantial tag firmly attached, or shall be approved by the Engineer for obliteration of material identity markings. **513.05** Care of Material. Structural material shall be stored at the shop above the ground, upon platforms, skids or other supports. It shall be straight and have clean and dry surfaces before being worked in the shop. Any rusted or corroded material shall be cleaned prior to use and shall meet ASTM A 6 thickness tolerances after cleaning.

**513.06** Workmanship and Straightening. If straightening of rolled material is necessary, it shall be done by methods that will not damage the member. When carefully planned and supervised, the application of localized heat is permitted for straightening. The temperature of the heated area shall not exceed 1200°F as controlled by pyrometric stick or thermometers. Quenching to accelerate cooling is prohibited.

Fabricated structural steel shall be within the dimensional tolerances specified by Articles 3.5 and 9.23 of the AWS Code, except where indicated otherwise in these specifications, and with the following additions. Waviness, the deviation of the top or bottom surface of a flange from a straight line or plan curvature, shall not exceed 1/8 inch when the number of waves in a 10 foot length is four or less, or 1/16 inch when more than four, but sharp kinks or bends shall be cause for rejection.

For the measurement of camber during laydown, the bearing points shall be relatively positioned both horizontally and vertically to plan dimensions  $\pm 1/8$  inch.

**513.07** Finish. Sheared edges of all main material shall be planed to a minimum depth of 1/4 inch except for ASTM A36 material having a thickness of 5/8 inch or less. Burrs and sharp edges shall be removed.

Structural steel permitted by these specifications may be flame cut, provided a smooth surface free from cracks and notches is secured and provided that an accurate profile is secured by the use of a mechanical guide. At the project site the use of a mechanical guide may be waived at the discretion of the Engineer.

Rolled and flame cut surfaces shall meet the requirements of AWS D 1.1 and Ohio Department of Transportation Supplement 1027.

The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I:

ANSI 2	2,000
ANSI 1	,000
ANSI	500
ANSI	250
	ANSI 2 ANSI 1 ANSI ANSI ANSI

Pins and pin holesANSI	125
Sliding bearingsANSI	125

**513.08 Stiffeners.** The bearing ends or bearing stiffeners shall be flush and square with the web and shall have at least 75 percent of this area in contact with the inner surface of the flange. The other end of the stiffener shall have a tight fit as defined below. Bearing stiffeners shall be positioned to be vertical after erection.

Intermediate stiffeners to which crossframe angles are connected shall be welded to the top and bottom flange. Where intermediate stiffeners are not used in pairs they shall be welded to the compression flange. A tight fit is defined as one in which the stiffener and flange are in physical contact over some portion of the end of the stiffener and having no gap in excess of 1/16 inch. Welds attaching stiffeners to the web plate shall not extend into the clip area.

All stiffeners shall be clipped to clear flange-web welds and fillet of rolled shapes. The clip shall be 2-1/2 inches along the web and 1 inch along the flange.

**513.09 Fillers.** Fills shown on the shop drawings shall be dimensioned to the nearest 1/16 inch in thickness, but not less than 1/8 inch thick, based on the dimensions for detailing and intended relative position of the abutting elements to be spliced. However, in the final shop assembly, fills shall be furnished with thicknesses sufficient to compensate for any misalignment of abutting elements due to standard rolling mill tolerances. The actual fills used shall be such as to compensate for differences in total thickness or relative positions of more than 1/16 inch.

Fill plates in bolted joints shall be made flush with the perimeter of the splice plates and not be tack welded.

**513.10 Horizontally Curved Beams and Girders**. Beams and girders shall be heat curved as specified by AASHTO Standard Specifications for Highway Bridges, except that flanges for girders may be cut to shape.

When members are to be heat curved, the detailed procedure including necessary calculations shall be submitted with the shop drawing for approval prior to starting work.

**513.11 Joints and Splices**. In bolted construction where tension or flexural members are spliced, not more than 1/4 inch clearance will be allowed between the abutting surfaces of spliced members. For spliced compression members, the abutting surfaces shall be truly faced so as to have a uniform bearing when properly aligned and completely bolted.

In welded construction, all abutting surfaces shall receive the proper joint preparation as shown on approved shop drawings. The preparation for field welded

butt joints in main members shall be verified by a complete shop assembly as specified in 513.21.

Any opening in a joint or splice in the finished structure that allows the entrance of water shall be filled as directed by the Engineer with an approved caulking before paint is applied.

**513.12 Pin Holes**. Pin holes shall be bored true to gage, at right angles to the axis of the member and parallel to each other. The boring shall be done after the member is completely fabricated.

Pin holes for up to 5 inch diameter pins shall not exceed the pin diameter by more than .020 inches; holes for larger pins shall not exceed the pin diameter by more than .031 inches.

**513.13 Pins and Rollers**. Pins and rollers shall be of cold rolled steel and accurately turned to gage; they shall be straight and smooth and entirely free from flaws.

Pins over 9 inches in diameter shall be annealed. In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis.

One pilot and one driving nut shall be furnished for each size of pin.

**513.14** Holes for High-Strength and Bearing Bolts. Holes shall be cylindrical, perpendicular to the member, clean cut, and free of ragged edges. All burrs shall be removed by countersinking not more than 1/16 inch or by grinding. The finished size of the holes for high-strength bolts shall be not larger than the nominal diameter of the bolt plus 1/16 inch and for bearing type bolts the holes shall provide a driving fit. The diameter shall not vary by more than 1/32 inch from a true circle for 85 percent of the holes in a contiguous group, and not more than 1/16 inch for the remainder.

Punched holes shall be made with a die whose diameter does not exceed that of the punch by more than 1/16 inch.

Reaming and drilling shall be done with twist drills, and wherever possible the reamer shall be directed by mechanical means.

Holes for shop bolts shall be subpunched or subdrilled 3/16 inch less in diameter than the nominal diameter of the bolt, and shall be reamed to size with the parts assembled, except:

1. A36 material thicker than 3/4 inch and high strength material thicker than 5/8 inch shall not be punched.

- 2. Materials assembled and adequately clamped together may be drilled full size.
- 3. Secondary and detail material of A36 steel not thicker than 3/4 inch and high-strength steel not thicker than 5/8 inch fastened with high strength bolts may be punched full size.

Holes for field bolts shall be made in the same manner as holes for shop bolts except:

- 1. Field splices in and connections to main material shall be reamed or drilled assembled. See 513.21.
- 2. Assemblies such as floor beams to girders and rolled beam spans connected by diaphragms may be made through steel templates.

All holes punched full size, subpunched, or subdrilled shall be located with sufficient accuracy that after assembling (before subpunched or subdrilled holes are reamed) a cylindrical pin 1/8 inch less in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member without drifting in not less than 75 percent of the contiguous holes in the same plane. All holes shall permit a pin 3/16 inch smaller than the nominal size of the punched holes to be inserted in the above manner.

After holes are reamed or drilled full size, 85 percent of the holes in any contiguous group shall have no offset greater than 1/32 inch between adjacent plies; the remainder of the holes shall not be offset more than 1/16 inch between adjacent plies.

Plugging of improperly located holes is permitted only as approved by the Engineer.

Steel templates shall have hardened bushings in holes accurately located in relation to the centerline of the connection as inscribed on the template. The template shall be accurately positioned and bolted or clamped firmly in place prior to its use in reaming or drilling full-size holes. Templates used for reaming matching members or the opposite faces of a single member shall be exact duplicates. Templates used for connections on like parts or members shall be located with sufficient accuracy that the parts or members are duplicates and require no individual match marking.

Holes through multiple plies shall be reamed or drilled full size only when the plies of the joint are held tightly together with bolts or clamps. The joint shall also be pinned if the holes have been subpunched or subdrilled. The plies shall be disassembled and cleaned of burrs and shavings prior to final assembly.

**513.15 High-Strength Steel Bolts, Nuts and Washers.** High strength steel bolts, nuts and washers shall meet the provisions of 711.09.

1. General. The Engineer shall be furnished the necessary access to the work in order that he may observe the installation, tightening and checking of the bolts.

Based on the experience gained by the Engineer and Contractor during the use of the below described installation and inspection procedures for a particular bridge, the Engineer may elect to modify the amount of testing specified in order to expedite the work while still accomplishing properly compacted joints and tightened bolts.

Consideration will be given to the use of other fastening systems or assemblies and bolt tightening procedures, if a written request is submitted to the Engineer in accordance with 108.05.

The required bolt length shall be determined by adding to the grip the value shown in Table 1. The table values are generalized, with an allowance for manufacturing tolerances, to provide for the nut and a positive "stick-through" at the end of the bolt. For each hardened flat washer that is used, add 5/32 inch, and for each beveled washer add 5/16 inch. The length determined by the use of Table 1 should be adjusted to the next 1/4 inch so that when installed, the end of the bolt shall project several thread lengths outside the face of the nut.

	To determine required bolt
Bolt Size	length, add to grip*
	inches
1/2	11/16
5/8	7/8
3/4	1
7/8	1-1/8
1	1-1/4
1-1/8	1-1/2
1-1/4	1-5/8
1-3/8	1-3/4
1-1/2	1-7/8

TABLE 1

\*Total thickness of all connected material exclusive of washers.

Washers may when necessary be clipped at one location not closer than 7/8 of the bolt diameter from the center of the washer.

2. Preparation. Joint surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of paint (except for inorganic zinc primers), lacquer, dirt, oil, loose scale, rust, burrs, pits and other substances or defects which would prevent solid seating of the parts or would interfere with the development of complete frictional contact. No gaskets or other yielding material shall be interposed.

Bolts, nuts and washers are normally received with a light residual coating of oil and galvanized nuts are provided with additional lubricant. These coatings are not detrimental and need not be removed. However, no additional oil or grease shall be applied.

Hot-dip galvanized contact surfaces shall be lightly scored by wire brushing or brush blasting prior to assembly.

3. Installation. In the final assembly of the parts to be bolted, drift pins shall be placed in a sufficient number of holes (preferably not less than 25 percent for field erection) to provide and maintain accurate alignment of holes and parts, and sufficient bolts shall be installed and brought to a snug tight condition to bring all parts of the joint into complete contact. However in each flange and web of each beam or girder a minimum of two drift pins shall be used. Snug tight shall be defined as the tightness attained when an impact wrench begins to impact or when the full effort of a man using an ordinary spud wrench is applied. Bolts shall then be installed in any remaining open holes and tightened to a snug tight fit, after which all bolts shall be tightened completely by the turn-of-nut method. Where difficulty is experienced with the fit of the connection and the bolts are used to draw the elements into contact, the bolts in the affected portion of the connection shall be checked for sustained snug tightness after all the bolts are installed. Drift pins shall then be replaced with bolts tightened in the same manner.

After the bolts are snug tight, the outer face of the nut shall be match-marked with the protruding portion of the bolt to provide the Engineer visual means of determining the relative rotation occurring between the bolt and nut during the process of final tightening. Such marks shall be made by the wrench operator with crayon or paint.

Each bolt shall have a hardened washer under the element (nut or bolt head) turned in tightening. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism.

Galvanized A 325 bolts shall not be reused. Retightening previously tightened bolts, which have become loose by tightening adjacent bolts, is not considered a reuse.

4. Tightening. Tightening of the bolts in a joint should commence at the most rigidly fixed or stiffest point, and progress toward the free edges, both in the initial snugging up and in the final tightening. If required because of bolt entering and wrench operation clearances, tightening may be done by turning the bolt. Impact wrenches, if used, shall be of adequate capacity to perform the required tightening of each bolt in approximately ten seconds.

5. Bolt Tension. Each bolt shall be tightened to provide, when all bolts in the joint are tight, at least the minimum bolt tension shown on Table 2 for the size of bolt used.

BOLT TENSION		
	Bolt Tension*	
Bolt Size	kips, minimum	
inches	A 325	
1/2	12	
5/8	19	
3/4	28	
7/8	39	
1	51	
1-1/8	56	
1-1/4	71	
1-3/8	85	
1-1/2	103	

TABLE 2

\*Equal to 70 percent of specified minimum tensile strengths of bolts, rounded off to the nearest kip.

The bolt tension specified in Table 2 shall be attained by tightening all bolts in the joint the applicable amount of nut rotation specified in Table 3 by the turn-of-nut method.

		Disposition of Outer of Bolted Parts	Faces
Bolt Length (as	Both faces	One face normal to	Both faces sloped
measured from	normal	bolt axis and other	not more than 1:20
underside of head to	to bolt axis	face sloped not more	normal to bolt axis
extreme end of point)		than 1:20 (bevel	(bevel washers not
		washer not used)	used)
Up to and			
including 4			
diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters			
but not exceeding			
8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters			
but not exceeding			
12 diameters	2/3 turn	5/6 turn	1 turn

 TABLE 3

 NUT ROTATION FROM SNUG TIGHT CONDITION

Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, a tolerance of plus or minus 30 is permitted; for bolts installed by 2/3 turn and more a tolerance of plus or minus 45 is permitted.

6. Inspection. (a) The first completed connection of each bridge on the project and as many subsequent connections as are deemed necessary by the Engineer shall be inspected as per paragraph (b) below. Thereafter where the Engineer has approved the joint compactness and snug tight condition of bolts prior to bolt tightening by the turn-of-nut method, the bolt tension as required in Table 2 shall be considered as attained if the amount of nut rotation specified by Table 3 is verified by the required match-marking.

(b) Bolts shall be inspected by the use of manual torque wrenches furnished by the Contractor. This testing shall be witnessed by the Engineer and shall be performed to his satisfaction. The inspection wrenches shall be calibrated at least once each working day, in a device capable of indicating bolt tension. In this device, which shall have been approved by the Engineer, three bolts representative of the grade, size, length and condition used in the structure shall be placed and tensioned individually. A washer shall be used under the part being turned.

(c) Each of the three bolts shall be tightened in any convenient manner to the tension shown in Table 2. Then the inspection wrench shall be applied by a slow steady pull to the tightened bolt and the torque required to turn the nut or head 5 degrees (approximately 1 inch at a 12 inch radius) in the tightening direction shall be

determined. The average torque measured in the tensioning of the three bolts shall be taken as the job inspection torque.

(d) Bolts represented by the sample described in paragraph (b) which have been tightened in the structure, shall be inspected by applying, in the tightening direction, the inspection wrench and its job inspection torque to 10 percent of the bolts, but not less than two bolts, selected at random in each connection. If no nut or bolt head is turned by this application of the job inspection torque the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspection torque, this torque shall be applied to all the bolts in the connection, and all bolts whose nut or head is turned by the job inspection torque shall be tightened with the inspection wrench to the job inspection torque. The connection shall then be reinspected in the original manner.

7. Calibration Devices. Each calibration device shall be periodically examined by a manufacturer of such devices or by a qualified testing laboratory. Such examination shall be made at least once each year or more often if requested by the Engineer. The testing agency shall certify that each calibration device furnishes, after recalibration if necessary, an accurate indication of actual bolt tension.

**513.16 Bearing Bolts**. Turned, ribbed or other approved bearing type bolts shall meet the provisions of 711.10. The bolts shall be of sufficient length to project at least 1/4 inch beyond the nut when tightened and the threads on the projecting end shall be burred. The thread shall not extend into the shear planes of the contact surfaces between the connected parts. In determining whether the bolt threads are excluded from the shear planes, thread length of bolts shall be calculated as two thread lengths greater than the specified thread length as an allowance for thread run out. A washer not thicker than 1/4 inch may be used under the nut.

**513.17 Welding**. All welding shall be performed by the shielded metal-arc, submerged arc, gas metal-arc, flux cored arc, or stud welding process. Consideration will be given to other methods of metal-arc welding if a written request is submitted to the Engineer in accordance with 108.05.

In other respects, the AWS Structural Welding Code modified by Ohio Department of Transportation Supplements shall govern.

**513.18 Stud Shear Connectors.** Stud welding shall conform to the requirements of 513.17, to the AWS Structural Welding Code modified by Supplement 1027 and the following.

Stud shear connectors that are to be welded to the top flanges of beams or girders shall be placed after the steel has been erected and suitable scaffolding or deck forming has been provided. Studs that are to be welded to beam or girder webs, end dams, bearing plates, or to other secondary members and detail material may be placed in the shop. In addition to the stud bend tests of supplement AWS 4.24 and 4.25, bend tests of stud shear connectors shall also be made at the start of each work day, when welding has been interrupted for an hour or more, when changing grounds, when changing weld settings or when changing cable loop due to arc blow. In any case, no more than 500 studs shall be welded to a beam or girder without the welds being field bend tested in accordance with the specified procedure. All tested studs that show no sign of failure as determined by the Engineer shall be left in the bent position.

**513.19 Threads for Bolts and Pins**. Threads for bolts and pins shall conform to the Unified Standard Series UNC-ANSI B1.1 Class 2A for external threads and Class 2B for internal threads except that pin ends having a diameter of 1-3/8 inches or more shall be threaded 6 threads to the inch.

**513.20 Camber**. Rolled beams shall be cambered as called for on the plans in the fabricating shop by use of heat or hydraulic jacks. Heating shall be controlled as specified in 513.06.

Plate girders shall be cambered by trimming web plates prior to assembly.

Camber shall provide a smooth unbroken curve over the full length of the member.

During fabrication, shipping and erection, members shall be so supported and handled that camber is maintained.

**513.21 Shop Assembly**. All contact surfaces shall be free of paint, grease, oil, rust, loose mill scale and protruding edges or burrs.

The flanges and webs of plate girders shall not be assembled and welded to form the girder, nor shall any fabrication or assembly which would interfere with the repair of a butt weld be accomplished until radiographs of all butt welds in the component parts are examined and approved by the inspector.

All fit-up work shall be done with the members assembled in their unloaded position as shown on the shop drawings layout required by 513.02. While assembled in the shop, members shall be adequately supported to prevent misalignment or deflection, especially at joints. Supports shall be designed to prevent settlement during the fit-up, reaming or drilling of connections. The Fabricator shall maintain records of the actual dimensions and relative positions of each assembly and furnish a copy to the Inspector; this provision shall apply to both horizontal and vertical dimensions. Members that become a part of two assemblies shall be repositioned for the second assembly to the dimensions recorded for the first assembly.

All connecting parts assembled in the shop for the purpose of reaming or drilling of holes for field connections or for fit-up of field welded connection shall be match-marked with steel stamps prior to disassembly.

Continuous beam and plate girders, including sections adjacent to hinged or pin connected joints exclusive of those having sliding bearings loaded in compression, shall have at least three adjacent segments assembled and holes reamed or drilled while assembled. The fit-up of field welded connections shall be checked by similar shop assembly.

Transverse girders, floor beams, and diaphragms into which longitudinal girders or beams frame or connect, shall be shop assembled to check fit-up of connections to be field welded or to ream or drill holes for bolted connections.

Trusses shall be assembled in lengths not less than three abutting panels before field connections are drilled or reamed while assembled.

Deck expansion devices shall be shop assembled after fabrication to check fit-up, straightness and roadway crown.

Parts not completely assembled in the shop shall be secured by bolts, as far as practicable, to prevent damage in handling and shipping. Field splice plates may be bolted in their final position in the shop or shifted laterally with respect to their final positions so that the ends of the plates are flush with the ends of the member.

Welding or tacking will not be permitted on bolted assemblies unless shown on the shop plans and approved by the Engineer. Authorized welding shall be performed according to 513.17.

**513.22** Nondestructive Testing. Nondestructive testing shall conform to the AWS Structural Welding Code modified by Ohio Department of Transportation Supplements and this item.

Welded repairs in main members for thick scabs, deep kerfs or nicks, misplaced holes and similar gross flaws shall be subject to ultrasonic or radiographic inspection as directed by the Engineer.

All examined welds and base metal adjacent to a welded joint shall be subject to the quality requirements specified in 513.17. Welds requiring nondestructive testing shall be allowed to cool before they are tested.

Where controversy may arise, regarding the interpretation of radiographs, magnetic particle indications or the acceptability of welds, the Engineer shall have the final authority to approve the welds.

<u>A. Radiographic Inspection of Welds.</u> Radiographic inspection shall be made of the following welds:

- (1) The full length of all buttwelds in flange material of plate girders or rolled beams.
- (2) The top and bottom one-third of transverse web splices in plate girders or rolled beams including the cope holes, if any.
- (3) Butt welds in longitudinal stiffeners attached to tension areas of webs.
- (4) Twenty-five percent of each longitudinal web splice as selected by the inspector.
- (5) Any other weld specified by the plans.

The radiograph identification mark shown on the shop drawing layout shall be stamped in the area marked "Weld Identification" of AWS Code Figure 6.10.5a in a manner to make it visible in the radiograph of the area without resorting to superimposed like markings. Stamped identification marks on flange plates shall be placed, so that after assembly of girders, they will be on inside of flange, but out of the area to which the web will fasten. Films of repaired welds shall also be identified by the letter "R." Stamped identification numbers shall not be placed within the weld area. Other required markings shall be made by using superimposed characters.

Where areas being radiographed are adjacent to the edge of the plate, the film shall be located and a technique employed which will include the top and bottom images of the plate edge.

Films 4-1/2 by 17 inches shall be used where practicable; the minimum film size shall be 4-1/2 by 10 inches.

Whenever an unacceptable weld occurs in the web sections enumerated, an adjoining 12 inch length of weld not previously examined shall be radiographed; if unacceptable flaws are found in this adjoining segment, the remainder of the weld (if any) shall be examined.

Radiographs submitted to the Inspector shall be accompanied by certification from the Contractor or Fabricator that the radiographic examination was performed in conformance to these specifications and by two copies of the radiographic technician's analysis report listing unacceptable defects and causes for rejection. The technician's report shall also include identification and energy level or source strength in curies of the radiation source, film to source distance, film type, and exposure time for each radiograph as well as the signature of the technician and his NDT level. The contact films shall become the property of the City. <u>B.</u> Magnetic Particle Inspection of Welds. Dry powder magnetic particle inspection shall be made of at least one foot of each ten feet or fraction thereof for each size of weld in the following:

- (1) Flange-to-web welds
- (2) Moment plate to flange welds
- (3) Bearing stiffener welds
- (4) Other welds designated by the plans.

Test sections shall be random locations selected by the Inspector, and the examination shall be conducted with the Inspector observing. The Fabricator shall notify the Engineer at least 48 hours in advance of such inspection. Requests for an Inspector to observe the examination shall be limited to not less than 500 feet of weld unless a lesser amount constitutes the entire project.

The Fabricator shall position the weldments as necessary for the inspection with consideration of safety and convenience to the inspecting personnel.

Weldments shall be inspected after they have been cleaned. Test equipment shall be provided with a functioning ammeter. The magnetizing current shall be 100 amperes per inch of prod spacing but not less than 400 amperes.

When unacceptable defects are found in a section, both adjacent 5 foot segments, or the full length of the weld if it is a lesser amount, shall be tested. Welds requiring repair shall be retested after repairs are completed.

Not all of the enumerated subsurface defects of Article 9.25 of the AWS Code will be located by an inspection of this type. Welds shall be considered unacceptable if they produce such indications that are, in the Inspector's opinion, in excess of the above quality standards.

The Fabricator shall record for each structural member the location of inspected areas, the location and description of any defects found, and repairs made. This report shall be submitted to the Engineer.

- <u>C. Ultrasonic Testing of Welds.</u> Ultrasonic inspection shall be made of the following:
- (1) At least 1 foot in each 10 feet or fraction thereof at locations selected by the Inspector of all complete joint penetration flange-to-web welds.
- (2) Other welds designated by the plans.

**513.23** Shipping, Storage and Erection. Structural members shall be loaded, transported, unloaded, stored and erected in such a manner that they will not be excessively stressed, deformed or otherwise damaged.

During transport, adequate blocking shall be in place between members to prevent movement and facilitate unloading. Field connection holes shall not be used for tie-down unless they are reinforced by additional plates, angles or other material bolted in place. Bearing components shall be banded together.

Material to be stored either in the fabricating shop or in the field shall be placed on skids or blocks to prevent the metal from coming in contact with the ground. Girders and beams shall be placed and shored in an upright position for shipment and both field and shop storage. All material shall be kept clean and properly drained.

Bearing devices and anchorages shall be installed according to 516.

Bearing surfaces and surfaces to be in permanent contact shall be thoroughly cleaned before the members are assembled. During erection, drifting will be permitted to draw the parts into position, but the holes shall not be enlarged nor the metal distorted.

Erection (drift) pins shall be cylindrical and not more than 1/32 inch smaller than the diameter of the hole.

Field splices and connections shall have not less than one-half of the holes filled with pins and snug tight bolts (preferably half bolts and half pins) before the member is released from the hoisting equipment. Field splices and connections commenced prior to erection of the connected parts shall be completed before erection.

Splices and connections subject to construction loads during erection shall have not less than three-fourths of the holes so filled.

Permanent fastening of steel truss tension chord members shall be completed before the falsework is removed, but compression chord members shall not be permanently fastened until the span is released sufficiently from the falsework to bring the compression chord joints into full bearing. Elevations of panel points and ends of floor beams shall be properly regulated and maintained until the falsework is removed.

Enlarging by any method the holes of splices and/or connections between segments or elements of Main members is prohibited without prior approval of the Engineer.

Structures shall be adjusted to correct alignment and camber before permanent fastening is begun.

Crossframes and lateral bracing in continuous beam or girder spans shall not be permanently fastened in any span until all Main connections in adjacent spans have been completed; however, sufficient bracing shall be installed to meet the requirements of 501.06. Where erection bolts are used, they shall be not less than 5/8 inch diameter. Bolts for unpainted applications of A 588 steel shall be A 325, Type 3. Erection bolts shall remain in place with the nut tightened and tack welded to the bolt.

End crossframes and end dams shall be erected in a manner that assures all bearing parts will remain in bearing contact.

**513.24 Cleaning ASTM A 588 Steel**. The exposed surfaces of ASTM A 588 steel that are to be left unpainted shall be free from grease, oil, chalk marks, paint, concrete splatter or other soilage. The use of acid for cleaning will not be permitted.

The outside surfaces and the bottom surface of the bottom flange of the fascia beams (girders) shall be blast cleaned to grade Sa 1 after the superstructure concrete has been placed.

**513.25 Shop Painting**. Steel surfaces specified to be painted shall receive a prime coat applied in the shop (except that structural steel joints containing elastomeric compression seals shall not be painted). Payment for which is included in the price bid for structural steel.

**513.26 Method of Measurement**. Structural steel shall be measured by the plan weight of steel, or by a lump sum, as shown on the plans.

The quantity of structural steel to be paid for shall be the number of pounds as computed from the approved shop drawing by using a unit weight of 490 pounds per cubic foot. Waste material, such as is removed by burning, cutting, machining, etc., shall not be considered as pay weight except for that material removed in the edge preparation for groove welds. Material removed to form bolt holes shall be included in the pay quantity provided that only those portions of the bolts projecting beyond the holes are included for payment. Only bolts and materials that remain in place shall be included. Any thickness and weight of members in excess of that called or on the plans (due to overweight or other cause) shall not be included in determining the weight to be paid for, unless an increase in size of a member has been requested by the Engineer.

Pay weight for steel castings shall be based on scale weights of the finished pieces prior to painting. Castings shall be weighed by the Fabricator, in the presence of the Inspector, and weights recorded on shop bills.

The weight of paint coat, galvanized coat, run-off bars, and weld metal in all field welds and shop butt welds shall not be included. Fillet welds may be included if completely itemized.

The weight of other metals and preformed bearing pads not separately itemized is to be included with the structural steel. The following unit weights in

### 513.27

pounds per cubic foot shall be used: cast steel and deposited weld metal 490, cast iron 450, phosphor or leaded bronze 550, lead 710. The weight of preformed bearing pads shall be calculated as an equivalent volume of lead.

The number of welded stud shear connectors to be paid for shall be the actual number installed and accepted.

**513.27 Basis of Payment**. Payment for accepted quantities will be made at the contract prices for:

Item	<u>Unit</u>	<b>Description</b>
513	Pound	Structural steel (AISC Certification not required)
513	Pound	Structural steel (AISC Category I)
513	Pound	Galvanized structural steel (AISC Category I)
513	Pound	Structural steel (AISC Category III)
513	Pound	Fracture critical structural steel (AISC Category III)
513	Each	Welded stud shear connectors

## **ITEM 514 PAINTING**

- 514.01 Description
- 514.02 General
- 514.03 Materials
- 514.04 Shop Painting New Steel
- 514.05 Field Painting New Steel
- 514.06 Cleaning Existing Steel
- 514.07 Field Painting Existing Steel
- 514.08 Painting Wood
- 514.09 Soil Testing
- 514.10 Method of Measurement
- 514.11 Basis of Payment

**514.01 Description**. This item shall consist of furnishing all paint and incidental materials, cleaning the surfaces, and applying the paint as specified, including soil testing if specified on the plans.

## 514.02 General.

(1) Provisions for Field Inspection. In addition to the requirements of CMS 105.12, the Contractor shall furnish and erect scaffolding or other appropriate access to permit inspection of any portion of the bridge during all phases of the cleaning and painting operations and after the painting is completed. Scaffolding shall meet Ohio Administrative Code and 0.S.H.A. requirements. Rubber rollers, or other protective devices meeting the approval of the Engineer shall be used on

scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

(2) Protection of Persons and Property. The Contractor shall protect all portions of the structure which are not to be painted against damage or disfigurement by splashes, spatters or smirches of paint.

For bridges over railroad tracks the Contractor shall be apprized of the specific requirements of the railroad companies and be in compliance at all times. No work shall commence until certificates of insurance have been furnished to the Engineer and the various railroad companies involved.

The Contractor shall submit to the Engineer for approval a procedure for handling complaints resulting from overspray of moving vehicles. No work shall commence until the method of handling complaints has been approved by the Engineer.

The Contractor shall install and maintain suitable shields between painting operations and open traffic lanes to prevent damage to vehicles traveling on or under the structure. The shields shall be of a type and construction approved by the Engineer to prevent materials from dropping onto or being blown into pavement lanes open to traffic. Shields shall be suitably anchored and reinforced to prevent interference with traffic operations in the open lanes.

Whenever the intended purposes of the protective devices and methods for blasting and painting are not being accomplished, work shall be suspended until corrections are made.

The Contractor shall collect, remove and dispose of all buckets, rags or other discarded materials, and leave the job site in a clean manner and condition.

(3) Pollution Control. The Contractor shall take all necessary precautions to comply with pollution laws, rules and regulations of federal, state or local agencies. In addition, the Engineer shall have the Contractor cease operations if the wind or other conditions are such that the surrounding environment is being detrimentally affected due to the work.

Any additional costs resulting from restrictions or additions to the blast cleaning and painting operations, and any penalties resulting from violation of any pollution control regulations shall be borne by the Contractor.

The Contractor is responsible for cleanup of all blasting debris which may collect on roadways, sidewalks and buildings in the vicinity of the structure at the end of each day's work. Also, should analysis reveal that lead levels in soil samples taken within a specified distance of the bridge have risen above 5 p.p.m.due to the paint removal operation, the cost of removal and legal disposal of the offending soil

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and debris and restoration of the ground to its original condition shall be borne by the Contractor.

(4) Mixing the Coating. The coating shall be mixed with a high shear mixer (such as a Jiffy Mixer), in accordance with the manufacturer's direction, to a smooth, lump-free consistency. Paddle mixers or paint shakers are not permitted. Mixing shall be done, as much as practicable, in the original containers, and shall be continued until all the metallic powder or pigment is in suspension. Care shall be taken to insure that all the coating solids that may have settled to the bottom of the container are thoroughly dispersed. The coating shall then be strained through a screen having openings no larger than those specified for a no. 50 sieve in ASTM E 11.

(5) Thinning the Coating. In general, the coatings are supplied for normal use without thinning. If it is necessary to thin the coating for proper application in cool weather or to obtain better coverage of the urethane topcoat the thinning shall be done in accordance with the manufacturer's recommendations.

(6) Conditions for Coating. Coatings shall be applied only after the following conditions have been met:

The surfaces to be painted shall be clean and free of moisture or frost.

Welds on new work shall be blast cleaned or neutralized.

All cleaned surfaces shall be approved by the Engineer, and painting shall be completed on the inspected surfaces before they have degraded from the prescribed standards, but in all cases within 24 hours.

Temperature. The temperature of the air and steel shall be above  $40^{\circ}F(4^{\circ}C)$  for coatings other than epoxies. For epoxies the temperature of the air and steel shall be above  $50^{\circ}F(10^{\circ}C)$ . Coatings shall not be applied if the temperature is high enough to cause blistering.

Humidity. The coating shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that

a clearly defined thin film of water placed with a damp cloth upon the surface being coated fails to evaporate within 15 minutes.

Before any work commences, the Contractor shall demonstrate the ability to provide the required surface preparation. This will be accomplished on a small area of the bridge near one abutment. The appearance of the blast cleaned demonstration area shall correspond to the applicable pictorial standards of SSPC-VIS 1-67T. Work will not proceed until it is assured that the Contractor can meet those requirements. At that time, work can proceed and the Contractor is expected to clean the remainder of the bridge to the same degree as the demonstration area.

All abrasive and paint residue shall be removed from steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. If the double blowing method is used, the exposed top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free and primed within eight hours after blast cleaning.

Care shall be taken to protect all freshly coated surfaces, appurtenances not intended to be painted, galvanized surfaces and adjacent concrete from blast cleaning operations by masking. Blast damaged primed surfaces shall be thoroughly wire brushed or if visible rust occurs, reblasted to a commercial grade SSPC SP6. The wire brushed or blast cleaned surface shall be vacuumed and reprimed.

Each coat of paint shall be applied in a neat workmanlike manner as a continuous film of uniform thickness which is free of holidays, pores, runs or sags. Spray application shall produce a wet coat at all times; the deposition of semi-dry particles on the surface shall not be permitted. The paint shall penetrate all joints, connections and edges of all surfaces in contact. An approved caulking material shall be used where necessary to seal open joints. The Contractor or Fabricator shall take precaution to prevent contamination of surfaces that have been prepared for painting and surfaces freshly painted. These precautions shall include the suppressing of traffic dust during field painting when necessary, as determined by the Engineer.

The dry film thickness will be determined by use of a magnetic film thickness gage. The gage shall be calibrated on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. A Tooke film thickness gage may be used to verify the coating thickness when requested by the Engineer. If the Tooke gage shows the primer coat to be less than the specified minimum thickness, the total coating system will be rejected even if the total dry film thickness exceeds the minimum total thickness of all coats.

The completion date, month and year, of the finish coat shall be stenciled in a contrasting color at a location directed by the Engineer.

**514.03** Materials. The Contractor shall select a complete coating system from the following products list:

#### 514.04

Producer	Cost	Product	Min. Dry Film Thickness (Mils)
Koppers Company Inc	<u>let</u>	Koppers Organic Zinc	<u>1 IIICKIICSS (IVIIIS)</u> 3
Organic Materials Group	2nd	Koppers Hi-Gard Epoxy	6
Elmhurst Illinois 60126	3rd	Koppers 1122BRS Urethane	2
(312) 530-6300	510.	Koppers 1122DKb Oremane	2
or			
Ameron	1st.	Ameron's Amercoat 68A	3
Protective Coating Division		Zinc Rich Primer	
P.0. Box 349	2nd.	Ameron's Amercoat 383HS	6
Akron, Ohio 44309		Polyamide Epoxy	
(216) 896-3602	3rd.	Ameron's Amercoat 450GL Aliphatic Polyurethane	2
or		1 5	
Mobil Chemical Company	1st.	Mobil Zinc 4	3
Maintenance,		Series' 13-F-4	
Transportation and			
Steel Container	2nd.	Mobil's High Solids	6
Coatings Department		Epoxy 76 Series	
901 North Greenwood Ave			
Kankakee, Illinois 60901	3rd.	Val-Chem Urethane	2
(815) 933-5561		Enamel 40 Series	

All three coats shall be manufactured by the same company. The color of the coatings shall be as selected by the Engineer. Before any coating work commences, the Contractor shall furnish the Engineer with the product data sheets, which shall indicate the mixing and thinning directions and recommended application equipment and instructions.

The coating materials specified can be hazardous to the health of the applicator if not applied as per manufacturer's instructions. The Contractor shall follow the recommendations contained on the material safety data sheet, product data sheet and the label on the paint containers. These precautions shall include the use of respirators and eye and skin protection as specified. The Contractor shall comply with the City's "Right to Know" laws as defined in Chapter 100 of the City Code.

**514.04** Shop Painting New Steel. Oil and grease shall be removed from surfaces to be painted with a suitable solvent prior to cleaning by blasting.

Steel surfaces specified to be painted shall be prepared in conformance with ASTM D 2200 by blast cleaning to grade Sa 2-1/2, except for interior surfaces that are inaccessible to blast cleaning after fabrication which may be cleaned by scraping and brushing to grade St 3.

Cleaning shall be done with abrasives suitable to produce a surface having a nominal height of profile equal to or greater than 2 mils but not greater than 3 mils, and having a texture similar to that obtained by use of grit or sand.

The prime coat shall be applied within the shop and the steel shall not be handled unnecessarily or removed from the shop until the paint has dried sufficiently to allow thickness gaging and to resist being marred in handling and shipping. Pins, pin holes and contact surfaces of bearing assemblies, except those containing self-lubricating bronze inserts, shall be painted with one coat of prime paint.

Erection marks shall be applied after the prime coat is dry, using a thinned paint of a type and color which will be completely concealed by and compatible with the second coat. The Fabricator's name may be applied in a similar manner by use of a stencil or by use of removable tape.

The coating system used for the shop paint shall match that selected for the field painting.

A prime coat shall be applied to all steel surfaces including contact surfaces of connection or splice material which are to be fastened with high strength bolts but excluding surfaces which are to be imbedded in concrete and surfaces within 2 inches of field welds other than those attaching intermediate or end crossframes to beams or girders.

The dry film thickness for the prime coat shall be not less than 3 mils or more than 10 mils, except that on faying surfaces of bolted splices the thickness shall not exceed 5 mils. Thick films shall be reduced by screening, sanding or sweep blasting. Any recoating of prime paint that has cured longer than 24 hours with prime paint shall be done as recommended by the paint manufacturer's printed instructions.

If "mud cracking" occurs, the affected area shall be scraped to soundly bonded paint and the area recoated.

Uncured paint damaged by rain, snow or condensation shall be permitted to dry; the damaged paint shall then be removed and the surface repainted.

**514.05 Field Painting New Steel**. Before the steel is erected, surfaces other than contact surfaces which will later be inaccessible for painting shall be given one coat each of intermediate and finish paint. Field painting of the interior of voided or hollow sections where the void is permanently sealed from the weather is not required.

After the steel is erected, field bolts, field welds and adjacent surfaces, edges of contact surfaces and all surfaces from which the prime coat was omitted or has been removed or has become defective shall, using procedures specified in 514.04, be cleaned and painted with one spot coat of the same type and color paint as used for the prime coat. The prime coat shall be free of foreign materials and, if necessary, the steel shall be cleaned by the use of bristle brushes, high pressure water spray or washing with solvents and recoated.

All exposed steel surfaces shall receive intermediate and finish coats of paint. Adequate curing time shall elapse between the application of the prime and intermediate coats, and between the intermediate and finish coats, as determined by the Engineer, but in no case less than that recommended by the paint manufacturer's printed instructions. The coatings shall be applied by spray methods except that small touch up areas may be brushed. The minimum dry film thickness shall be as specified in 514.03. Concrete shall be shielded to protect it from overspray and to permit complete coverage of the steel surfaces adjacent to the concrete.

**514.06** Cleaning Existing Steel. Prior to commencing any paint removal operations, the Contractor shall submit to the Engineer for approval the method of worker protection and details of the methods of paint removal, containment and recovery. When the existing coatings on the structure consist of lead based paint systems, the Contractor shall provide suitable respiratory and eye protection to all workers and inspectors in the vicinity of blasting operations. To eliminate environmental health hazards of lead particulates polluting the air, water and soil, the Contractor shall provide a blast enclosure or use vacuum-shrouded blasters and hand tools as necessary in order to contain and recover all removed paint as nearly as practicable, as determined by the Engineer.

All ungalvanized steel surfaces to be painted shall be blast cleaned, and areas of oil and grease shall be cleaned with clean petroleum solvents and then blast cleaned, per SSPC-SP1O-near white blast cleaning to SSPC-VIS-1 pictorial standard (grade Sa 2-1/2). Abrasives used for blast cleaning shall be either cast steel shot and grit, malleable iron shot and grit, chilled cast iron shot and grit, crushed metal refining slag, zircon, novaculite, copper slag, silicon carbide, or aluminum oxide. Not more than 1 percent by weight of the abrasive shall be able to pass through a no. 70 U.S. standard sieve, and after blasting not more than 1.8 percent by weight shall be 0.005 millimeters or smaller. The abrasive shall have a gradation which will produce a uniform profile of 2 to 3 mils, as measured with replica tape, or by other approved methods.

At piers, a minimum of 5 feet on each side of the piers shall be blast cleaned on the same day and primed as a unit to prevent damage to previously primed surfaces.

All fins, tears, slivers and burred or sharp edges that are present, or that appear after blast cleaning, shall be removed by grinding, and the area reblasted to give a 2-to 3-mil surface profile.

Scaling hammers may be used to remove heavy scale, but heavier type chipping hammers that would excessively scar the metal shall not be used.

**514.07** Field Painting Existing Steel. After the surfaces to be coated have been cleaned and approved by the Engineer, the coatings shall be applied with the spray equipment in accordance with the paint manufacturer's printed instructions so as to attain the film thickness specified. The recommended pressures and nozzle sizes must be supplied to the Inspector.

Compatible brushes and rollers may be used for portions of the structure inaccessible with spray equipment. Bristles and roller material shall not be left in the paint film. If this occurs, no further coating shall be done until system-compatible application equipment is obtained and used. The minimum dry film thickness shall be as specified in 514.03.

The visual differentiation of coats shall be facilitated by the prime coat color obviously differing from the near-white steel substrate and by the intermediate coat color obviously differing from both the prime coat color and the finish coat color.

All dry spray shall be removed, by sanding if necessary. In areas of deficient primer thickness the areas shall be thoroughly cleaned, with power washing equipment if necessary, to remove all dirt, wire brushed, vacuumed and recoated.

At least 24 hours, but no more than 7 days, shall be allowed for curing of a coat before applying a succeeding coat.

After the steel is primed, it shall be vacuumed before any remaining coats are applied, and vacuuming between paint coats shall be continued until the entire blasting operation is completed, at which time vacuuming may be suspended by the Engineer. If for any reason vacuuming does not remove all the accumulated dust and/or dirt, or if more than three (3) weeks has elapsed since the steel was primed, or if in the opinion of the Engineer the surface is unfit for additional coating, the surface shall be scrubbed with a mild detergent solution (any commercial laundry detergent) and thoroughly rinsed with clean water before applying additional coating.

All coating shall be done in a neat and workmanlike manner as described in SSPC-PA 1, producing a uniform even coating which is bonded to the underlying surface. All metal coated with impure, unsatisfactory or unauthorized coating material or coated in an unworkmanlike or objectionable manner shall be thoroughly cleaned and recoated or otherwise corrected as directed by the Engineer. If the application of coating at the required thickness in one pass produces runs, bubbles or sags, the coating shall be applied in multiple passes of the application equipment, the passes separated by several minutes. Where excessive coating thickness produces "mud-cracking", such coating shall be scraped back to soundly bonded coating and the area recoated to the required thickness.

Particular care shall be given to rivet heads, bolts, edges and corners to ensure adequate coverage.

**514.08 Painting Wood**. New wood shall be painted with a prime coat, a second coat and a finish coat, all of 708.05 except where black paint is specified. Black paint shall conform to 708.11. Butt ends of timbers and all surfaces inaccessible after erection shall be well coated with white lead paste before erection.

Previously painted wood shall have all cracked or peeling paint, loose chalky paint, dirt and other foreign matter removed by wire brushing, scraping or other approved means immediately before repainting.

**514.09 Soil Testing**. Environmental sampling and analysis or lead in the soil beneath and, within a distance noted on the plans, on either side of the bridge shall be conducted prior to blasting operations and after completion of painting. Locations of sampling sites shall be determined by the Engineer.

Analysis of the soil samples for determination of the mobile/fraction of lead in the soil shall be performed according to the extraction procedure (EP) toxicity test in accordance with Environmental Protection Agency requirements.

All sampling and analysis shall be performed by an independent testing laboratory selected by the Contractor subject to the approval of the Engineer and the City of Akron.

**514.10** Method of Measurement. Field painting of structural steel and wood are based on lump sum. Soil testing will be measured as the actual number of samples taken and analyzed.

**514.11 Basis of Payment**. Shop prime painting of new steel is included in the unit price bid for structural steel. Payment for accepted quantities of field painting and soil testing will be made at the contract price for:

Item	<u>Unit</u>	<u>Description</u>
514	Lump Sum	Field painting new steel
514	Lump Sum	Field painting existing steel
514	Lump Sum	Field painting wood
514	Each	Soil testing

#### ITEM 515 PRESTRESSED CONCRETE BRIDGE MEMBERS

- 515.01 Description
- 515.02 General
- 515.03 Materials
- 515.04 Plant Requirements
- 515.05 Casting Beds
- 515.06 Cold Weather Operations
- 515.07 Equipment
- 515.08 Inspection Facilities
- 515.09 Construction Methods
- 515.10 Concrete
- 515.11 Release of Prestressing Strands

# 515.12 Transportation, Storage and Erection515.13 Method of Measurement515.14 Basis of Payment

**515.01 Description**. This item shall consist of the manufacture, transportation, storage and erection of prestressed concrete bridge members produced in accordance with the plans, proposal and these specifications.

**515.02** General. Fabricator approval shall be in accordance with 501.04. Shop drawings shall be prepared, submitted and approved according to pertinent paragraphs of 501.05 and 513.02.

All members shall be produced in accordance with 511, except as herein provided.

**515.03 Materials**. Material shall conform to the following:

Concrete	
Aggregate*	
Portland cement	701.01 thru 701.06
Air-entraining admixture	
Chemical admixtures for concrete	
Prestressing steel	711.27
Reinforcing steel	
Transverse tie rods	711.01

\*Coarse aggregate shall be modified as follows:

Deleterious materials, max 0.4%

Gradation shall be No. 57, No. 6, No. 67, No. 7, No. 78 or No. 8 standard size coarse aggregate.

**515.04 Plant Requirements.** Plants for the manufacture of precast pretensioned bridge elements shall be approved by the Engineer before bridge elements are produced. Requests for such approvals shall be submitted to the Engineer at least three weeks prior to the date of manufacture of elements. Requests shall include details of the plant facilities and the production method the manufacturer intends to use. Satisfactory qualification on previous projects of similar type will be accepted as prequalification, provided plant operations continue to be satisfactory.

**515.05 Casting Beds**. Casting beds shall be constructed of steel or concrete. The beds shall be above grade to insure that they will not be submerged due to accumulation of water as a result of curing operations. Beds and abutments shall be so designed that they are capable of safely resisting all forces applied to them without appreciable movement or deflection. These forces consist of compression

and eccentric forces due to end-jacking operations, forces at holddown points when draped strands are used and downward forces due to the dead weight of the members.

**515.06** Cold Weather Operations. The following procedures will be employed when the ambient air temperature is below 50°F. Mixing water, aggregates or both shall be heated as necessary to result in concrete temperatures not less than 50°F and not more than 70°F when placed. Water heated above 150°F shall not be permitted to come in contact with forms, reinforcing steel, prestressing strand or other hardware materials having a temperature less than 32°F. When casting bed temperatures are less than 30°F, prestressing strand shall be tensioned to provide the design tension at 50°F.

**515.07 Equipment.** Hydraulic jacks of sufficient capacity and stroke shall be used for tensioning strands. Either single or multiple strand tensioning may be used. Tensioning jacks shall be equipped with automatic cutoff valves and gages with a minimum diameter of 6 inches and 500 pound increments. Gages shall be calibrated for the jacks with which they are to be used and a graph or table showing the calibration shall be furnished the Inspector. Two calibrated gages shall be provided for jacks, one of which shall be used during routine stressing, while the other is locked out and used only by the Inspector to verify the accuracy of the working gage. Calibration of jacks shall be done by a method acceptable to the Laboratory, at least once every six months or as ordered by the Engineer.

The jacking system shall be of such design as to insure uniform stress in all strands. When multiple strands are tensioned simultaneously, plants shall be equipped with approved types of dynamometers for equalizing the initial stress on all strands prior to application of the full tensioning load with the master jack. The capacity of the dynamometers shall be such that the desired readings are in the middle to upper range.

**515.08** Inspection Facilities. The plant shall provide a minimum floor area of 120 square feet for the use of Inspectors. This area shall be adequately heated and ventilated and equipped with necessary desks, chairs, tables and electrical outlets.

**515.09 Construction Methods**. Forms shall be adequate to produce members within the tolerances set forth on the plans. Only metal forms shall be used, with the exception of bulkheads and voids. The surface of the forms in contact with the concrete shall be smooth, and the joints between panels shall be tight. The soffit form shall have a plane surface at right angles to the vertical axis of the members and the two bottom edges shall be beveled 3/4 inch with a triangular strip built into the forms.

The length of the members shall be increased by the amount expected for elastic shortening and normal concrete shrinkage, and the forms shall be so designed that they will not resist this movement. Forms for voids in box beams shall be water-resistant and shall be constructed of a material that will resist breakage and deformation during the placing of the concrete, and they shall not excessively increase the dead load of the beams.

When forms are coated in accordance with 508.03, care shall be taken to prevent the oil from coming in contact with the prestressing strands or other reinforcing steel.

Strands shall be accurately placed in the positions shown on the plans. Strands with kinks, bends, nicks, broken wires or other defects, including scale or loose rust, will not be permitted. Slight rusting, provided it is not sufficient to cause visible pits, shall not be cause for rejection. Before placing of the concrete, the strands shall be carefully cleaned of all dirt, grease, oil or other foreign matter. Splicing of the strands within a member will not be permitted.

Each strand shall be tensioned to the stress indicated on the plans. When two or more strands are stressed by one jack, each strand shall be individually stressed to about 1000 pounds by means of a dynamometer before being attached to the jacking system. The required stress in the strands shall be measured by the jacking equipment and checked by the elongation of the strands. A record shall be kept of all jacking forces and elongations.

The strands shall be secured by suitable anchorage devices capable of developing at least 85 percent of the ultimate strength of the strands. The anchorage shall be such that no slippage of the strand will occur after the tensioning operation.

When draped strands are used the loss of stress due to friction shall not exceed 5 percent, which shall be proved to the satisfaction of the Inspector. In order not to exceed 5 percent, the strands shall be tensioned at both ends if necessary. Hold-down points shall be placed within 12 inches of the locations shown on the plans.

**515.10 Concrete**. The concrete shall be machine mixed according to 499 except that 499.03 does not apply. The concrete shall contain 6 plus or minus 2 percent entrained air and slump shall be maintained within the range 1 to 4 inches.

The concrete shall be proportioned of materials specified in 515.03 to provide a minimum cylinder strength of 5500 psi in 28 days, as determined from the testing by the Laboratory of at least 2 cylinders. Each pair of cylinders shall have an average strength of not less than 5500 psi and each cylinder shall have at least 90 percent of this strength. A minimum of 2 cylinders shall be cast for each 200 feet of beam produced in a day, or each casting bed used per day.

Calcium chloride or admixtures containing calcium chloride are prohibited.

Concrete may be placed in the bottom flange of a box beam before the interior forms and reinforcement for the upper portion of the member is placed, providing continuous placement is not interrupted for more than 45 minutes.

The top surfaces of non-composite members shall be screeded and finished with a burlap drag or other means to provide a uniform surface with a gritty texture suitable for waterproofing. The top surface of composite members shall be screeded and given a wire broom finish, in a transverse direction, penetrating the finished surface approximately 1/4 inch.

The concrete shall be given an accelerated cure by low pressure steam or radiant heat within a suitable enclosure to contain the live steam or heat. The initial application of the steam or heat shall be from two to four hours after the final placement of concrete to allow the initial set to take place. If retarders are used, the waiting period shall be increased to four to six hours. The time of initial set may be determined by ASTM C 403, and the time limits described above may then be waived.

During the waiting period the temperature within the curing enclosure shall be not less than  $50^{\circ}$ F.

During the initial application of live steam or radiant heat, the ambient temperature within the curing enclosure shall increase at an average rate not exceeding 40°F per hour until the curing temperature is reached. The maximum curing temperature shall not exceed 160°F. The maximum temperature shall be held until the concrete has reached the desired strength. Detensioning shall be accomplished immediately after the steam or radiant heat curing has been discontinued. Additional curing is not required after detensioning.

(1) Curing with low pressure steam. Application of live steam shall not be directed on the concrete forms so as to cause localized high temperatures.

(2) Curing with radiant heat. Radiant heat may be applied by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. Moisture loss shall be minimized by covering all exposed concrete surfaces with plastic sheeting or by applying an approved liquid membrane curing compound to all exposed concrete surfaces. Shear faces of composite members and other surfaces to which field-cast concrete or other materials will be bonded in the finished structure shall have the curing compound removed from them unless tests are performed which prove that the residue of the membrane does not reduce the bond on the shear face below the design value.

Cavities in the exposed surface of beams shall be neatly filled with grout. Honeycomb that is considered to impair the member shall be cause for rejection.

**515.11 Release of Prestressing Strands**. Prestressed strands shall not be released until the concrete has reached a strength of at least 4000 psi as determined

by the testing of pairs of concrete cylinders made according to AASHTO T 23, cured by the exact method used to cure the beam, and tested according to AASHTO T 22. These cylinders shall be tested in the manufacturer's laboratory. The Inspector shall be notified in advance and shall have the right to observe the testing of the cylinders by the manufacturer.

The strands shall be released immediately after accelerated curing by steam has been discontinued. Prior to release of prestressed strands, forms and hold-downs which restrict either horizontal or vertical movement of prestressed members shall be loosened or removed.

Each strand shall be burned or heat released simultaneously at selected exposed points between anchorages and the sequence should follow a predetermined pattern, approved by the Engineer, to equalize the forces being transferred to the various areas of the cross section of the member. For heat release, a low-oxygen flame shall be used with at least a 4 inch length of strand being uniformly heated.

**515.12 Transportation, Storage and Erection**. Prestressed members shall not be shipped until the 28 day design strength of the concrete is reached.

The members shall be stored, transported and erected in an upright position, and points of support and direction of reactions shall be approximately the same during storage and transportation as when the members are in their final position. Whenever members are to be stored, care shall be taken to provide unyielding horizontal supports capable of maintaining the members in a vertical position. If it is found necessary to transport the members in any position other than vertical, it shall be done only with the written approval of the Engineer. The members shall be lifted by approved lifting devices. Members damaged by improper handling, storing, transportation or erection shall be replaced at no expense to the City.

**515.13 Method of Measurement**. The quantity shall be the number of members, or the linear feet of members.

This item includes all inserts, sleeves, fittings, reinforcing steel fully or partially encased in the members, and all transverse tie rods necessary to complete this item.

Concrete diaphragms 511 and bearing plates or pads or other expansion materials 516 will be paid for as separate items.

**515.14 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
515	Each	Prestressed concrete bridge members
515	Linear Foot	Prestressed concrete bridge members
# ITEM 516 EXPANSION AND CONTRACTION JOINTS, JOINT SEALERS AND BEARING DEVICES

- 516.01 Description
- 516.02 Materials
- 516.03 Expansion and Contraction Joints
- 516.04 Joint Sealer
- 516.05 Bearing Devices
- 516.06 Method of Measurement
- 516.07 Basis of Payment

**516.01 Description**. This item shall include the furnishing of all materials and labor necessary to fabricate, assemble, construct, paint, coat, and install expansion and contraction joints, vertical extension of structural expansion joints, joint sealers or bearing devices of the type and size necessary specified. The fabrication and painting of joints and bearings shall conform to 513 and 514 respectively.

**516.02** Materials. Materials shall conform to the following:

711.15
711.16, 711.17, 711.18
711.19

Mill test reports for structural steel, steel castings, bronze and sheet lead shall be submitted according to 501.07.

**516.03 Expansion and Contraction Joints**. Open expansion joints shall be completely open for the dimension specified for their full length. Care shall be taken to remove all stones, forms or other material that would in any way interfere with expansion.

The surfaces against which preformed expansion joints are to be placed shall be finished to a smooth, uniform surface. The expansion joint materials shall be adequately anchored, but methods of fastening that interfere with the free compression of the joint material shall not be used. The joint material shall neatly fill the space, and have a uniform thickness for the full extent of the joint. Preformed joints between sliding surfaces shall consist of two thicknesses of joint material, laid without surface irregularities and with joints in the layers staggered.

Folded metal joints shall be watertight, and so placed that the fold will be free from kinks. The splices shall be riveted and soldered. At bends the strip shall be preferably one piece.

**516.04 Joint Sealer**. The surface to which joint sealer is applied shall be prepared as follows: concrete shall be cleaned of all foreign matter, curing compounds, oil, grease, dirt, free water and laitance; steel shall be thoroughly cleaned by sand blasting.

The joint sealer shall have a minimum depth of 1 inch at its thinnest section. Joints shall be filled to within 1/4 inch of the roadway surface.

No joint sealer shall be placed in contact with any bituminous material but shall be separated from it by a barrier of foil or other material that is impervious to bitumen.

Where it is required to prevent bonding of the joint sealer with a joint surface, a suitable bond breaker barrier shall be placed, at no extra cost, before applying the joint sealer.

Any joint sealer that is intended to be bonded but is not bonded to the joint face 24 hours after placing, shall be removed and the joint shall be thoroughly cleaned by sand blasting and resealed at the Contractor's expense.

The mixing and placing instructions of the manufacturer shall be adhered to. A copy of these specifications for the application shall be filed with the Engineer.

Joints which will be subjected to concrete protective coatings containing mineral spirits shall have the sealer protected by an impervious masking tape during the application of the protective coating.

**516.05 Bearing Devices.** For sliding plates the sliding surfaces shall be lubricated with flake graphite and one shall be superimposed on the other with their edges flush.

Concrete surfaces on which sheet asbestos packing is to be placed shall be finished smooth with a metallic trowel.

Elastomeric bearings, bearing pads and bolsters shall be accurately set as to level and alignment. Bearing plates and bolsters shall be bedded on sheet lead 1/8 inch thick, meeting the requirements of 711.19, or preformed bearing pads 1/8 inch thick, meeting the requirements of 711.21.

Elastomeric bearing pads shall be set directly on the concrete surface. Bearing plates or bolsters shall be placed upon bridge seat areas which are plane and smoothly finished. If the bridge seat area is high or uneven, proper elevation and a level surface shall be secured by bushhammering or grinding the area and then smoothing with a thin film of portland cement mortar or paste to fill the pitted surface. If the bridge seat area is low, the proper elevation shall be secured by the use of steel plate shims of the same bearing area as the bearing plates and bolsters.

Rockers or rollers shall be so placed that when the bridge is completed and at  $60^{\circ}$ F the rockers will stand in a vertical position and the rollers will center on the base.

Anchor bolts that are clear of the beam or girder flanges shall be set in the concrete after the erection of the main structural steel, except as hereafter specified for bearing devices at abutments. When structural steel will interfere with the setting of the anchor bolts, they shall be set before the steel is erected by the use of a template for support and embedded in the concrete when it is placed, or by drilling or forming the holes. Bearing devices at abutments shall not be permanently fastened to the abutments, steel beams or girders until the abutments have been backfilled to within one foot of the top of the bridge seat. Reinforcing steel in the bridge seat shall be placed so that it will not interfere with the drilling of anchor bolt holes. Anchor bolts shall be accurately set in the holes and bedded in cement mortar. Care shall be used to prevent the entrance and freezing of water in anchor bolt holes.

Swedged anchor bolts or bars shall be fabricated by deforming a minimum of 20 percent of the embedded bolt surface with deformations whose radial dimensions are 15 to 20 percent of the bar diameter.

**516.06 Method of Measurement**. The quantity shall be the actual number, linear feet, square feet, or pounds. The quantity for structural steel expansion joints extended vertically, for the purpose of deck resurfacing, shall be the actual horizontal length of joint.

**516.07 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
516	Lin. Ft., Lb.	Structural steel expansion joints
516	Lin. Ft.	Structural expansion joints inc. elastomeric seals
516	Lin. Ft.	Elastomeric compression seals for structural steel joints, width.
516	Lin. Ft.	Folded copper strip
516	Lin. Ft.	Vertical extension of structural expansion joints
516	Sq. Ft.	Preformed expansion joint filler
516	Lin. Ft.	Joint sealer
516	Ea., Lin. Ft.,	

	Sq. Ft., Lb.	Bearing devices
516	Ea.	x Elastomeric bearing pads
516	Ea.	x Laminated elastomeric bearings
516	Sq. Ft.	1/8-inch Preformed bearing pads

# **ITEM 517 RAILINGS**

- 517.01 Description 517.02 General
- 517.02 General
- 517.04 Steel and Iron Railings
- 517.05 Aluminum Railings
- 517.06 Method of Measurement
- 517.07 Basis of Payment

**517.01 Description**. This item shall include the furnishing of all materials and the necessary labor to construct and erect the completed railing of the type specified. Structural posts, anchors, connections, anodizing and galvanizing are a part of this item.

**517.02** General. The line and grade of the railing shall be true to that shown on the plans. Railing posts, panels and openings shall be vertical, except that posts for low metal railings on concrete parapets shall be normal to grade line. Tops of railings shall be parallel to grade line.

The shores or falsework supporting the superstructure shall be removed or released before placing railing that has no expansion joints or that is of the concrete parapet type.

**517.03 Materials**. Railing materials shall conform to the following:

Concrete, Class S	
Reinforcing steel	
Structural steel	513
Ductile iron castings	711.13
Aluminum	
Stainless steel fasteners	711.14
Metal deep beam rail	710.06
Timber	
Paint	
Pipe	
Steel tubing	
Preformed fillers (sponge rubber or PVC)	

Mill test reports for structural steel and aluminum shall be submitted according to 501.07.

**517.04 Steel and Iron Railings**. All parts of steel and iron railings shall be galvanized except where painting according to 514 is specified.

Erection of metal deep beam rail elements shall be in accordance with 606.

**517.05** Aluminum Railings. The materials for aluminum railings shall be an alloy conforming to 711.20.

The extreme outer surfaces of cast railing posts shall be given a 40-grit finish. No special finish shall be required for other portions of railings, but care shall be taken to avoid scratches, dents or other defects that may affect the durability or appearance of the railing.

Anchor bolts and hexagon nuts shall be galvanized steel conforming to 711.02. The entire projecting portion of such bolts shall be coated with aluminum-impregnated caulking compound and the space between the bolts and the post base shall be filled with the same material.

Where aluminum is to be in contact with concrete or stone masonry, the contact surfaces shall be thoroughly coated with an aluminum-impregnated caulking compound or with heavy bituminous paint, provided the exposed paint shall be pigmented with aluminum powder or paste, so as to have an aluminum appearance. Where aluminum is to be in contact with another metal, the contact surface shall be thoroughly coated with an aluminum-impregnated caulking compound, or a synthetic rubber impregnated fabric gasket shall be used. Aluminum shims, if required, shall be similarly separated from other metals.

Welding will be permitted only where specifically called for on the plans, and it shall be done by the inert gas shielded metal-arc or tungsten-arc method without flux, or by other approved methods.

**517.06 Method of Measurement**. The footage shall be the actual length of railing including end posts. Where deep beam guardrail is used the footage shall be the length of railing between the first posts off the bridge. Where hand rails or tubular backup rails are used any portions extending beyond the first posts off the bridge shall not be measured for payment, but are included for payment in the unit price bid for the measured footage.

**517.07 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
517	Linear Foot	Railing

### **ITEM 518 DRAINAGE OF STRUCTURES**

518.01 Description
518.02 Materials
518.03 General
518.04 Porous Backfill
518.05 Pipe
518.06 Scuppers
518.07 Painting
518.08 Excavation
518.09 Method of Measurement
518.10 Basis of Payment

**518.01 Description**. This item shall consist of constructing drainage systems according to the details and dimensions called for on the plans. All work shall be governed by the parts of this specification that are applicable.

**518.02** Materials. Drainage materials shall conform to the following:

Porous backfill shall be durable gravel, stone or air-cooled blast furnace slag, No. 467, No. 57, No. 67, No. 6 or No. 78 size. The sodium sulfate soundness loss shall not exceed 15 percent.

Pipe specials shall be of a grade at least as high as the type of pipe specified.

Plastic pipe	
Other metals	

Mill test reports for all metals shall be submitted according to 501.07.

**518.03 General.** The structure drainage shall be a satisfactory operating system and all parts shall be properly connected to new or existing sewers or other outlets, insofar as such connections are called for on the plans.

Special care shall be exercised to prevent sags and low points. In making superstructure installations the deflection of spans under full dead load shall be taken into account.

**518.04 Porous Backfill**. Porous backfill shall be placed behind the full length of abutments, wing walls and retaining walls with a thickness normal to the abutment or wall face of not less than 18 inches except that undisturbed rock or shale

#### 518.05

within this limit need not be removed. The bottom of the porous backfill shall be between 3 and 6 inches below the weep holes of perforated pipe except that it shall extend no lower than the bottom of the footing when the bottom of the perforated pipe is specified to be placed at the elevation of the adjacent footing. The top surface shall coincide with the plane of the subgrade within the roadway area extended laterally to the wing walls or to the embankment side slopes. Sufficient coarse aggregate or other material shall be placed immediately adjacent to but not more than 6 inches below the bottom of the weep hole to retain the porous backfill. The method of compacting the fill shall be as described in 203, and the combination of material sizes used shall be such as to obtain a rigid unyielding fill, which will also permit free drainage through the open voids to the outlet system.

**518.05 Pipe**. Conductor pipe leading down from the superstructure shall be either alloy steel pipe, 707.11; galvanized steel pipe, 707.08; or plastic pipe, 707.19. The specials, elbows, tees, wyes, etc., essential for a complete and satisfactory installation shall be supplied in the same material and have the same quality as the pipe furnished.

Joints shall be watertight and have adequate strength. In steel pipe, they shall be made by welding or by use of clamp-type couplings having a ring gasket; in plastic pipe, joints shall be made in accordance with the pertinent ASTM specification. The pipe shall be securely fastened with hanger and/or clamp assemblies to the structure. These assemblies shall be galvanized in accordance with 711.02 or be painted as specified for alloy steel conductors when used with plastic and galvanized or alloy steel pipe respectively.

Alloy steel conductors and accessories shall be painted in accordance with 514.

Subsurface pipe shall be placed as described in 551.

For corrugated metal pipe, specials need not be perforated and bends may be made with adjustable elbows meeting the gage and thickness requirements of the pipe specifications.

**518.06 Scuppers.** All connections shall be secure and watertight, including the connection to adjacent concrete. Castings shall be sound and shall be true to form and dimension. Structural steel scuppers shall have welded joints. All work shall be neatly finished. Scuppers shall be galvanized according to 711.02.

**518.07 Painting**. All exposed steel surfaces except galvanized surfaces shall be painted according to 514. The color of coats shall be such as to match the color of the adjacent concrete or steel surface.

Painting shall be included with the pertinent drainage item for payment.

**518.08 Excavation**. The excavation needed for the installation of the pipe or other drainage facility back of abutments and for outlets, including removal of all materials encountered, shall be of such dimensions, with necessary sheeting and bracing, as to give ample space for satisfactory construction. Backfill and excavation not separately itemized shall be considered as included for payment with the drainage facility which necessitates them.

**518.09 Method of Measurement**. The quantity or quantities shall be the actual amount of each kind and size, according to the specified unit of measurement. Pipe specials shall be measured by the same method as the pipe proper; if pipe is by the linear foot, it shall be measured along its center line.

Subdrainage for wearing surface course shall be measured as the length of the longitudinal conductor.

**518.10 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
518	Cubic Yard	Porous backfill
518	Linear Foot	inchPipe, including specials
518	Each	Scuppers, including supports
518	Pound, Linear Foot	Trough horizontal conductors
518	Pound, Linear Foot	Pipe horizontal conductors
518	Linear Foot	inch Pipe downspout including specials

## **ITEM 519 PATCHING CONCRETE STRUCTURES**

- 519.01 Description
- 519.02 Materials
- 519.03 Determination of Repair Areas
- 519.04 Removal of Disintegrated Concrete
- 519.05 Cleaning and/or Replacement of Reinforcing Steel
- 519.06 Preparation of Surface
- 519.07 Patching with Concrete
- 519.08 Method of Measurement
- 519.09 Basis of Payment

**519.01 Description**. This item shall consist of the removal of all loose and disintegrated concrete, the preparation of the surface, the furnishing and placing of the reinforcing steel including welded steel wire fabric, dowels and expansion bolts, the coating of the surface with cement grout and the placing of concrete patches, including curing of same. All operations not described in this item shall be done in

accordance with the requirements of the item of these specifications that apply to the particular kind of work being done.

**519.02 Materials**. Materials shall conform to the following:

Concrete Class S	
Dowels	709.01, 709.03 or 709.05
Reinforcing steel	
Welded steel wire fabric	709.10 or 709.12

\*Aggregate for Superstructure shall meet the requirements of 703.02 and shall be No. 57 or No. 8 size.

**519.03 Determination of Repair Areas.** The Contractor shall make a detailed examination of the surfaces to be repaired. Hammer and/or chain drags of a type designed for the purpose of examining concrete shall be furnished by the Contractor and used, as directed by the Engineer, to determine, by sound or by loosening disintegrated surface concrete, the limits of concrete to be repaired. The area limits of repair shall be marked by the Contractor as directed by the Engineer.

All existing asphalt patch material shall be removed, whether sound or not.

For vertical surfaces, the Contractor shall furnish and erect scaffolding, or provide other appropriate access to permit the examination of concrete surfaces to be repaired. Scaffolding shall meet the Ohio Administrative Code and 0.S.H.A. requirements.

**519.04 Removal of Disintegrated Concrete**. All loose and disintegrated concrete within the area limits shall be removed in such a manner and to such an extent as to expose a sound concrete surface. The perimeters of all marked removal areas that are not full depth removals shall be sawcut to a depth of 1/2 inch, with square or preferably slightly undercut shoulders. Sound concrete (beneath the disintegrated concrete) shall be removed for a depth of not less than 1/4 inch and not more than one inch, provided that the minimum depth of patch is maintained. Square or preferably slightly undercut shoulders, having a depth not less than the specified minimum depth of the patch, shall be made at the edges of all patch.

Care shall be used in working around reinforcing steel so as to not loosen the steel, or to shatter the concrete around the steel, beyond the area to be patched. Where the bond between the concrete and a reinforcing bar has been destroyed, or where more than one half of the periphery of such bar has been exposed, the adjacent concrete shall be removed to a depth that will provide a minimum one inch clearance around the bar, except where other reinforcing bars make this impracticable. Reinforcing bars which have become loose shall be adequately supported and tied back in place.

Only pneumatic or hand tools that will give results satisfactory to the Engineer shall be used in the removal of disintegrated concrete and in preparing and shaping the areas to be patched. Concrete may be removed by chipping or hand dressing. Chipping hammers shall not be heavier than nominal 35 pound class and shall be operated at an angle of less than 45 degrees with respect to the surface of the deck. Concrete shall be removed in a manner that prevents cutting, elongating or damaging the reinforcing steel. Reinforcing damaged during Contractor's operation shall be replaced at no cost to the City.

After completion of the removal operations, the deck shall be resounded as described in 519.03 to insure that only sound concrete remains.

If the Contractor punches through the deck, a full depth repair shall be made in the area. If punching through the deck is a result of improper workmanship such as use of too large a chipping hammer, operation at too vertical an angle, or any other unacceptable practice, the full depth repair shall be made at the Contractor's expense. In full depth repair areas, provisions shall be made to adequately key the replacement concrete to the remaining concrete slab.

The Contractor shall accept complete responsibility for assuring the integrity of the structure throughout the duration of the contract. Wherever necessary, barricades, shoring and bracing shall be provided, installed and maintained, and shall remain in place until the concrete repairs are completed and the concrete has cured for at least seven days.

**519.05** Cleaning and/or Replacement of Reinforcing Steel. Reinforcing steel exposed by the concrete removal operation shall be sandblasted to remove rust and scale. Where corrosion has reduced the area of the existing steel to 75 percent or less than the area of new steel of the same nominal size, additional new steel reinforcement shall be installed.

New bars of the same nominal size shall be tied to the existing bars, and shall extend at both ends 32 bar diameters beyond the length requiring replacement. Where impracticable to extend 32 bar diameters, in the opinion of the Engineer, reinforcement shall consist of welded steel wire fabric either 2 inch by 2 inch using wire size number W 0.9 or 3 inch by 3 inch using wire size number W 1.4. This fabric shall cover the entire area of the patch and shall be placed and held approximately 1 inch from the completed exposed surface of the patch. It shall preferably be securely fastened to the reinforcing steel in the original structure exposed in removing the disintegrated concrete, but when there is no such steel exposed or it is not practicable to fasten the fabric to this steel, it shall be fastened to dowels or expansion bolts installed, by the Contractor, at not to exceed 18-inch centers in both directions.

**519.06 Preparation of Surface**. After all disintegrated and loose concrete has been removed, the area to be patched shall be properly shaped. All surfaces of the area to be patched shall be thoroughly cleaned of all dirt, dust or other foreign

#### 519.07

materials by the use of water, air under pressure or any other method that produces satisfactory results. Before coating with the bonding grout, the surfaces shall be allowed to dry.

Immediately prior to placing the repair concrete and/or mortar, the surfaces of the area to be patched shall be cleaned by an air blast and then covered with a thin coating of bonding grout, which shall consist of equal parts by volume of portland cement and sand, mixed with enough water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to existing concrete surfaces in a thin even coating that will not run or puddle. The grout shall be scrubbed onto the dry surfaces (surfaces which are dry enough to absorb some of the moisture from the grout) with enough care to insure that excess grout will not collect in low areas. The bonding grout shall be applied only for a short distance in advance of the placement of fresh concrete so that grout does not dry or set up prior to placing repair concrete and/or mortar.

The surfaces of full depth repair areas shall be similarly cleaned and coated with bonding grout, which shall be thinned to a paint consistency, immediately prior to placing the repair concrete.

**519.07** Patching with Concrete. The concrete shall be Class S and shall be proportioned, mixed, placed and finished in accordance with 499 and 511. The depth of a patch shall be not less than 4 inches, except on top horizontal surfaces, on which it shall be not less than 3 inches.

When the patched area extends across a construction or control joint in the existing deck, the joint shall be replaced in kind in the same location.

Every attempt shall be made to make the repaired area blend in with the existing concrete. All exposed surfaces of patches shall be finished by rubbing or by other acceptable methods so as to match as nearly as practicable the surrounding concrete. In full depth repair areas, the concrete surface on the underside of the deck shall have all fins, ridges and protrusions removed and all voids filled with mortar.

All patched surfaces shall be cured in accordance with 511.14 Method (a) Water Curing. Method (b) Waterproof Membrane Curing is not permitted.

After curing and before final acceptance, all patched areas shall be sounded. All unsound areas shall be removed and replaced.

**519.08 Method of Measurement**. The quantity shall be the actual volume in cubic feet or the actual area in square feet of concrete placed, completed and accepted. If area measure is used, it shall be of the exposed surfaces of all completed patches, irrespective of the depth or thickness of the patch; if a patch includes corners or edges of such members as beams, curbs, columns, etc., all of the exposed surfaces shall be included, or if a patch extends completely through a member or a

slab, both exposed surfaces shall be measured. Contractor and Engineer shall agree on quantity before the placement of any patching material.

**519.09 Basis of Payment**. The accepted quantities will be paid for at the contract unit price, complete and in place. Barricades, shoring, bracing, reinforcing steel, wire mesh, dowels, expansion bolts, cement grout, removal of fins, ridges and protrusions and other related items will not be paid for separately, but the cost thereof shall be included in the cost of this item of which they are a part.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
519	Square Feet, Cubic Feet	Patching Concrete Structures

## **ITEM 520 PNEUMATICALLY PLACED MORTAR**

- 520.01 Description
  520.02 Materials
  520.03 Removal of Concrete
  520.04 Reinforcement
  520.05 Preparation of Repair Area
  520.06 Mixing
  520.07 Proportions
- 520.08 Pressures
- 520.09 Placing
- 520.10 Method of Measurement
- 520.11 Basis of Payment

**520.01 Description**. This item applies to the surface repair of concrete structures using pneumatically placed mortar, where the depth of repair generally will be less than 6 inches. This item consists of the removal of all loose, soft, honeycombed and disintegrated concrete, the removal of sound surface concrete in areas designated for repair, the preparation of the surface, the furnishing and placing of reinforcing steel including wire fabric, dowels and/or expansion anchor bolts, mixing and applying pneumatically placed mortar composed of portland cement and sand, to the areas shown or noted on the plans or where directed by the Engineer. The thickness of pneumatically placed mortar shall be not less than 1-1/2 inches, except on top horizontal surfaces where it shall be not less than 3/4 inches. Mortar repairs shall be finished flush with the original masonry surface, except as noted below for areas of exposed reinforcing steel.

**520.02 Materials**. Materials shall conform to the following:

Fine aggregate		. 703.02,	703.03
Portland cemen	t	••••••	701

Reinforcing steel	
Welded steel wire fabric	

Water shall be free from sewage, oil, acid, strong alkalis, vegetable matter, clay and loam. Water which is potable is satisfactory for use in mortar.

**520.03 Removal of Concrete**. In areas to be repaired, all loose, soft, honeycombed and disintegrated concrete, plus a 1/4 inch depth of sound concrete, shall be removed. Additional concrete shall be removed, where necessary, to permit the placement of the minimum specified mortar thickness. All work shall be done in such manner as not to damage or shatter the concrete that is to remain. Square or preferably slightly undercut shoulders shall be made at the edges of all repair areas.

Reinforcing bars exposed after concrete removal, as required above, shall be encased with pneumatically placed mortar. Where such bars would be less than 1 inch from the proposed finished surface of mortar, they shall, if practicable, be driven back into recesses cut in the masonry to obtain that coverage, but if this is impracticable, because of large concentrations of reinforcing bars, the minimum specified mortar coverage shall be provided by such modification of the finish surface as approved by the Engineer.

Where the bond between the concrete and a primary reinforcing bar has been destroyed, or where more than one half of the periphery of such a bar has been exposed, the adjacent concrete shall be removed to a depth that will provide a minimum 3/4-inch clearance around the bar except where other reinforcing bars make this impracticable. Reinforcement which has become loose shall be adequately supported and tied back into place. Reinforcement that is damaged during the Contractor's operations shall be replaced at no cost to the City.

Only pneumatic or hand tools that will give results satisfactory to the Engineer shall be used in the removal of concrete and in preparing and shaping the areas to be repaired.

Care shall be used in working around reinforcing steel so as not to loosen the steel, or to shatter the concrete around it, beyond the repair area.

**520.04 Reinforcement**. Where pneumatically placed mortar is specified to repair areas of unsatisfactory concrete, or for surface coverage of exposed reinforcing steel, wire fabric shall be placed in all areas where the thickness of the mortar patch is 1-1/2 inches or more. For areas where the thickness of the mortar patch exceeds 4 inches, a single layer of wire fabric shall be used to reinforce each 4 inch thickness of patch or fractional part thereof. Fabric shall be either 2 inch by 2 inch using 12 gage wire, or 3 inch by 3 inch using 10 gage wire. All fabric shall be placed parallel to the proposed finished surface. Each layer of fabric shall be completely encased in mortar which has taken its initial set, before the succeeding layer of fabric is applied. Fabric supported adjacent to the prepared masonry surface shall be no closer than 1/2 inch to the existing surface. Adjacent sheets of fabric shall

be lapped 6 inches and securely tied together. Fabric shall be carefully prebent before installation to fit around corners and into re-entrant angles, and shall in no case be sprung into place.

All steel items, including reinforcing bars and wire fabric shall be no closer than 1 inch to the proposed finished surface of mortar.

Wire fabric shall be supported by anchor bolts except where existing reinforcing steel in the repair area is considered by the Engineer to be satisfactory for this purpose. Anchors shall consist of 1/4 inch minimum diameter expansion hook bolts, each of which shall have sufficient engagement in sound masonry to resist a pull of 150 lbs., applied parallel to the axis of the bolt. For repairs that are generally 4 inches thick or less, anchors shall be spaced no more than 12 inches and 18 inches, center to center, on overhead and vertical surfaces respectively, and 36 inches, center to center, on top horizontal surfaces. For repairs that exceed 4 inches in thickness, anchor bolts shall be capable of supporting three times the weight of suspended mortar and two times the weight of mortar on vertical surfaces. No less than three anchors shall be used for each patch.

When specified, reinforcing exposed in the original structure, or exposed after concrete removal as required above, shall be thoroughly cleaned and any appreciable reduction in steel area restored as directed.

**520.05 Preparation of Repair Area**. After all unsatisfactory concrete has been removed, the sound concrete surface properly shaped, dowels and/or expansion hook bolts placed, the existing reinforcing steel cleaned and steel area restored as directed, the concrete surfaces shall be thoroughly cleaned of all dirt, dust and other foreign materials by the use of water or air under pressure and such other methods as are necessary to secure satisfactory results. Where a bonding compound is not specified the following shall be strictly adhered to: the prepared masonry surface shall be drenched with water and kept wet during the 2 hours preceding the placement of the mortar. All surfaces shall be damp, without free water, as mortar is placed. Preparation and condition of all surfaces shall be approved by the Engineer immediately prior to the application of the mortar.

**520.06** Mixing. The materials shall be thoroughly mixed dry in a batch mixer. Before placing the mixture in the hopper of the cement gun, all materials and lumps over 1/4 inch in size shall be removed by screening.

The screened sand and cement shall be applied to the masonry surface within 1 hour after being combined.

**520.07 Proportions**. The mixture as placed in the hopper shall be one volume of portland cement and three volumes of sand.

**520.08 Pressures**. Not less than 35 pounds pneumatic pressure per square inch at the cement gun shall be used in placing the mixed material. If more than 100

feet of hose or a greater lift than 25 feet is used the pressure must be increased proportionately. The water shall be maintained at a uniform pressure of not less than 25 pounds above the pressure of the air on the gage at the cement gun.

**520.09 Placing**. The premixed, dry cement and sand shall be placed by pneumatic equipment with the proper amount of water applied in the mixing nozzle for the correct placement consistency. In order to reduce shrinkage cracks to a minimum, the mortar shall be applied as dry as practicable. Shooting strips shall be employed to insure square corners, straight lines and a plane surface of mortar, except as otherwise permitted by the plans or approved by the Engineer. They shall be so placed as to keep the trapping of rebound at a minimum. At the end of each day's work, or similar stopping periods requiring construction joints, the mortar shall be sloped off to a thin edge. In shooting all surfaces, the stream of flowing material from the nozzle shall impinge as nearly as possible at right angles to the surface being covered, and the nozzle shall be held from 2 to 4 feet from the working surface.

A sufficient number of mortar coats shall be applied to obtain the required thickness. On vertical and overhead surfaces, the thickness of each coat shall be not greater than 1 inch, except as approved by the Engineer, and shall be so placed that it will neither sag nor decrease the bond of the preceding coat. Where a successive coat is applied on mortar which has set for more than 2 hours, the mortar surface shall be cleaned and dampened as required in 520.05 for the prepared masonry surface. Deposits of rebound from previous shooting, whether loose or cemented, shall be removed.

After mortar has been placed to desired thickness, all high spots shall be cut off with a sharp trowel, or screeded to a true plane as determined by shooting strips or by the original masonry surface, or as directed. Screeds, where used, shall be lightly applied to all surfaces so as not to disturb the mortar for an appreciable depth, and they shall be worked in an upward direction when applied on vertical surfaces. After placing, all mortar patches shall be sounded and any indications of sand pockets or hollow areas shall be investigated and repaired as directed. Special care shall be taken to obtain a sightly appearance on all exposed surfaces.

The pneumatically placed mortar patches shall be covered with burlap or cotton mats and kept wet for 7 days after placing, but where not practicable to use mats, it shall be kept wet by sprinkling for the same length of time. Where the Engineer determines that the above curing procedures are impracticable, because of the inaccessibility of isolated repair areas, the final mortar surface may be cured according to 511.14, Method (b). No pneumatically placed mortar may be placed when the air temperature is below 50°F or against a surface in which there remains any frost. All mortar placed after October 31 and before April 15 shall be protected according to the requirements of 511.12.

**520.10** Method of Measurement. The quantity shall be the area in square feet determined as follows:

The actual area of exposed surfaces of all completed patches, irrespective of depth or thickness of the patch; if a patch includes corners or edges of such members as beams, columns, curbs, etc., all of the exposed surfaces shall be included, or if a patch extends completely through a member or a slab, both exposed surfaces shall be included. Measured area shall be agreed upon by the Contractor and Engineer before any mortar is placed.

**520.11 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription520Square FootPneumatically placed mortar

# ITEM 522 STRUCTURAL PLATE CORRUGATED METAL STRUCTURES ON FOOTINGS

- 522.01 Description
- 522.02 Materials
- 522.03 General
- 522.04 Method of Measurement
- 522.05 Basis of Payment

**522.01 Description**. This item shall consist of furnishing structural plate corrugated metal structures of specified dimensions, including metal bearing angles or channels as required, and erecting same on concrete footings as detailed on the plans. The structures shall be constructed at locations designated on the plans or ordered by the Engineer, in reasonably close conformity with specified lines and grades.

Excavation will be performed under 203 or 503 as indicated on the plans. Backfilling shall be performed in accordance with 503. Concrete footings will be constructed under 511.

**522.02** Materials. Plates and bolts shall be in accordance with 707.03 or 707.23. Steel bearing angles or channels shall be in accordance with either 707.03 or 711.01. Aluminum bearing angles or channels shall be in accordance with 707.23.

**522.03 General.** The metal bearing angle or channel shall be properly supported in the position shown on the plans before footing concrete is placed.

The plates shall be erected according to the manufacturer's assembly instructions. The unsupported edges of all plates shall be held in position by temporary props. A sufficient number of bolts shall be progressively installed to hold the plates in position. Bolts shall not be tightened until tightening will not interfere with the adjustment and matching of additional sections. Special care shall be exercised in the use of drift pins or pry bars to prevent chipping or injury to the galvanized coating. Final tightening of bolts shall be to a minimum torque of 100 ft. lbs.

**522.04 Method of Measurement**. The footage shall be the actual number of linear feet of the corrugated metal structure installed in place. The measurements shall be the average of the two side measurements, end to end, at the point of bearing.

**522.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>		
522	Linear foot	ft	_ inch Structural	plate
		corrugated me	etal structure,	- inch

## **ITEM 523 DYNAMIC LOAD TESTS**

- 523.01 Description 523.02 General
- 523.03 Equipment
- 523.04 Test Procedures
- 523.05 Method of Measurement
- 523.06 Basis of Payment

**523.01 Description**. This item shall consist of a dynamic load applied by a pile hammer to a driven pile (restrike) or to a pile being driven, while transducers obtain measurements for predicting the static capacity of the pile. Waiting periods may be required so that soil set-up and relaxation characteristics can be determined.

**523.02** General. The Contractor shall notify the Engineer of his intent to drive piling at least three days prior to the installation of the first pile. The Engineer shall determine if the test is to be performed or if some pile driving experience at the proposed site is to be obtained before a decision can be made. The Engineer will establish a date for the tests and will also determine the location of all piles to be dynamically load tested.

The hammer selected for driving the test loaded pile shall be used for driving all piles represented by the load test pile. If the Contractor subsequently finds it necessary to use a different hammer, the Engineer will determine if an additional dynamic load test is necessary. Any such test shall be completed at no additional cost to the City.

**523.03 Equipment**. The Contractor shall supply all personnel and equipment needed to strike the test pile with the pile hammer. The Contractor shall also supply a source of 115 V, 1500 VA, 60 Hz electrical power with extension power cords. When fluted piles are being used, the Contractor shall supply a cutting torch.

The City will provide the transducers, the Pile Driving Analyzer, and the personnel to operate the equipment.

**523.04 Test Procedures**. Approximately three piles will be tested in one day. City personnel will drill holes into the piles to be tested so that electronic transducers (2 accelerometers and 2 stain gages) can be attached. When the transducers have been placed in position and the Pile Driving Analyzer has been made ready to receive the acceleration and strain measurements, the Contractor shall strike the pile with the pile hammer as many times as is required to obtain adequate measurements as determined by City personnel.

After the dynamic testing measurements have been obtained and analyzed, the City will provide instructions for driving the piles.

**523.05** Method of Measurement. The hours to be paid for under this item will be the sum of the time intervals that the City has requested the Contractor to discontinue his normal production pile driving operation so that the dynamic load tests can be performed. The Engineer will measure and record the time needed to perform the tests to the nearest one-tenth of an hour.

**523.06 Basis of Payment**. Payment for the sum of the testing time intervals will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
523	Hour	Dynamic load tests

# **ITEM 524 WATERPROOF DECK COATING**

- 524.01 Description
- 524.02 General
- 524.03 Materials
- 524.04 Preparation of Surfaces
- 524.05 Application
- 524.06 Method of Measurement
- 524.07 Basis of Payment

**524.01 Description**. This item consists of furnishing the necessary labor, materials, equipment and supervision required to install a fluid applied waterproofing system to parking decks as indicated on the plans.

**524.02 General.** The system applicator shall submit evidence of either being licensed by the manufacturer or having a minimum of five (5) years experience as a General Contractor in the application of urethane deck coatings to areas in excess of 25,000 square feet.

Submit complete manufacturer's literature and technical data for the coating system proposed, along with test results from a recognized independent laboratory verifying manufacturer's published technical data.

Completed installation shall be guaranteed against defects of materials and workmanship, as defined in the Proposal, for a period of five years, beginning with the date of acceptance by the City of Akron of the deck coating system. Guarantee shall be submitted prior to commencing work.

Deliver materials to the job site in sealed, undamaged containers. Each container shall be identified with material name, date of manufacture and lot number.

Components shall be products of a single approved manufacturer, or shall be certified as compatible with components produced by the approved manufacturer.

**524.03** Materials. Deck coating materials shall be a fully loaded system comprising of a low odor polyurethane elastomer, capable of producing a seamless, waterproof, traffic bearing deck coating such as the following:

"Iso-Flex 750U-HL – MVT & HVT", as manufactured by Lym-Tal International,

"Qualideck Traffic Coating System – Standard & Heavy Duty", as manufactured by Advanced Polymer Technology,

"Conipur II – Medium Duty & Heavy Duty" (Heavy Duty 1-TC Method not accepted), as manufactured by Sonneborn,

"Mark 170.2 Flexodeck II – Medium Duty & Heavy Duty", as manufactured by Poly-Carb, or an approved equal.

Two coat systems shall be applied to parking areas and three coat systems shall be applied to traffic areas. Locations of heavy-duty traffic areas are marked on the plans or will be designated by the Engineer. Final coatings shall match the color of the existing deck coating. Dry mil thickness of each coat shall be according to manufacturers specifications. The use of solvents, such as Xylene in the waterproofing material is to be utilized only upon approval from the Engineer and in accordance with the manufacturers recommendations.

All coatings shall be low or no odor and VOC compliant.

Five copies of the material specifications shall be submitted to the Engineer for review prior to the application of any deck coatings.

**524.04 Preparation of Surfaces**. Voids in the existing concrete surfaces shall be patched prior to waterproofing.

All surfaces designated for waterproof deck coating shall be cleaned by the shot blast method such as the Blastrac Surface Preparation System, Wheelabrator-Frye, Inc., Materials Cleaning Systems Division, 500 Byrkit Avenue, Mishawaka, Indiana 46544, telephone: (219) 255-2141 or an approved alternate. Any surface inaccessible to the shotblast method of cleaning shall be cleaned by sandblasting. A thin layer of portland cement concrete shall be removed from the entire area in addition to any dirt, dust, laitance, oil, grease, paint, bituminous material and other foreign matter. The surface shall be left free of loose particles and shall be without sharp ridges, projections, voids and concrete droppings that would be mechanically detrimental to membrane application. Preparation of surfaces shall be in accordance with the recommendations of the manufacturer of the waterproof deck coating system.

A 1/4" deep saw cut shall be made at the edge of any section to be coated for the purpose of providing a secure termination of the coating material. This sawcut is to be filled during the application of the base coat. The deck coating shall be extended 2" beyond the sawcut.

All construction and control joints to be coated shall be cleaned and filled with sealant.

Provide flashings as recommended by coating manufacturer at all locations of potential movement such as wall/slab intersections.

At projections through the deck such as posts, vents, pipes, stanchions, railings and similar locations of potential slight movement, provide a 1/4" bead of sealant. Tool sealant to form a cove and allow to cure before overcoating.

Prime all concrete, masonry and metal surfaces. Apply primer at coating manufacturer's recommended rate.

Detail work shall be as recommended by the coating manufacturer and shall include all flashings, cracks, new concrete used for patching of the deck surface, control joints, and construction joints. For repairs to and recoating of waterproofing membrane, follow the manufacturers written instructions and recommendations. Base coat should be applied to areas where repairs have been performed and the waterproof membrane her been removed. The base coat should be applied to a thickness such that it matches the profile of the existing waterproof membrane.

Areas to be coated with a medium duty or heavy duty membrane will be cleaned and prepared according to the polyurethane manufacturers recommendations and coated with the approved coating system which includes primer, polyurethane and aggregate.

All joints shall be routed and cleaned to approximately <sup>1</sup>/<sub>4</sub> inch wide by <sup>1</sup>/<sub>2</sub> inch deep. A backer rod shall be installed and the joint filled with polyurethane sealant such as Sikaflex -1CSL or an approved equal. Rout or sawcut all cracks exceeding 1/16 inch but less than 1 inch in width and fill with sealant.

**524.05 Application**. Before membrane work is commenced, surface shall be reinspected and treated as necessary to remove laitance, loose material on the surface, grease, oil and other contaminants which could affect bonding of the membrane. Surfaces shall be left broom and vacuum clean.

Concrete surface shall be visibly dry and pass a four-hour rubber mat test (no condensate) prior to application of coating system. Mat shall be taped to deck on all edges.

Do not apply if rain is anticipated within eight hours of application.

Substrate surface temperatures shall be above 40°F (5°C) and lower than 110°F (44°C).

Continuous positive ventilation shall be provided for interior applications throughout the application period and eight hours after. Open fires, smoking and operation of spark producing equipment shall not be permitted in the application area until vapors have dissipated.

The waterproof deck coating shall be applied to a height of four inches at walls, curbs, columns and other vertical intersections unless otherwise noted on the plans.

Apply base coat material at the dry film thickness recommended by the coating manufacturer. Base coat shall be rolled to assure uniform coverage of surface.

Apply deck top coat and aggregate to parking areas and travel lanes as shown on the plans in strict conformance with manufacturer's written specifications.

**524.06** Method of Measurement. Waterproof deck coating shall be based upon the area in square feet of membrane completed in place.

**524.07 Basis of Payment**. Payment for joint cleaning and sealing, crack filling, caulking, removal of the existing waterproofing if necessary and all other surface preparation along with the application of the waterproofing system shall be included in the price bid for the item listed below:

ItemUnitDescription524Square FootWaterproof Deck Coating

#### **ITEM 525 MICRO-SILICA MODIFIED CONCRETE OVERLAY**

- 525.01 Description
- 525.02 Quality Assurance
- 525.03 Materials
- 525.04 Equipment
- 525.05 Proportioning and Mixing
- 525.06 Preparation of Existing Deck
- 525.07 Finishing Machine Dry Run
- 525.08 Placing, Consolidating and Finishing
- 525.09 Curing
- 525.10 Limitation on Placing Operations
- 525.11 Manufacturer's Representative
- 525.12 Method of Measurement
- 525.13 Basis of Payment

**525.01 Description.** This work shall consist of furnishing the necessary labor, materials and equipment to overlay concrete bridge decks in accordance with these specifications and in reasonably close conformity with the grades, thicknesses and cross sections shown on the plans or as directed by the Engineer. This work shall include the removal of patches other than sound portland cement concrete and all loose and unsound concrete by hydrodemolition; preparation of the existing concrete surface; removal, forming and concrete for full-depth repairs; blast cleaning; furnishing, placing, finishing, texturing and curing of a micro-silica modified concrete (MSC) overlay; and all other operations necessary to complete this work according to the specifications and to the satisfaction of the Engineer.

The MSC overlay shall be not less than 1-1/4" inches thick (thicker where loose or disintegrated concrete is to be replaced and/or as indicated on the plans) and be constructed as a single monolithic element of the structure. Its surface shall be finished level with the surface of the original concrete deck.

**525.02** Quality Assurance. The contractor shall submit evidence of having a minimum of five (5) years experience in the placement of micro-silica modified concrete overlays.

12, ASTM C 494, Type A or D
e
.705.12, ASTM C 494, Type F repair)511, Class S ?05.05 or 705.06, white opaque 511.14
ed and furnished by:
uclid Chemical Co. Ieveland, Ohio
faster Builders leveland, Ohio

525.03 Materials. The materials shall conform to the following requirements:

- \* Deleterious material shall not exceed one-half the requirement for superstructure aggregate and sodium sulfate soundness loss shall not exceed that specified for superstructure concrete in 703.02.
- \*\* Only one brand of cement shall be used for each bridge deck overlay unless otherwise permitted by the Engineer.
- Note: The Contractor shall obtain a written statement from the manufacturer of the micro-silica admixture that he is satisfied with the compatibility of the combination of materials and the sequence in which they are combined.

## 525.04 Equipment.

A. Mixers. Concrete shall be mixed in a central mixing plant or by a ready-mixed concrete truck capable of discharging concrete having a maximum water-cement ratio of 0.36. Mixing equipment shall meet the requirements of 499.04(b). Admixtures shall be introduced into the concrete in such a manner that will disperse it throughout the entire load. Batch plants shall meet the requirements of 499.04(a) and shall be located such that the maximum time required from start of mixing to completion of discharge of the concrete at the site of work shall not exceed 90 minutes.

B. Finishing Machine. An approved self-propelled finishing machine shall be used with supports outside the scarified deck surface to be overlaid, except where hand finishing equipment is authorized. The finishing machine shall be equipped with forward and reverse drive mechanisms that enable precise velocity control of the machine while it is moving in either direction. It shall be equipped with one or more rotating rollers. It shall be equipped with augers and either a vibrating pan or vibrating rollers. Vibrating frequency for pans and rollers shall be variable from 1500 to 5000 pulses per minute. The Contractor shall furnish the necessary verification of these vibration frequencies. Screeds shall have provisions for raising above the finished concrete surface.

The placing and finishing equipment shall be designed so that the elapsed time between depositing concrete and final finishing shall not exceed 10 minutes.

C. Finishing Machine Rail and Supports. Finishing machines shall be supported by rail and supports made of steel. Rail shall be furnished in sections not less than 10 feet in length and be of sufficient cross-section so that the weight of the finishing machine causes zero vertical deflection while in motion. Rail shall be straight with no sections exceeding a tolerance of 1/8 inch in 10 feet in any direction. Rail supports shall be screw-type, adjustable saddles and shall be of sufficient number under the rail so that zero vertical deflection occurs under the weight of the finishing machine.

D. Hydrodemolition Equipment. The hydrodemolition equipment shall be a self-propelled machine that utilizes a high pressure water jet stream capable of removing concrete to the depth specified herein and/or as shown on the plans and be capable of removing rust and concrete particles from reinforcing steel. Hand held high pressure wands or 35 lb. maximum jackhammers operated at no more than a 45 degree angle from horizontal shall be used in areas that are inaccessible to the self-propelled machine or in patching areas that require work to remove the remaining unsound concrete.

**525.05 Proportioning and Mixing**. All required characteristics of the mix, i.e. air entrainment and slump, shall be adjusted off the deck before placement of the overlay begins. The components for micro-silica modified concrete shall be combined into a workable mixture of uniform composition and consistency. They shall be proportioned as follows:

Coarse	Fine			Maximum Water-
Aggregate	Aggregate	Cement	Silica	Cement
<u>(lbs)</u>	<u>(lbs)</u>	<u>(lbs)</u>	<u>(lbs)</u>	Ratio
1265	1430	700	70	0.36
1280	1430	700	70	0.36
1110	1430	700	70	0.36
	Coarse Aggregate ( <u>lbs)</u> 1265 1280 1110	Coarse         Fine           Aggregate         Aggregate           (lbs)         (lbs)           1265         1430           1280         1430           1110         1430	Coarse         Fine           Aggregate         Aggregate         Cement           (lbs)         (lbs)         (lbs)           1265         1430         700           1280         1430         700           1110         1430         700	Coarse         Fine           Aggregate         Aggregate         Cement         Silica           (lbs)         (lbs)         (lbs)         (lbs)           1265         1430         700         70           1280         1430         700         70           1110         1430         700         70

## QUANTITIES OF MATERIAL PER CUBIC YARD (DRY WEIGHTS\*)

\*The specific gravities used for determining the above weights are: natural sand 2.62, gravel 2.62, limestone 2.65, slag 2.30 and micro-silica 2.20.

The batch weights previously described shall be corrected to compensate for the moisture contained in the aggregate at the time of use. A chemical admixture (705.12, Type A or D) shall be used. The transit mixer charge shall be limited to 3/4 of its rated capacity or 6 cubic yards, whichever is the smaller, unless a larger size is approved by the Engineer.

The specified cement content shall be maintained and a maximum water-cement ratio of 0.36 shall not be exceeded. Any admixture added at the job site shall be mixed a minimum of five minutes at mixing speed. After five minutes, the addition of any additional admixture to the concrete shall be mixed a minimum of five minutes. After all components have been added, the slump range shall be 6 plus/minus 2 inches. The air content of plastic concrete at the time of placement shall be 8 plus/minus 2 percent. Two cylinders shall be made for every other ready-mixed concrete truck load of MSC incorporated into the work. The Contractor shall furnish the required materials and samples without charge to the City.

If a slump loss occurs after mixing and before placement of the MSC overlay, the charge may be "retempered" with the admixture to restore plasticity. The slump range and air content shall be rechecked to ensure conformance to the allowable values. If the consistency of the charge after "re-tempering" is such as to cause segregation of the components, this will be cause for rejection of the load. The MSC overlay shall still be placed within the 90 minute limitation as per 525.04.

The Contractor shall make one trial batch of the MSC to be hauled at least 4 days before the overlay is to be placed. He shall cast one or more small test slabs, e.g. 8 ft. long x a width which is wide enough to accommodate his tining equipment x 1-1/4 in. thick, for texturing according to 525.08 and shall prepare other samples and specimens as directed by the Engineer. The Contractor shall furnish the required materials and samples without charge to the City. The Engineer shall be notified 7 days in advance of the test batch preparation and will conduct all the required tests.

#### 525.06. Preparation of Existing Deck.

**Concrete Removal by Hydrodemolition**. The entire top surface of the concrete bridge deck shall be completely removed to a depth 1/4" or as shown on the plans.

The measurement shall be nominal and shall be taken from the portland cement concrete surface to the mortar line.

The intent is to permit the removal of unsound concrete using hydrodemolition equipment. The contractor may choose to use conventional scarifying equipment to make an initial pass across the deck to remove a portion of the total depth required (not to exceed 3/5 of the total removal depth of the concrete bridge deck or 1/8"). In all cases, hydrodemolition shall be used for the final pass. If the use of mechanical scarifying equipment results in exposing or snagging the top mat of reinforcing steel, approval of the use of the scarifying equipment shall be immediately rescinded and the remaining removal will be done with hydrodemolition equipment or by chipping. Damaged or dislodged reinforcing steel shall be repaired or replaced at the Contractor's expense.

Prior to the commencement of the removal operation, the equipment shall be calibrated on an area of sound concrete as designated by the Engineer

The Engineer will verify the following settings:

- 1. Water Pressure Gauge
- 2. Machine Staging Control (step)
- 3. Nozzle Size
- 4. Nozzle Speed (travel)

During the calibration, any or all of the above settings may be modified in order to achieve removal in accordance with the requirements of the plan. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Engineer.

Calibration shall be required on each structure, each time the hydrodemolition is performed and as required to achieve the results required by the plan. The depth of removal shall be verified as necessary, and at least every 30 feet along the cutting path. The readings shall be documented and, if necessary, the equipment re-calibrated to insure the specified depth of removal.

The Contractor shall block all drains on the deck and install aggregate dams every 150 feet [6 inches high by 1 foot wide, minimum] to strain run-off. The deck shall be used as a settlement basin within itself. A settlement basin outside or at the end of the structure is required if further straining is necessary to produce visibly clear water.

The Contractor shall provide shielding, as necessary, to insure containment of all dislodged concrete within the removal area in order to protect the traveling public from flying debris both on and under the work site.

After the hydrodemolition operation has completed the removal, and the deck is allowed to dry, the deck shall be resounded to assure that all unsound material has been removed. The final sounding of the deck shall be done by the Engineer and shall not be performed within 24 hours after a rain. In no case shall the final sounding be made unless the deck is dry. Final sounding shall consist of as many successive resoundings as required to ensure that all deteriorated and fractured concrete has been removed. Additional removal shall be performed with the hand held wand or 35 lb. maximum jackhammer operated at an angle of no more than 45 degrees from horizontal. If the bond between concrete and reinforcing steel has been destroyed, the adjacent concrete shall be removed to a depth that will provide a minimum 3/4-inch clearance around the steel except where other reinforcing steel makes this impractical.

Cleaning shall be performed with a vacuum system capable of removing wet debris and water all in the same pass. The deck shall then be blown dry with air to remove excess water. Cleaning shall be done in a timely manner, before debris and water is allowed to dry on the deck surface. All exposed reinforcing steel which is left unsupported by the hydrodemolition process shall be adequately supported and protected from bending from all construction wheel traffic. All reinforcing steel damaged or dislodged by these operations shall be replaced with bars of the same size and coating at no additional cost to the City.

**Full Depth Repair.** Where the deck is sound for less than one half of its original depth, the concrete shall be removed full depth except for limited areas as may be designated by the Engineer. Forms shall be provided to support concrete placed in full-depth repair areas. The forms for areas of up to 4 square feet may be suspended from wires from the reinforcing steel. For areas greater than 4 square feet, the forms shall be supported from the primary members of the superstructure or by shoring from below. Areas of full-depth repair shall have the concrete faces and reinforcing steel cleaned as described below.

**Preparation Prior to Overlay Placement**. Not more than 24 hours prior to placing the overlay, all surfaces to which the overlay is to bond, including exposed reinforcing and structural steel, the work face of a previously placed overlay, and the faces of curbs and barriers up to a height of at least 1 inch above the proposed overlay surface, shall be cleaned by abrasive blasting or an approved method of waterblasting with 7000 psi minimum pressure. Steel surfaces shall be cleaned nearly to White Metal cleanliness, until at least 95% of the surface area is free of all visible residues. Concrete surfaces shall be made free of spalls, laitance, and all contaminants detrimental to achieving an adequate bond.

Bridge scuppers shall be cleaned of all foreign matter and plugged prior to placement of the overlay. Scuppers shall be unplugged to permit free drainage of water from the deck surface following overlay placement.

General. Vehicles other than approved construction equipment will not be permitted on those sections of the deck where concrete removal operations or scarification have begun. Contamination of the deck by construction equipment or from any other source shall be prevented.

The Contractor is responsible for protecting traffic under the bridge while removing deck concrete. This may require temporary plywood sheeting (adequately supported) be erected under the deck to prevent pieces of concrete from falling onto traffic below.

**525.07** Finishing Machine Dry Run. After the screed rails or other supports have been set to proper profile and prior to placing the overlay, the finishing machine, with filler blocks attached to the bottom of the screed, shall be passed over the entire area of the deck to be overlaid. The thickness of the filler blocks shall be the plan specified overlay thickness minus 1/4 inch.

The filler blocks should clear the scarified deck surface by not more than 1/8 inch. Concrete which does not clear the filler blocks shall be removed by hydrodemolition or other methods approved by the Engineer.

**525.08** Placing, Consolidating and Finishing. Immediately before the MSC overlay is placed, the newly exposed concrete surfaces shall be cleaned with an air blast and then surfaces that have been prepared with a jackhammer shall be covered with a coating of bonding grout. The MSC overlay shall be placed only when the existing deck is surface dry. The bonding grout, if required, shall consist of equal parts by volume of portland cement and sand, mixed with enough water to form a slurry of paint-like consistency which shall be such as to allow it to be applied with a stiff brush or broom to existing concrete surfaces in a thin even coating that will not run or puddle. The grout shall be scrubbed onto the surface dry deck (surfaces which are dry enough to absorb some of the moisture from the grout) with enough care to ensure that all surfaces are evenly covered and that excess grout will not collect in low areas. The bonding grout shall be applied for only a short distance, not to extend beyond the rear of the mixer or overlay carrier, in advance of the placement of the overlay and shall not be allowed to dry prior to overlay placement. The grout shall be mixed and placed within the same time requirements as for the overlay.

The newly exposed surfaces in full-depth repair areas shall be similarly cleaned and prepared immediately prior to placing concrete.

Concrete for full-depth repairs shall be 511 concrete or, at the option of the Contractor, MSC placed simultaneously with the overlay. When 511 concrete is used, it shall be pre-placed onto the plan lower boundary of the overlay, given a broom finish, and cured as specified in 525.09.

At the option of the Contractor, the deep areas of variable thickness may be pre-placed with 511, Class S concrete using No. 8 size coarse aggregate prior to the uniform thickness. Pre-placed areas must be a minimum of 1 inch in depth. The perimeter of these patches shall be nearly vertical or slightly undercut. Prior to

placing concrete, the areas of pre-placed variable thickness shall be cleaned as per 525.06. The concrete shall be hand vibrated during placement, given a wire broom finish, water cured and shall have attained a modulus of rupture of 400 psi prior to loading. Before placing the uniform thickness of MSC, all surfaces including the cured pre-placed variable thickness areas shall be blast cleaned as per 525.06.

Contamination of the wetted deck by construction equipment or from any other source shall be prevented by placement of a clean 4-mil polyethylene sheet (or any other covering as approved by the Engineer) on the surface of the deck following the air blast cleaning. Where reinforcing steel is exposed, the Contractor shall provide adequate supports for the concrete mixer so that reinforcing steel and its bond with the concrete will not be damaged by the weight and movement of the concrete mixer, or shall provide means to convey concrete from the mixer to the finishing machine.

The MSC overlay shall be placed, consolidated and finished to the plan surface. Hand vibrators shall be used for full depth repair, variable depth area, at all edges and adjacent to joint bulkheads.

After the MSC has been consolidated and finished, it shall be textured transversely to provide a relatively uniform pattern of grooves spaced on 5/8-inch centers with a tolerance of plus/minus 1/8 inch. Grooves shall be approximately 0.15 inches deep and 0.10 inches wide. A strip of surface 9 to 12 inches wide adjacent to curbs and barriers shall not be textured.

At the Contractor's option an evaporation retardant and finishing aid may be used after finishing and prior to the texturing operation. Any product used for such purpose shall be specifically marketed for such use (plain water is not acceptable). The product may also be sprayed over textured areas. The evaporation retardant and finishing aid shall be applied as per the manufacturer's recommendations. The wet burlap cure shall follow this operation as closely as possible.

The Contractor shall stencil the date of construction (month and year) and the letters MS into the overlay before it takes its final set. The date shall be located in the right-hand corner of the deck at the forward abutment. It shall be placed parallel to the edge of the overlay and centered at 12 inches in from both the edge of the overlay and end finish. The numerals shall be 3 to 4 inches in height, 1/4-inch in depth and face the centerline of the roadway.

Longitudinal joints are permitted, but only to the extent necessary to accommodate the width of the finishing machine, to facilitate changes in roadway crown, and to permit maintenance of vehicular traffic, except as approved by the Engineer. Longitudinal joints shall not be used in close proximity to faces of curbs or barriers or at edges of decks. All joints in the overlay shall be formed.

Any pending problem which is noted prior to final acceptance of the overlay shall be corrected by the Contractor at no cost to the City.

A 10-foot straightedge shall be used to check the overlay directly behind the finishing machine. It shall also be used to check transversely along the edges of the overlay where hand finishing is done. Any irregularities exceeding 1/8 inch in 10 feet shall be corrected immediately.

**525.09** Curing. Before a full-depth repair made with 511 concrete is overlaid, it shall be water-cured and shall have attained a modulus of rupture of 400 psi.

As soon as the tining operation is completed, the finished overlay surface shall be covered with a single layer of clean wet burlap. The fresh overlay surface shall receive a wet burlap cure for 3 days. For the entire curing period of 72 hours the burlap shall be kept wet by the continuous application of water through soaker hoses. Either a 4-mil white opaque polyethylene film or a wet burlap-white opaque polyethylene sheet shall be used to cover the wet burlap for the entire 72 hour period.

A cure day shall be defined as a 24-consecutive hour period of time. The temperature at the overlay surface shall be maintained above 35 degrees Fahrenheit until the curing period is completed. Any day during which the air temperature at the overlay surface falls below 45 degrees Fahrenheit shall not be counted as a cure day.

As soon as the overlay has been cured, all joints and abutting surfaces shall be sealed with an approved high molecular weight methacrylate sealer. The sealer shall be prepared and applied in accordance with the manufacturer's recommendations. Joints to be sealed shall include transverse joints in the MSC overlay, joints between MSC overlay and steel end dams, longitudinal joints between MSC overlay placements, and longitudinal joints between MSC concrete and safety curbs, barriers, parapets, bulb angles, etc. On the edges of decks without curbs, the interface between the overlay and the existing deck shall be sealed in a similar manner. Any cracking which occurs prior to opening traffic shall be sealed in this manner or repaired or corrected in another manner as directed by the Engineer at no cost to the City. The deck shall be sounded and any delaminated areas removed and replaced at the Contractor's expense.

Traffic will not be permitted on the finished overlay surface until after completion of the 3-day wet cure.

Any improperly cured overlay may be ordered to be removed by the Engineer.

**525.10** Limitation on Placing Operations. Prior to overlay placement, the Engineer shall establish the Contractor's ability to place the overlay on a continuous basis and to consolidate finish, texture and commence curing within the time interval specified in 525.09. Once the finishing machine has made the first pass, workers shall not be allowed to walk in the freshly placed overlay.

#### 525.11

The overlay shall be placed only when the local ambient temperature is above 45 degrees Fahrenheit and is forecast to remain above 45 degrees Fahrenheit for the curing period. The overlay shall not be placed when rain is forecast within the intended working period. Overlays shall be placed only if the overlay surface evaporation rate, as affected by ambient air temperature, concrete temperature, deck temperature, relative humidity and wind velocity, is 0.1 pound per square foot per hour or less. The Contractor shall determine and document the atmospheric conditions, subject to verification by the Engineer. No MSC shall be placed if the ambient air temperature is 85 degrees Fahrenheit or higher or predicted to go above 85 degrees Fahrenheit during the overlay placement regardless of the surface evaporation rate.

Figure 1 in section 511.08 shall be used determine graphically the loss of surface moisture for the overlay. In no case shall the temperature of the MSC exceed 90 degrees Fahrenheit during placement. If rain occurs during placing of the overlay, all operations shall cease. No MSC overlay shall be placed after October 15th except by specific permission of the Engineer.

If placement of the overlay is to be made at night, the Contractor shall submit a plan which provides adequate lighting for the work area. The plan shall be submitted at least 15 calendar days in advance and be approved by the Engineer before concrete is placed. The lights shall be so directed that they do not affect or distract approaching traffic.

During delays in the overlay placement operations of more than 10 minutes, the work face of the overlay and any bonding grouted areas shall be temporarily covered with wet burlap. If an excessive delay is anticipated, a bulkhead shall be installed at the work face and the overlay placement operation terminated.

Unless otherwise authorized by the Engineer, an overlay shall not be placed adjacent to a previous overlay which has cured for less than 36 hours.

Adequate precautions shall be taken to protect the freshly placed overlay from rain.

Prior to the end of the full curing period for any section, no power driven tools heavier than a 15-pound chipping hammer shall be used adjacent to the new overlay.

Vehicles other than approved construction equipment will not be permitted on those sections of the deck where concrete removal operations have begun. Contamination by construction equipment or from any other source shall not be permitted.

**525.11. Manufacturer's Representative.** The manufacturer's technical representative for the micro-silica admixture shall be notified when the admixture is selected and shall be present during the placement of the overlay unless his presence is waived by the Engineer. Operations and procedures which are considered by the representative as being detrimental to the integrity of the overlay will not be permitted.

**525.12.** Method of Measurement. MSC overlay 1-1/4 inches thick shall be measured as the actual deck area in square yards overlaid. The thickness shall be as per 525.01. The bid price for this item includes the cost of furnishing, placing, finishing, texturing and curing the specified thickness overlay. It also includes the cost of surface preparation (includes all handwork), removal of surface preparation debris, cleaning, applying bonding grout if required, and all other materials, labor and equipment required to complete this work, but not specifically included in the other items for payment. Payment shall also include all labor and equipment to place the variable thickness overlay (since the variable thickness and the constant thickness overlay are placed in one operation).

Full-depth repair shall be measured as the volume in cubic yards based on the measured area of full-depth openings in the deck and the existing slab thickness, less 1/4 inch. The bid price for this item includes the cost of removing sound concrete where the depth of sound concrete is less than half of the original thickness of the deck, furnishing and installing forms and supports, furnishing and placing MSC, and if the full depth repair is pre-placed, the finishing and curing required.

MSC overlay (variable thickness) shall be the volume in cubic yards measured as the difference between the total volume (as indicated by the batch quantity tickets for the ready-mix trucks) of MSC overlay placed and accepted, less the calculated volume of the MSC overlay (plan specified thickness), less the volume of the overlay concrete used for full-depth repair, and less any wasted overlay concrete. The volume of overlay concrete remaining in the drum of the last ready-mix truck shall be weighed or measured by the Engineer. The bid price for this item includes the cost of <u>material only</u>, furnished to the job site. No separate payment shall be made for the placement of the concrete or for any tools, labor, equipment or incidentals necessary for such placement complete and in conformance with these notes. The intent of this item is to pay material costs only for all materials, other than uniform thickness overlay material, regardless of the depth of removal incurred and including any material required for grade correction.

Concrete for the test slabs required under 525.05 shall be paid for on a lump sum basis. All other concrete for testing purposes shall be furnished without charge to the City.

**525.13 Basis of Payment**. Payment for completed and accepted quantities as measured above will be made at the contract price bid for:

Item	<u>Unit</u>	<b>Description</b>
525	S.Y.	MSC Overlay Using Hydrodemolition 1-1/4" Overlay
525	C.Y.	MSC Overlay (Variable Depth Repair-Material Only)
525	C.Y.	Full Depth Repair
525	L.S.	Test Slab

#### ITEM 526 – CRACK FILLING WITH EPOXY

- 526.01 Description526.02 Quality Assurance526.03 Delivery, Storage & Handling
- 526.04 Job Conditions
- 526.05 Surface Preparation
- 526.06 Materials
- 526.07 Mixing and Application
- 526.08 Cleaning
- 526.09 Method of Measurement
- 526.10 Basis of Payment

**526.01 Description.** This item shall include all materials, labor and equipment for the repair of cracks in concrete structures. The Contractor shall accompany the Engineer or his authorized representative in making a detailed examination of the designated work areas to locate cracks between 1/8" and 1/4" wide in need of repair. Cracks to be repaired shall be marked by the Contractor as directed by the Engineer. This item shall be completed after patching any concrete structures and before application of any waterproofing membrane.

**526.02** Quality Assurance. Contractor qualifications: Contractor shall be an approved Contractor of the manufacturer of the specified product, who has completed a program of instruction in the use of the specified repair material, and provide a notarized certification from the manufacturer attesting to their approved Contractor status.

Provide a notarized certificate stating that the repair material meets the specified requirements and have the manufacturer's current printed literature on the specified product.

**526.03 Delivery, Storage and Handling.** Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

Store and condition the specified product as recommended by the manufacturer.

**526.04 Job Conditions.** Environmental Conditions: Do not apply material if rain or snow will come in contact with material during application.

Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified repair material.

**526.05** Surface Preparation. The cracks and adjacent substrate must be clean, sound and free of frost. Remove dust, laitance, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting

materials from the surface by mechanical means, i.e. - sandblasting, high pressure waterblasting, etc., as approved by the Engineer.

Epoxy resin adhesive - repair area may be dry or damp, but free of standing water prior to product application.

**526.06 Materials.** The crack filling material shall be an epoxy adhesive such as Sikadur 35, Hi-Mod LV with Sikadur 31, Hi-Mod Gel as manufactured by the Sika Corporation, Concresive Standard LVI with Concresive Paste SPL as manufactured by Master Builders Technologies, or an approved equal.

Seven copies of the material specifications shall be submitted to the Engineer for his review.

**526.07 Mixing and Application.** Follow the material manufacturer's instructions and recommendations in the mixing and application of the crack filling material.

#### 526.08 Cleaning.

A. After the epoxy resin adhesive has cured, removal of the epoxy resin adhesive for sealing and porting devices shall be removed as required by the Engineer. Grinding of cured epoxy overflow shall be executed in such a manner to produce a finished appearance acceptable to the Engineer.

B. The uncured epoxy resin adhesive can be cleaned from tools with an approved solvent. The cured epoxy adhesive can only be removed mechanically.

C. All injection ports shall be removed by cutting the ports and grinding the remainder down to the concrete surface or to a depth acceptable by the Engineer.

D. Leave finished work and work area in a neat, clean condition without evident of spillovers onto adjacent areas.

**526.09** Method of Measurement. The quantity to be paid for under this item shall be the number of linear feet of crack epoxy injected, complete and accepted.

**526.10 Basis of Payment.** The repair of the structural and non-structural cracks will be paid for at the contract unit bid price per lineal foot, which payment shall be full compensation for furnishing and installing all materials, grinding, labor tools, equipment, and other incidentals necessary to complete the specified operation. Payment will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
526	L.F.	Crack Filling with Epoxy

# 550 PIPE CULVERTS, SEWERS AND DRAINS

#### 551 GENERAL

- 551.01 Description
- 551.02 Materials
- 551.03 Excavation
- 551.04 Protection of Excavation
- 551.05(a) Bedding for Rigid Pipe
- 551.05(b) Bedding for Non-Rigid Pipe
- 551.06 Storing and Laying Pipe
- 551.07 Joining Pipe
- 551.08 Shop Strutting
- 551.09 Backfilling
- 551.10 Restoration of Streets and Cleaning Up
- 551.11 Reconstructed Pipe
- 551.12 Low Pressure Air Test, Deflection Test, and T.V. Inspection
- 551.13 Method of Measurement

**551.01 Description**. This work shall consist of the construction or reconstruction of pipe culverts, sewers and drains (referred to below as Type A, Type B, Type C, and Type D pipe), complete in place as specified, using pipe of sizes and types called for by the plans, proposal, or these specifications, and in conformity with lines and grades shown on the plans and profiles, or as established by the Engineer. This work shall include all excavating and the removal of all materials necessary for placing the pipe, manholes, inlets and other appurtenances; maintaining flow in existing culverts, sewers or drains; furnishing, mixing, placing or removing materials, including lining materials; furnishing and placing bedding and backfilling materials as specified; furnishing, setting and removing of forms; pointing or plastering of surfaces; joining to existing and proposed appurtenances as required; performing low pressure air test and deflection test as specified; protecting existing utilities, structures or other improvements in the vicinity of the proposed pipe culverts, sewers and drains; and cleaning up and restoring disturbed facilities and streets and other surfaces.

**551.02 Materials**. Pipe shall be of the size and kind specified in the proposal and meet the requirements of pertinent sections of 706 and 707. When the kind of pipe is not specifically itemized, any of the kinds listed herein under the specified pipe type may be used. Higher strength concrete or plastic pipe of the same type may be furnished where lower strength pipe is specified. A thicker metal pipe of the same corrugation profile and type may be furnished where a lesser thickness is permitted or specified.

Other materials shall be as follows:

Reinforcing Steel	
Special Fittings	
Brick Masonry	
Slag and Limestone Bedding	
Crushed Gravel for Bedding	
Material for Backfill	
Cement for Mortar	
Sand for Mortar	

Unless otherwise specified, all reinforced concrete circular pipe shall comply with the requirements of 706.02 and 706.11 and shall comply with the standard specifications of ASTM C76 Class IV, Wall B or Wall C, unless otherwise specified on the plans. All reinforced concrete pipe shall be manufactured using Type II cement.

Only Vitrified Clay Pipe and Reinforced Concrete Pipe shall be considered as rigid pipe materials. All other pipe materials listed herein shall be considered non-rigid pipe materials.

#### **Type A Pipe - Storm Sewers Under Pavement**

Vitrified Clay Pipe	.706.08 with 706.12
Reinforced Concrete Pipe, Class IV	.706.02 with 706.11
Reinforced Concrete Elliptical Pipe	.706.04 with 706.15
Corrugated Polyethylene Watertight Smooth Lined Pip	e707.23
Glass Fiber Reinforced Pipe	

#### **Type B Pipe - Storm Sewers Not Under Pavement**

Type B Pipe - Storm Sewers Not	Under Pavement
Vitrified Clay Pipe	706.08 with 706.12
Reinforced Concrete Pipe, Class IV	706.02 with 706.11
Reinforced Concrete Elliptical Pipe	706.04 with 706.15
PVC Composite Sewer Pipe	
PVC Gravity Sewer Pipe	
Corrugated Polyethylene Watertight Smooth Lined	Pipe707.23
PVC Smooth Interior Pipe	
Glass Fiber Reinforced Pipe	

# Type C Pipe - Sanitary / Combined Sewers

Vitrified Clay Pipe	/06.08 W	ith /06.12
Reinforced Concrete Pipe,		
Class IV (30" Diameter and Over)	706.03 w	ith 706.11
Reinforced Concrete Elliptical Pipe	706.04 w	ith 706.15
PVC Composite Pipe		707.18
PVC Gravity Sewer Pipe		707.20
Glass Fiber Reinforced Pipe		707.25

#### **Type D Pipe - Steep Slopes / Special Conditions**

High Density Polyethylene Pipe (HDPE), Solid Wall ......707.26
#### 551.03

**551.03 Excavation**. Excavation shall include the removal and disposal of all material, including concrete, masonry and rock which may be removed with commonly used excavation equipment necessary for the construction and completion of work under this item. Excavation operations shall be conducted from the surface, except where tunneling is required on the plans or permitted by the Engineer. Tunnel openings shall be made subject to the approval of the Engineer.

Except in rock, water-bearing earth, or where a granular or concrete base is to be used, mechanical excavation of trenches shall be stopped above the final invert elevation so that the pipe may be laid on undisturbed soil. If overdigging occurs, all loosened earth shall be removed and the trench bottom brought back to grade, at the Contractor's expense, with granular material which may be fortified with cement, if so directed by the Engineer.

Width of trenches, except for pipe underdrains, in which pipe is to be installed shall be such as to provide adequate space for workmen to place and joint the pipe properly, but in every case the trench shall be kept to a minimum width. For all rigid pipe installations, the width of the trench at the top of the pipe shall not exceed the outside pipe diameter, including bells, plus the clear width on each side of the pipe as listed in the following table:

Pipe Size	Maximum Clear Width
6 inch to 24 inch	12 inches
27 inch to 54 inch	15 inches
60 inch and over	24 inches

For all non-rigid pipe installations, the minimum trench width shall be per the pipe manufacturer's recommendations, but at no time shall the width be less than that specified in ASTM D2321.

The length of trench or tunnel open at any one time shall conform to the limits approved by the Engineer. In general, not more than 100 feet of trench shall be opened in advance of the completed work.

Excavation shall be of sufficient depth and width to permit the installation of the work to the lines, grades, and dimensions called for by the plans, and for all sheeting, pumping, and draining. In general, the sides of the trench or other excavation shall be vertical and the walls properly supported with sheeting, bracing or other approved method where necessary for the protection of workmen, adjacent property, structures, utilities or existing improvements. The width at the top of the excavation shall be the minimum width that will permit the proper construction of the sewer or other structures, or the placing of sheeting. Should two sets of wood sheeting be used, the top width shall exceed the bottom width only by the thickness of the necessary rangers and planking plus one inch on each side for additional clearance of lower sheeting past upper rangers.

Trenches in rock shall be excavated to a depth not less than 6 inches below the bottom of the pipe by any acceptable method, including use of explosives, with the approval of the Engineer. Where blasting is permitted, it shall be done by persons experienced in such work and in accordance with 107.09. All blasts shall be well covered, and provisions made to protect pipes, conduits, sewers, structures, persons, and any property adjacent to the site of the work. No blasting shall be permitted within twenty-five feet of the completed pipe culvert, sewer or drain.

The Contractor shall provide proper and satisfactory means and devices for the removal of all groundwater entering the trench excavation and remove such groundwater as fast as it may collect in such matter as to not interfere with the prosecution of the work. The Contractor shall submit a dewatering plan to the Engineer for review prior to commencing work. The groundwater level must be lowered enough to allow a workable trench. Dewatering shall be continued until backfilling is completed in any manhole-to-manhole span. Cost of dewatering shall be included in the price bid for the item requiring the dewatering.

Should the Contractor excavate outside the limits as specified, or should he carry the excavation below or beyond the lines and grades given by the Engineer, or wherever material is loosened sufficiently, in the opinion of the Engineer, to endanger the bearing or foundation of the sewer or other structure to be built, the Contractor shall at his own expense remove all such loosened material and refill all such excavated space with suitable material as directed by the Engineer.

Where the soils encountered are not suitable for foundation, the excavation shall be carried to such additional depths or widths as directed by the Engineer.

Payment for excavation shall be included in the price bid for the item requiring the excavation. Payment for additional excavation, required by the Engineer because of unsuitable material encountered at the elevation of the pipe or appurtenance, shall be included in the unit price submitted for the material used to refill the area of unsuitable material. If there is no item in the contract, payment shall be as provided for in 104.03.

Where the pipe culverts, sewers, or drains are built upon the surface of the ground, the surface shall be grubbed and cleared of all stumps, grass, muck, or other vegetable matter. If 201 Clearing and Grubbing is not included in the contract, the cost of this work shall be included in the price bid for the item requiring the work. Pipe culverts, sewers, or drains shall not be constructed on frozen ground.

Unless otherwise indicated in the contract or permitted by the Engineer, the Contractor will not be permitted to store excavated materials along the line of the work.

**551.04 Protection of Excavation**. When excavating, the Contractor shall provide, place, and adequately maintain sheeting, bracing, cribbing or other trench

support for the safety of workmen or the adequate protection of adjacent property, structures, utilities or existing improvements.

The Engineer may order the Contractor to prepare and submit a trench protection plan. The required plan must identify how the Contractor will comply with specific plan notes requiring trench protection as well as identify methods to be used throughout the work.

No excavation work will be permitted within the limits of the work identified in the Engineer's request for a plan until that plan is approved in writing by the Engineer. Any deviation from the approved plan must also be approved by the Engineer.

Approval of a plan, failure to request a plan, or failure to request additional trench protection by the Engineer shall not be construed as relieving the Contractor from full responsibility for damages or injuries resulting from weak or insufficient trench protection or a lack of trench protection.

When wood sheeting is used and driven below the invert of a pipe culvert, sewer, or drain, it must be cut off and the portion below the pipe not disturbed. Any sheet piling or wood sheeting left in place shall be set or cut-off a minimum of two feet below the finished grade or bottom of pavement unless otherwise noted on the plans.

The cost of sheeting, bracing, cribbing, or other trench protection shall be included in the price bid for the items requiring the protection unless expressly noted in the proposal and/or the plans. Where sheeting, bracing or cribbing is a separate pay item, the work shall be paid for as 503 Cofferdams, Cribs and Sheeting or as 504 Temporary Sheet Piling.

**551.05 (a) Bedding for Rigid Pipe**. Class "A" bedding shall consist of a continuous concrete encasement or concrete cradle conforming to the dimensions given herein unless otherwise called for on the plans. Trenches in which continuous monolithic and integral concrete cradles or encasements are to be placed may be excavated completely with mechanical equipment. Prior to formation of the cradle or encasement, temporary supports consisting of timber wedges or pieces of brick shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at not more than two locations, one adjacent to the shoulder of the socket and the other near the spigot end. After jointing of the pipe has been completed, concrete for cradle or encasement shall be uniformly placed beneath and on both sides of the pipe.

Concrete cradles shall have vertical sides and the bottom shall be a plane surface parallel to the invert of the pipe. Standard cradles shall encase the pipe to the level of the horizontal centerline of the pipe, and shall extend a minimum of six (6) inches to each side of the pipe, and six (6) inches below the outside of the pipe. Concrete for cradles shall be Class "C". Full encasement shall completely envelop the pipe. The

minimum thickness of concrete for full encasement shall be (six) 6 inches, measured from the outside wall of the pipe. Concrete for full encasement shall be Class "F".

Extreme care shall be exercised in the placing of concrete encasement to prevent the displacement of the pipe from proposed line or grade.

Class "B" bedding shall consist of crushed limestone, crushed air cooled blast furnace slag or crushed gravel. The aggregate size shall be No. 5, No. 6, No. 56, or No. 57 as defined by AASHTO M43, unless otherwise approved by the Engineer. Bedding materials shall be placed in the trench bottom to a depth of not less than 6" below the pipe bottom. The layer of bedding material shall be shaped to receive the pipe for a depth approximately 10 percent of the diameter or rise of the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

After the pipe is placed and line and grade verified, the bedding material shall be extended up around the sides of the pipe to the horizontal center line. The material shall be placed under the pipe haunch, taking care to not disturb the line and grade of the pipe and to insure sufficient material has been placed and compacted along the sides of the pipe to provide adequate side support. Granular bedding material shall be compacted to 95 percent of the maximum laboratory dry weight as determined by AASHTO T99.

Flooding or puddling shall not be used to compact embedment materials for any pipe, whether rigid or flexible. Preparation of the trench bottoms and placement of all pipe shall be carefully made so that when in final position, the pipe is true to line and grade and supported throughout its length. Blocking will not be permitted to bring pipe to grade.

Trenches shall be dry when trench bottom is prepared.

The cost of furnishing and placing materials to achieve the required class of bedding shall be included in the item requiring the bedding.

**551.05 (b) Bedding for Non-Rigid Pipe.** Class "NR" Bedding for installation of non-rigid pipe shall be in an envelope consisting of bedding, haunching, and initial backfill extending from a depth of 6 inches below the bottom of the pipe to 12 inches above the top of the pipe. Material for the envelope shall meet the requirements for Class "B" Bedding materials, except only No. 56 and No. 57 size material shall be used. Slag shall only be permitted for use with 707.23 pipe material.

The bedding shall be placed and shaped to fit the pipe. After installation of the pipe, bedding material shall be placed and compacted under the haunches and along the sides of the pipe up to the horizontal centerline to provide adequate side support, taking care to not disturb the line and grade of the pipe.

The initial backfill shall then be placed uniformly across the trench to a minimum depth of 12 inches above the top of the pipe.

Flooding or puddling shall not be used to compact embedment materials for any pipe. Preparation of the trench bottoms and placement of all pipe shall be carefully made so that when in the final position, the pipe is true to line and grade and supported throughout its length. Blocking will not be permitted to bring the pipe to grade. Trenches shall be dry when the trench bottom is prepared.

Cost of furnishing and placing of bedding materials to achieve the required class of bedding shall be included in the item requiring the bedding.

**551.06** Storing and Laying Pipe. Pipe shall be stored at the job site in such a manner as to protect the pipe from damage. Non-rigid pipe must be stored to prevent bowing. Pipes having deviations from straight greater than 1/16-inch per foot of length shall not be used. Pipe, fittings and specials with visible breakage or other defects shall not be used, or repaired and used, unless specifically approved by the Engineer in writing. Pipe shall be kept clean at all times.

Pipe shall be laid accurately to the line and grade designated on the plans. Pipe shall be carefully centered so that when laid it will form a sewer with close fitting joints and a uniform invert.

All pipe shall begin and end with pipe ends as normally fabricated by the manufacturers. If field cutting of 707 pipe is required, cutting shall be performed by the use of tools or equipment that will provide a neat perpendicular cut without structural damage to the pipe wall or damage to coatings or fillers.

Metal pipe shall be placed with any longitudinal laps or seams at the side and shall be placed with circumferential seams lapping on the inside in the direction of flow.

706.02 reinforced concrete pipe with elliptical reinforcement and 706.04 reinforced concrete horizontal elliptical pipe with single cage reinforcement shall be handled and placed with the reinforcement markings along a vertical plane. 706.02 reinforced concrete pipe with auxiliary supports shall be handled and placed with the centerline of the auxiliary support system in a vertical plane.

Care shall be taken with all precut holes, fittings, specials, etc. to insure that they are placed at the location and elevation indicated on the plans.

It is intended that curves in 30 inch or larger diameter 706.02 reinforced concrete pipe sewers be truly circular. This work shall be monolithic construction of brick and/or concrete unless otherwise specified on the plans. However, the use of 706.02 radius pipe or 706.02 cut curves may be permitted where the alignment shown on the plans can be maintained, and a shop drawing of the cut curves or radius pipe illustrating the layout and geometry is approved by the Engineer.

Bedding provided for rigid pipe shall be as called for on the plans but in no case will a bedding providing a load factor less than a Class "B" bedding be permitted.

Bedding for non-rigid pipe shall be as called for on the plans, or shall conform to Section 551.05(b). If directed by the engineer, the contractor shall provide additional bedding material or pipe foundation not required by the plans or specifications, in order to adequately support the pipe. Payment for furnishing and placing the additional bedding and/or foundation shall be in accordance with item 603 or section 109.04, as appropriate.

Where bracing plates or a trench box is used for the installation of flexible pipe, all voids caused by the withdrawal of the bracing plates or the trench box shall be completely filled.

All lifting holes in 706.02 and 706.04 pipe shall be grouted with cement mortar or other approved material after the pipe has been placed.

**551.07 Joining Pipe**. Before joining pipe with a coupling or bell end, all surfaces of the portions of the pipe to be joined and all surfaces of factory made jointing materials shall be clean and dry. Lubricants, primers, adhesives, solvents, bolts, etc. shall have been manufactured specifically for their intended use and shall be used as recommended by the pipe and/or pipe joint manufacturer. The jointing materials shall be fitted and adjusted or applied in such a manner as to obtain a close fitting joint and to obtain the degree of water tightness required.

For elliptical reinforced concrete pipe preformed butyl rubber material 706.15 shall be used. The butyl material shall be of sufficient quantity to seal the joint but not necessarily fill the joint when the pipe is placed in its final position. Both sides of the joint shall be primed with an asphalt based primer as recommended by the manufacturer.

For corrugated metal pipe requiring banded joints, the pipe lengths shall be joined with coupling bands which have at least one circumferential corrugation that indexes into the inboard corrugation of each pipe. Bands with projections shall not be permitted. If coated pipe is used, coated coupling bands must also be used.

For Corrugated Polyethylene Smooth Lined Pipe, joints shall conform to the most current edition of AASHTO M294 for watertight requirements including continuously extruded bell and spigot without welds. If deemed necessary by the Engineer, water-tightness of joints shall be field-tested per ASTM F1417 or C969. Any testing shall be performed by the Contractor, with the cost to be included in the unit price bid for the pipe.

Where the joining of pipes of different materials is required or approved, this work shall be done utilizing special adapters and couplers manufactured specifically for this purpose. The adapters and couplers shall be installed and securely attached to both pipe barrels according to manufacturers recommendations.

As soon as possible after a joint is made, sufficient backfill materials shall be placed along each side of the pipe to support the pipe in its final position.

Where a pipe stub or run of pipe is to be temporarily terminated for future extension, the end of the pipe shall be sealed using an approved removable plug. Masonry bulkheads, if required, shall be constructed in such manner as to allow for their removal in the future without damaging the bell of the pipe. Masonry for bulkheads shall be per 602. Cost of this work to be included in the unit price bid for the pipe.

Where a pipe enters or exits a proposed or reconstructed manhole, the method of connection to the manhole shall be per the pipe manufacturer's recommendations, and shall form a watertight connection.

When pipe having exterior corrugations is being connected to a proposed or reconstructed manhole, the connection shall be made using a boot-type seal with stainless steel clamping band. The boot-type seal may be either cast into the manhole wall, or may be the field-placed expanding ring type. The use of manhole sleeves is not permitted.

**551.08** Shop Strutting. Where required by the plans, flexible pipe shall be elongated by increasing its vertical diameter 5 percent. The vertical elongation shall be maintained by horizontal wire struts that shall be left in place until the embankment is completed. The struts shall be removed as directed by the Engineer.

The completed installation shall at no point have out-of-round pipe deflections greater than 5 percent whether or not shop strutting is required. The Engineer may require a deflector meter or a "go, no-go" gauging test run prior to acceptance.

**551.09 Backfilling**. All trenches and excavations shall be backfilled as soon as practicable after the pipe has been installed unless other protection of the pipe is directed or shown on the plans. The backfill material, which is placed at the sides of the pipe and 2 feet over the pipe or other structure, shall be bank run gravel meeting the requirements of 604.02. Backfill material beyond 2 feet above the top of pipe shall be suitable material removed from the trench or other parts of the project or bank run gravel meeting the requirements of 604.02 as approved or directed by the Engineer. The material shall be moistened or dried, if necessary, to its optimum moisture content for compaction.

The backfill around the pipe up to the top of the pipe shall be placed in loose layers not exceeding 6 inches per layer and thoroughly compacted by hand or power tampers approved by the Engineer. Great care shall be used to obtain thorough compaction under the haunches and along the sides of the pipe. Over the top of the pipe, backfill layers of approximately 8 inch depth shall be added with each layer compacted separately and thoroughly until the trench is completely and uniformly filled to a depth of two feet above the top of the pipe. Backfilling operations shall be done in such a manner as to avoid movement or damage to the pipe.

If specified on the plans, the Contractor shall construct bulkheads using the approved soil at 100 foot intervals. The bulkheads shall be constructed in layers and

thoroughly compacted. They shall extend the full width of the trench, approximately 3 feet in length and brought up to a minimum of 2 feet above the top of the pipe.

Above this point backfill material shall be brought up evenly by depositing the material in layers approximately nine inches in loose depth and without injuring the pipe by shock, jar or excessive free fall. Each layer shall be thoroughly compacted by power tampers operated with care so as not to injure the underlying pipe or appurtenances or by water if proper drainage is provided for the free water. However, flooding or puddling shall not be used without written approval of the Engineer. If the Contractor intends to compact backfill with water he shall submit details of the proposed method for approval before beginning backfilling operations. Hand tampers may be used in corners or narrow places inaccessible to power tampers. Payment for the fill or backfill, including bulkheads, to two feet above the top of the pipe or appurtenances, shall be included in the unit price bid for the pipe or appurtenance being constructed. Payment for backfill obtained from the excavation or other parts of the project shall be included in the price bid for the item requiring the backfill.

If compaction is done using hydraulically-operated backhoe-mounted compactors, such as Ho-Pac Model 8700C or equal, the backfill material may be deposited in layers not more than 2 feet in loose depth. Layers in excess of 2 feet may be deposited only if tests, conducted at the contractor's expense, show, to the satisfaction of the Engineer, that the specified degree of compaction is being achieved. There shall be at least 3 feet of compacted backfill over the pipe before this method of compaction may be employed.

When required by the Engineer to use bank run gravel (604.02) for backfill, payment shall be made at the unit price bid for Item 604 - Bank Run Gravel. The limits for payment of bank run gravel fill shall be the widths as specified in 551.03, the depth shall be from top of subgrade or finished elevation, whichever is lower, to a point two feet above top of pipe and the length shall be measured horizontally from start of fill to end of fill.

For areas outside the street R/W the backfill shall be compacted to not less than 90% of the maximum dry density at  $\pm 2\%$  of optimum moisture content as determined by tests approved or conducted by the Engineer. Backfill shall be compacted to not less than 95% of the maximum dry density at  $\pm 2\%$  of optimum moisture content for areas within the street R/W.

Backfilling shall be kept completed up to a point within 100 feet of the end of the newly laid pipe unless otherwise directed by the Engineer. During backfilling operations, no sheeting or bracing shall be removed without permission of the Engineer.

**551.10 Restoration of Streets and Cleaning Up.** All surfaces affected by the construction work shall be permanently restored according to 104.07. The cost of all restoration made necessary by the construction of pipe culverts, sewers and drains,

## 551.11

unless otherwise provided for on the plans, in the proposal, or in the specifications, shall be included and paid for in the price bid for the pipe items or appurtenances as appropriate.

Before final acceptance the Contractor shall clean up the work area in accordance with 104.06.

**551.11 Reconstructed Pipe.** Where so required by the plans, existing pipe culverts, sewers and drains shall be reconstructed with materials of the types and at the locations specified for new pipe culverts, sewers or drains. All of the provisions of these specifications shall govern the reconstructing of existing pipe culverts, sewers and drains with the same materials and by the same methods as new construction of the same. Cost of connecting sewer pipe to existing manhole and restoring manhole wall shall be included in the cost of the pipe.

**551.12(a)** Low Pressure Air Test. All sewers, manholes or other structures and appurtenances which are to be used for sanitary sewage shall at all times be water tight and not permit the infiltration of water into, or the exfiltration of sewage therefrom. All such sewers shall be subject to an air leakage test to be performed by the Contractor, under the direct supervision of the Engineer. No request by the Contractor for waiver of the test will be considered. The cost of all air-leakage testing shall be included in the unit price bid for the pipe.

The air test shall be performed within a reasonable time after completion of the sewer, or sections of a larger installation, before the subfinal acceptance. The Contractor shall verify that the sewers, manholes, etc. are substantially complete and reasonably clean prior to performing the test.

The testing procedure and criteria shall be in accordance with ASTM C 828 (clay pipe), C 924 (concrete pipe), or F 1417 (plastic pipe), as applicable, and Table 551.12(a) which shows the required test time in minutes per 100 feet of pipe for each nominal pipe size for a 1.0 psi pressure drop from 3.5 to 2.5 psi. Testing procedures and criteria for PVC pipe (707.20) shall be in accordance with ASTM D3212. All sanitary sewer manholes shall be tested in accordance with ASTM C1244.

TABLE 551.12(a) Minimum Test Time for Various Pipe			
	Si	zes	
Nominal	T (time)	Nominal	T (time)
Pipe Size, in.	min/100 ft.	Pipe Size, in.	min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

If the sewer fails to meet the minimum test times shown in Table 551.12(a) the Engineer may order the Contractor to expose and repair as required joints or any section in the test, backfill, and restore the surface. Such additional work shall be at the Contractor's expense. Following the repairs, the sewer shall be retested until the minimum test time is equaled or exceeded.

In the event that the pipe fails to meet the test requirements,

No payment to exceed 75% of the price bid for the pipe items shall be made until the sewer(s) satisfactorily passes the low pressure air test. Passing an air test or making repairs and passing an air test does not release the Contractor from the responsibility of repair or replacement of sewers and appurtenances during the guarantee period.

**551.12(b) Deflection Test**. All sewers constructed using non-rigid pipe materials shall be subject to a pipe deflection test, regardless of the pipe stiffness, to be performed by the Contractor, under the direct supervision of the Engineer. No request by the Contractor for waiver of the test will be considered. The cost of performing the deflection testing shall be included in the unit price bid for the pipe.

The deflection test will be performed at the end of the guarantee period before release of the retainer or bond.

The test shall consist of pulling a mandrel (Go/No Go) device through the sewer by hand. No mechanical pulling devices shall be used. The mandrel shall be either the full circle or 9-arm type and conform to the dimensions noted in Table 551.12(b). No sewer will be accepted if the pipe deflection at any point is in excess of 5% of its average inside diameter as noted in Table 551.12(b).

TABLE 551.12(b) Average Inside Diameters & 5% Deflection Mandrel						
Dimensions						
	ASTM D-	3034	ASTM D-	2680	ASTM F-6	579
Minimal		5%		5%		5%
Pipe	Average	Deflection	Average	Deflection	Average	Deflection
Size	I.D.	Mandrel	I.D.	Mandrel	I.D.	Mandrel
Inches	Inches	Inches	Inches	Inches	Inches	Inches
6	5.893	5.598				
8	7.891	7.496	7.75	7.35		
10	9.864	9.371	9.75	9.25		
12	11.737	11.150	11.75	11.16		
15	14.374	13.655	14.75	14.01		
					T-1*	
18					18.165	17.257
21					21.415	20.344
24					24.092	22.887
27					27.152	25.794
					T-2*	
18					18.202	17.292
21					21.459	20.386
24					24.142	22.935
27					27.208	25.848

\*T-1 = Cell Classification 12454C

\*T-2 = Cell Classification 12364C

All portions of sewer found to exceed this limit shall be replaced or repaired by the Contractor promptly in a manner satisfactory to the Engineer. After a period of at least 30 days after backfilling the repaired area(s), the sewer shall again be tested for deflection. This procedure shall be repeated as necessary until the maximum pipe deflection is 5% or less. The Contractor shall bear the total cost of all repairs or replacement, including surface restoration in accordance with 104.07.

**551.12(c) T.V. Inspection**. All sewers, manholes, inlets and other appurtenances shall be subject to T.V. and visual inspections, to be performed by the Contractor, prior to subfinal acceptance of the sewer items. No request by the Contractor for waiver of the inspections will be considered. Costs associated with the T.V. inspection shall be included in the unit price bid for the pipe.

The T.V. inspections shall be performed after completion of the sewer items, before the subfinal acceptance and release of the retainer or bond. The Contractor shall verify that the sewers, manholes, inlets, etc. are substantially complete and reasonably clean prior to performing the inspection.

All pipe, manholes, inlets and appurtenances found to be defective shall be replaced or repaired by the Contractor promptly in a manner satisfactory to the Engineer. The Contractor shall bear the total cost of all repairs or replacement, including surface restoration in accordance with 104.07.

Passing the T.V. inspection or making repairs and passing the T.V. inspection does not release the Contractor from the responsibility of repair or replacement of sewers and appurtenances during the guarantee period.

**551.13 Method of Measurement**. The quantities to be paid for shall be the actual number of linear feet of pipe culverts, sewers and drains, constructed and accepted. Measurements shall be horizontal centerline measurements of the length of actual pipe in place. The length of fittings shall not be deducted from the gross length of the sewer even if paid separately under item 561. The interior dimension(s) of manholes or junction chambers will be deducted from the gross length of the sewer.

However, if the sewer pipe is 42 inches or more in inside diameter the deduction for manholes shall not be made. If monolithic brick and/or concrete curves, cut curves, or radius pipe are part of the construction, the quantity to be paid shall be measured horizontally along the centerline and payment made under the equivalent diameter pipe item. In the instance where a constructed in place or factory built transition section is used to change pipe size it shall be measured as above and included in the quantity to be paid for the larger adjacent pipe size. The quantities of items 503 Cofferdams, cribs and sheeting and 504 Temporary sheet piling or Sheet piling left in place to be measured for payment shall be the actual quantity measured in place and accepted. Payment for these items shall be made only within the limits specifically shown on the plan or noted in the proposal.

## **ITEM 552 STORM SEWERS**

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**552.01 Description**. This work shall consist of the construction or reconstruction of pipe storm sewers in accordance with 551.

**552.02** Materials. Material shall be as specified in the proposal and/or the plans. When the pipe material is not specifically itemized, any of the pipe materials listed herein under the specified pipe type may be used. Higher strength non-rigid pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified. Any concrete pipe used for storm sewers shall be manufactured using Type II cement.

Ľ	ype A Pipe - Storm Sewers under Pavement	
	Reinforced Concrete Pipe, Class IV 706.02 with	706.11
	Vitrified Clay Pipe, Extra Strength 706.08 with	706.12
	Reinforced Concrete Elliptical Pipe706.04 with	706.15

#### 552.03

Corrugated Polyethylene	
Watertight Smooth Lined Pipe	707.23
Glass Fiber Reinforced Pipe	

#### **Type B Pipe - Storm Sewers Not under Pavement**

Reinforced Concrete Pipe, Class IV	
Vitrified Clay Pipe, Extra Strength .	
Reinforced Concrete Elliptical Pipe.	
PVC Composite Sewer Pipe	
PVC Gravity Sewer Pipe	
Corrugated Polyethylene	
Watertight Smooth Lined Pip	e707.23
PVC Smooth Interior Pipe	
Glass Fiber Reinforced Pipe	

**552.03** Method of Measurement. The quantity to be paid under this item shall be measured as provided in 551.13.

**552.04 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract prices for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>		
552	Linear Foot	inch Storm sewer, Type	, Class	bedding
552	Linear Foot	xStorm sewer,	_, Class	_ bedding

# **ITEM 553 INLET CONNECTIONS**

553.01 Description
553.02 Materials
553.03 Construction
553.04 Method of Measurement
553.05 Basis of Payment

**553.01 Description**. This work shall consist of the construction or reconstruction of pipe from inlets or catch basins to manholes, sewers or other inlets as shown on the plans and in accordance with 551.

**553.02** Materials. Materials shall be as specified in the proposal and/or the plans. Where the kind of inlet connection pipe is not specifically itemized, any of the kinds listed hereunder may be used.

 However, in the case of extensions, repair or adjustment of existing inlet connections and where directed by the engineer, the contractor must use pipe material that is most similar to the existing pipe. Under no circumstances will nonrigid pipe be permitted for use as inlet connection pipe.

All inlet connections for modified inlets shall be RCP ASTM C76 Class IV Wall B or C, 706.02 with 706.11. Remove or abandon existing inlet connections as directed by the Engineer.

The standard pipe size for inlet connections shall be 12 inches, unless otherwise shown on the plans. If the inlet connection is to drain a sump or sag area, the size shall be a minimum of 15" diameter unless otherwise directed by the Engineer.

**553.03 Construction**. The pipe shall be laid and joints made according to 551. Junctions with existing sewers shall be made as per plan or as directed by the Engineer. Where sufficient manhole depth exists and unless directed otherwise by the Engineer, connections from inlets to manholes shall be laid straight on a line and grade, with a minimum grade of two percent, from a point in the manhole wall above the bench to the lowest part of the inlet.

When a connection runs directly from the sewer, it shall be laid straight from the horizontal centerline of the sewer to the lowest part of the inlet, unless otherwise directed by the Engineer.

Connections shall be constructed so as to form neat and tight junctions with the sewer or manhole, with slants, Y-branches or T-branches being used when connecting directly with sewers or stubs being used at manholes.

Portions of existing inlet connections, which will not be utilized, and fall within the trench excavation limits of the new inlet connection shall be removed. Cost to be included in the price bid for the new inlet connection.

Portions of existing inlet connections, which will not be utilized, and fall outside the trench excavation limits of the new inlet connection shall be removed or abandoned. Payment for the abandonment or removal shall be made under the appropriate 202 bid item.

**553.04 Method of Measurement**. The quantity to be paid under this item shall be measured as provided in 551.13.

**553.05 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

 Item
 Unit
 Description

 553
 Linear Foot
 \_\_\_\_\_\_inch Inlet connection, \_\_\_\_\_, Class \_\_\_\_\_ bedding

## **ITEM 554 DRIVEWAY, ROADWAY AND DITCH CULVERTS**

554.01 Description554.02 Materials554.03 Method of Measurement554.04 Basis of Payment

**554.01 Description**. This work shall consist of the construction and reconstruction of pipe for the purpose of enclosing roadside ditches under driveways or through intersections, enclosing ditches crossing the roadway or any ditch requiring pipe less than 30 inches in diameter. Construction shall be as specified in 551.

**554.02** Materials. Material shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength concrete or plastic pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified.

Reinforced Concrete Pipe	706.02
Vitrified Clay Pipe, Extra Strength	706.08
Galvanized Corrugated Steel Pipe	707.01
Bituminous Coated Corrugated Steel Pipe (2-2/3" x 1/2")	707.04
Paved Bituminous Coated Corrugated (2-2/3" x 1/2") Steel Pipe	707.05
Corrugated Aluminum Alloy Pipe	707.12
Bituminous Lined Corrugated (2-2/3 x 1/2") Steel Pipe	707.13
Fiber Bonded Corrugated Steel Pipe	707.16

**554.03** Method of Measurement. The quantity to be paid under this item shall be measured as provided in 551.13.

**554.04 Basis of Payment**. Payment for accepted quantities complete in place, including coupling bands and bolts on corrugated metal pipe, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>		
554	Linear Foot	inch Ditch culverts,	, Class	bedding
554	Linear Foot	inch Driveway culverts,	, Class	bedding
554	Linear Foot	inch Roadway culverts,	, Class	bedding

## **ITEM 555 DRAINAGE CULVERTS**

- 555.01 Description
- 555.02 Materials
- 555.03 Method of Measurement
- 555.04 Basis of Payment

**555.01 Description**. This work shall consist of the construction or reconstruction of pipe or pipe arches 30 inches or greater in equivalent diameter for the purpose of enclosing water courses. This work may be connected to headwalls, end walls, stilling basins, other end structures or have plain open ends. Construction shall be as specified in 551.

**555.02 Materials**. Materials shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength concrete or plastic pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified.

Reinforced Concrete Pipe 706.02 with 706.11
Galvanized Corrugated Steel Pipe707.01
Galvanized Corrugated (3" x 1") Steel Pipe
Structural Plate Corrugated Steel Structures
Bituminous Coated Corrugated (2-2/3" x 1/2")
Steel Pipe and Pipe Arches707.04
Paved Bituminous Coated Corrugated (2-2/3" x 1/2")
Steel Pipe and Pipe Arches707.05
Bituminous Coated Corrugated (3" x 1")
Steel Pipe and Pipe Arches707.06
Paved Bituminous Coated Corrugated (3" x 1")
Steel Pipe and Pipe Arches707.07
Corrugated Aluminum Alloy Pipe707.12
Bituminous Lined Corrugated (2-2/3" x 1/2")
Steel Pipe
Bituminous Lined Corrugated (3" x 1")
Steel Pipe
Fiber Bonded Corrugated Steel Pipe707.16
Fiber Bonded Corrugated Steel Pipe Arches707.17

**555.03** Method of Measurement. The quantity to be paid for under this item shall be measured as provided in 551.13.

**555.04 Basis of Payment**. Payment for accepted quantities, complete in place, including coupling bands and bolts on corrugated metal pipe, will be made at the contract pipe for:

<u>Item</u>	<u>Unit</u>	Description
555	Linear Foot	inch Drainage culvert,, Class bedding
555	Linear Foot	x inch Drainage culvert,, Class
		bedding

### **ITEM 556 HOUSE DRAIN PIPE**

556.01 Description
556.02 Materials
556.03 Length of Pipe
556.04 Construction Methods
556.05 Method of Measurement
556.06 Basis of Payment

**556.01 Description**. This work shall consist of furnishing and installing drain pipe for the purpose of conveying roof water to the street gutter or ditch.

When payment is made under 556 House Drain Pipe, Complete, this work shall consist of furnishing and installing drain pipe through the curb, under the lawn strip and/or sidewalk, and within private property to a maximum of three feet behind the R/W line, and shall include drilling the necessary holes through stone or concrete curbing, and where applicable, making the necessary tie-ins to existing or proposed drain pipe.

When payment is made under 556 House Drain Pipe, Type A, this work shall consist of furnishing and installing drain pipe within private property from three feet behind the R/W line to a convenient and suitable point of tie-in and shall include making the necessary tie-ins to existing drain pipe.

When payment is made under 556 House Drain Pipe, Type B, this work shall consist of furnishing and installing drain pipe within the street R/W from the face of the curbing to a convenient and suitable point of tie-in under the lawn strip, and shall include drilling the necessary holes through stone or concrete curbing and making the necessary tie-ins to existing drain pipe.

**556.02** Materials. Pipe shall be 3 inch diameter unless otherwise shown on the plans or directed by the Engineer.

Schedule 40 PVC Pipe and Fittings ......707.27

**556.03 Length of Pipe**. House Drain Pipe, Complete. Where there is curbing, the pipe shall extend from the face of the curbing to a maximum of three feet behind the R/W line. Where there is no curbing, the pipe shall extend from the roadway ditch line to a maximum of three feet behind the R/W line. Where the pipe is being installed under new sidewalk that does not abut the curb, a coupling shall be provided at each side of the walk. In lieu of a coupling, bell type pipe may be installed with the bell at the uphill side of the walk. In some cases the pipe shall be laid only under the sidewalk and shall have a suitable cap or plug installed at both ends. In instances where the pipe is to be capped behind the R/W line, the pipe shall extend a minimum of 12 inches beyond the back edge of the walk.

House Drain Pipe, Type A and B. The length of pipe furnished and installed shall be as required to make a convenient and suitable tie-in to the existing drain pipe as directed by the Engineer.

**556.04 Construction Methods**. The holes shall be provided through the curbing by drilling, using a method approved by the Engineer. The pipe shall be laid on a straight grade from the R/W line through the hole in the curbing. The pipe shall be laid under the walk in the subbase when the walk and lawn strip are of sufficient cross slope to allow the pipe to flow. The pipe shall be laid within the walk between the forms when the walk and lawn strip are not of sufficient cross slope. Standard manufactured fittings shall be used to connect new pipe to existing pipes.

House drain installations under existing sidewalk shall be installed by open-cutting. No jacking or tunneling under existing sidewalk shall be permitted. The affected sidewalk slab(s) shall be reconstructed back to the nearest existing construction, expansion or contraction joint per 456. Payment for the replacement of the sidewalk shall be considered incidental to this work unless payment is provided for in the contract under the appropriate sidewalk pay item.

Lawn areas on private property disturbed solely by the installation of house drain pipes shall be restored per 653 and 659. Cost of the lawn restoration shall be considered incidental to this item.

**556.05** Method of Measurement. The quantity of House Drain Pipe, Complete, to be paid shall be the actual number of pipes in place and accepted including holes in curbs, couplings and fittings.

The quantity of House Drain Pipe Type A and B to be paid under this item shall be the actual number of linear feet of pipe in place, completed and accepted including couplings and fittings. Couplings and fittings shall be measured in place as straight lengths of pipe, and paid for in the linear foot measurement.

**556.06 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

Item	<u>Unit</u>	Description
556	Each	House drain pipe, complete
556	Linear Foot	House drain pipe, Type A,
556	Linear Foot	House drain pipe, Type B,

## **ITEM 557 SANITARY SEWERS**

- 557.01 Description
- 557.02 Materials
- 557.03 Method of Measurement

### 557.04 Basis of Payment

**557.01 Description**. This work shall consist of the construction or reconstruction of pipe for sanitary sewers and combination sewers in accordance with 551.

**557.02 Materials**. Materials shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength non-rigid pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified. Sewers serving any industrial or commercial properties shall be constructed of a pipe material other than PVC. Any concrete pipe used for sanitary sewers shall be manufactured using Type II cement. All reinforced concrete pipe used for sanitary or combined sewers shall be epoxy coated per 706.03, if called for on the plans.

# For 8" to 15" Diameter

Vitrified Clay Pipe, Extra Strength	
PVC Composite Sewer Pipe	
PVC Gravity Sewer Pipe	

# For 18" Diameter to 27" Diameter

Vitrified Clay Pipe, Extra Str	rength	 	706.08	with	706.12
Glass Fiber Reinforced Pipe	•••••	 			707.25

### For 30" Diameter and Over

Reinforced Concrete Circular Pipe	706.03	with	706.11
Reinforced Concrete Elliptical Pipe*	706.04	with	706.15
Glass Fiber Reinforced Pipe			707.25

\* Epoxy coated as per 706.03, if called for on the plans.

**557.03** Method of Measurement. The quantity to be paid under this item shall be measured as provided in 551.13.

**557.04 Basis of Payment**. Payment for accepted quantities, complete in place, including all T-branches and Y-branches for existing or proposed lateral connections, will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>		
557	Linear Foot	inch Sanitary sewer,	,Class	bedding

# **ITEM 558 FORCE MAINS AND SYPHONS**

558.01 Description

558.02 Materials558.03 Testing558.04 Method of Measurement558.05 Basis of Payment

**558.01 Description**. This work shall consist of the construction or reconstruction of pipe for the purpose of conveying sewage or other waste liquids under pressure in accordance with 551 except 551.12 shall not be required.

**558.02** Materials. Materials shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified.

**558.03 Testing.** After the pipe has been laid and backfilled, the pipe will be filled with water for a leakage test. The pipe shall be tested under a pressure of 50 pounds per square inch greater than the working pressure that the pipe will experience in service, as determined by the Engineer. The pipe shall be tested in lengths of not more than 2,000 feet when possible. The duration of the test shall be two hours, unless directed otherwise by the Engineer, and the leakage during the test shall not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours.

The test shall be made by pumping the pipe to the test pressure and measuring the quantity of water required to pump the pipe back up to test pressure at the end of the test period. The Contractor shall furnish the necessary pumps, pipe, bulkheads, connections, gauges and measuring devices for making the test.

In the event that the pipe fails to meet the test requirements, the Engineer may order the Contractor to expose and repair as required joints or any section in the test, backfill, and restore the surface. Such additional work shall be at the Contractor's expense.

The Contractor shall be responsible for any damage to the trench, piping or appurtenances which may arise from, or in connection with, the tests, and all damaged pipe or appurtenances shall be replaced by the Contractor immediately.

Where testing would be expedited by access to open ends of pipe and where approved by the Engineer, the Contractor may test the pipe prior to installing the last final lengths(s) of pipe and/or connecting the pipe to pump station piping or appurtenances. This shall not be construed, however, as relieving the Contractor from responsibility for defects in the completed work which may appear during the maintenance period. This leakage test may be waived in its entirety, if so determined by the Engineer or if noted on the plans. **558.04 Method of Measurement**. The quantity to be paid under this item shall be as provided in 551.13.

**558.05 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
558	Linear Foot	inch Force main,
558	Linear Foot	inch Syphon,

# **ITEM 559 PIPE RECONNECTIONS**

559.01 Description
559.02 Materials
559.03 Construction
559.04 Method of Measurement
559.05 Basis of Payment

**559.01 Description**. This work shall consist of the extension of existing sanitary sewer laterals, the reconnection of existing sanitary sewer laterals as part of sanitary sewer reconstruction, adjustment of existing sewer laterals to provide clearance for storm sewer or utilities or the reconstruction of damaged sections of existing laterals.

**559.02** Materials. Materials shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength pipe of the same type may be furnished where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified.

However, where the Engineer so directs, the Contractor must use that pipe material listed above that is most similar to the existing material.

**559.03 Construction**. The pipe shall be laid and joints made in accordance with 551. Junctions with existing laterals or sewers shall be made as conditions require and at the direction of the Engineer. When necessary to connect new sewer pipes to existing lines, the Engineer may waive the requirement for the so-called "premium" joint materials to permit proper connections with existing lines. Such waiver is not to be interpreted to include any more pipe than is required to make the necessary connections with existing lines or to lay pipe around obstacles where the premium joints may not be workable.

Existing lateral and Y-branch locations are approximate. Before making a reconnection and where directed by the engineer, the contractor shall perform a dye test or utilize other appropriate means to determine the origin of a lateral and/or an active or unused status. The decision to reconnect or abandon any unused laterals shall be made by engineer. The cost of dye tests or other investigation shall be included in the unit price bid for item 559.

**559.04 Method of Measurement**. The quantities to be paid for under these items shall be the actual linear feet of pipe sewer and the number of bends. The number of bends shall be determined by actual count of those used. Payment for bends shall be based upon the number of short bends placed. Long bends shall be paid for as two short bends. Bends shall be considered "short bends" when the centerline length and radius are approximately two feet.

There shall be no special payment for stacks or chimneys. The pipe and bends, used for stack construction, shall be measured and paid for as described above.

Brick or concrete masonry used for stack or chimney construction shall be measured and paid for as provided in 602.

**559.05** Basis of Payment. Payment for accepted quantities, complete in place, will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>	
559	Linear Foot	inch Pipe reconnections,	, Class bedding
559	Each	inch Pipe bends,, Class	s bedding

## **ITEM 560 LATERALS AND STACKS**

560.01 Description
560.02 Materials
560.03 Construction
560.04 Stacks
560.05 Method of Measurement
560.06 Basis of Payment

**560.01 Description**. This work shall consist of the construction of complete lateral sewer connections, using pipe of the sizes and types specified, from the street sewer to the property line in accordance with the plans or as directed by the Engineer. This work includes tee or wye connections to existing and new sanitary or storm sewers and all stack or chimney construction when required.

**560.02** Materials. Materials shall be as specified in the proposal and/or the plans. Where the kind of pipe is not specifically itemized any of the kinds listed hereunder may be used. Higher strength pipe of the same type may be furnished

#### 560.03

where lower strength pipe is specified. A thicker wall pipe of the same type may be furnished where lesser thickness is permitted or specified.

### **Sanitary Laterals**

Vitrified Clay Pipe, Extra Strength	706.08 with 706.12
Concrete and masonry items shall b	be as specified in 602.02.
PVC Gravity Sewer Pipe	
Special fittings	

#### **Storm Laterals**

th 706.12
n 602.02.
th 706.11
707.20
8,707.20

**560.03** Construction. The pipe shall be laid and joints made in accordance with 551. Junctions with existing laterals or sewers shall be made as conditions require, and at the direction of the Engineer, as specified in 559.03.

The minimum grade for laterals shall be one percent. Unless otherwise specified or directed by the Engineer, all sanitary laterals shall be laid to a depth of eight feet below ordinance street grade at the property line. All storm laterals shall be laid to match the horizontal centerline of the mainline storm sewer, and be laid to match the slopes and inverts shown on the plans, unless otherwise directed by the Engineer.

Where the end of a lateral has been laid, before or after the contract was awarded, and is at or outside of the property line, the street lateral shall be laid to the end of the existing lateral and the same connected to the new work by the Contractor without additional cost.

Where the ends of lateral connections are left unconnected, they shall be tightly sealed with stoppers of the same material as the lateral, using the same joint materials specified for the lateral. The unconnected ends of all laterals shall be marked with a  $1 \times 2$  inch wooden strip extending from the top of the pipe to the surface of the ground, and a section of drain pipe 2 inch in diameter inserted over the top of the wooden strip.

**560.04 Stacks**. Vertical stacks for laterals shall be constructed of 6 inch pipe. Rigid pipe used for stacks shall be encased in concrete with a minimum thickness of 6 inches outside the barrel of the pipe. Non-rigid pipe used for stacks shall be completely encased in No. 57 stone, with a minimum encasement thickness of 6 inches, within a Sonotube. The connection to the sewer and details of the encasement shall be as shown on the plans or as directed by the Engineer.

**560.05** Method of Measurement. The quantity to be paid for under these items shall be the actual linear feet of encased Stack and the number of House Laterals

completed and accepted including stubs, slants, bends or special fittings. House laterals shall be classified by length as follows:

Length	Description
Less than 19 feet	inch short house lateral
19 to 31 feet inclusive	inch house lateral
More than 31 feet	inch long

\*For the purpose of classification the length shall be determined by the distance measured in a straight line horizontally from the end of the lateral at the property line to the center line of the sewer at the point of connection.

**560.06 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

Item	<u>Unit</u>	Description
560	Each	inch short house lateral,
560	Each	inch house lateral,
560	Each	inch long house lateral,
560	Linear Foot	inch house lateral,
560	Linear Foot	Stack inch encased
560	Linear Foot	inch storm lateral
560	Each	inch storm lateral

## **ITEM 561 SPECIAL FITTINGS**

561.01	Description
561.02	Materials
561.03	Construction
561.04	Method of Measurement
561.05	Basis of Payment

**561.01 Description**. This work shall consist of furnishing and installing special fittings on culverts, sewers, drains, force mains, manholes, inlets, junction chambers or such other places as may be directed. Special fittings shall include Y-branches, T-branches, stubs, slants, bends, flap gates, frames and covers, special adapters and couplers. These fittings shall not be paid for separately, unless specifically itemized in the proposal, but shall be included in the price bid for the respective item requiring the fittings.

**561.02** Materials. Items under this section which are related to pipe, or could be considered as pipe, shall be of the same kind and quality as specified or approved for the pipe. The joints shall also be of the same kind and quality unless otherwise specified or approved.

Materials for Cast Iron Special Fittings shall be:

Each casting shall have the cast mark of the foundry and shall be painted with two coats of painted with two coats of a waterbased bituminous or black epoxy paint approved by the Engineer.

**561.03** Construction. Special fittings shall be handled and laid as specified for pipe of the same kind.

Pipe with Y-branches or T-branches shall be laid and inclined sufficiently to bring the tops of the branches level with the top of the sewer pipe. The ends of the branches shall be tightly sealed with stoppers of similar material using the same joints as specified for the sewer unless the lateral branches are to be laid immediately. The location of each branch shall be marked with a 1 x 2 inch vertical wood strip, reaching from the end of the branch to the bottom of the pavement, or to within one foot of the surface of the ground.

Stubs or slants shall be neatly installed in the sides of sewers or manholes or other places as directed, with the bell end outward. Stubs or slants shall be set while the masonry is being constructed. They shall be securely placed, and the juncture with the sewer barrel or manhole neatly grouted with cement mortar without projections or voids, and the inner end of the stub or slant flush with the inside surface or the sewer, manhole, or other structure. Unless otherwise required, they shall be installed just above the spring line of the sewer. The bell end of the stubs or slants shall be sealed with stoppers of similar material and the locations marked as specified above.

Flap gates shall be installed in new or existing structures in accordance with Standard Drawing MH-7 or as directed by the Engineer.

New castings, including frames and covers for manholes and inlets, shall be set upon existing, or newly rebuilt, or newly adjusted masonry to grades designated by the plans or directed by the Engineer. Cost of rebuilding or adjusting the existing masonry shall be included under the respective items as specified in 562 or 563. Mortar required for setting, bedding, or filling the webs of special fittings shall be included in the price bid for the fitting.

**561.04 Method of Measurement**. The quantities to be paid for under these items shall be the number of Y-branches, T-branches, stubs, slants, bends, flap gates, frames and covers, special adapters, or couplers of each size and type furnished and installed as specified. The number shall be determined by the Engineer's count of them complete in place. Six inch bends used for reconnections shall be paid for under 559.

**561.05 Basis of Payment**. Payment for accepted quantities, complete in place including marking, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
561	Each	inch T or Y Branch oninch sewer
561	Each	inch Stub
561	Each	inch Slant
561	Each	inch Bend
561	Each	inch Special adapter
561	Each	inch Coupler
561	Each	inch Flap gate, standard
561	Each	Manhole frame and cover
561	Each	Inlet casting, No

## **ITEM 562 MANHOLES**

- 562.01 Description
- 562.02 Materials
- 562.03 Manhole on Sanitary Sewer or Storm Sewer; Drop Manhole
- 562.04 Manhole Adjusted
- 562.05 Brick Manhole Rebuilt
- 562.06 Precast Manhole Rebuilt
- 562.07 Manhole Reconstructed
- 562.08 Manhole Rechanneled
- 562.09 Manhole Steps Replaced
- 562.10 Method of Measurement
- 562.11 Basis of Payment

**562.01 Description**. This work shall consist of excavating for, constructing, adjusting, rebuilding or reconstructing manholes of the type and size as indicated on the plans, or as ordered by the Engineer, complete with standard casting, backfilling, rechanneling inverts, and placing steps. Concrete, gravel, limestone, or slag required for bedding shall be included in the price bid for the respective item requiring the bedding material.

# 562.02 Materials. Materials shall be:

Structural concrete (Class C)	499 and 511
Brick masonry units	
Granular material for backfill	
Precast concrete riser sections, cones, grade rings	
and flat slabs	
Preformed expansion joint fillers	
Reinforcing steel	
Cast frames, grates, covers	711.12 and 711.13

### 562.03

Welded frames and grates	
Steps	
Resilient and flexible gasket joints	
Resilient connectors between reinforced con	ncrete
manhole structures and pipes	
Curing materials	705.05, 705.07, 705.08
Slag or limestone	
Crushed gravel	
-	

Unless otherwise noted on the plans or in the proposal, the Contractor may use either brick or precast reinforced concrete manholes for new or reconstructed manholes on storm sewers. All new or reconstructed manholes on sanitary or combination sewers shall be precast reinforced concrete. All precast reinforced concrete manholes shall be manufactured using Type II cement.

When precast manholes are proposed to be incorporated into the work, the Contractor shall submit to the Engineer the following:

- a. Manufacturer's name and address
- b. Detailed shop drawings
- c. Material specifications

Approval will be based on complete inspection of manufacturer's plant, method of manufacture, samples of materials to be used and inspection and testing of actual units to be used.

**562.03 Manhole on Sanitary Sewer or Storm Sewer; Drop Manhole**. The Contractor shall construct manholes complete, in accordance with the plans, including castings, covers, slab tops, steps, plastering, pointing, interior coating, joint sealing and all incidentals. The inlet and outlet treatment of pipe at manholes shall be in accordance with the plans and shall be included in the price bid per linear feet of the appropriate pipe item. Pipe, fittings, concrete or masonry required for drop connections shall be included in the price bid for drop manholes complete. Sanitary, Combined or Storm manhole types shall be as designated on the plans. Excavation and backfill shall be in accordance with section 551.

The manhole bottom shall have a uniform bearing on a minimum of three inches of compacted #57 stone. Unsuitable material shall be removed and replaced as specified in Section 551.03.

Adequate precautions shall be taken to prevent concrete and/or mortar from freezing. Any material incorporated in these items having a temperature of  $40^{\circ}$ F or less shall not be placed until heated for a period sufficient to insure a temperature of  $50^{\circ}$ F to  $80^{\circ}$ F throughout the entire mass of the material.

All manholes shall be thoroughly bonded or securely connected to the barrel of the sewer, and all connections with pipes neatly made without projections or voids. Unless otherwise noted on the plans, all pipe connected to precast concrete manholes

shall be sealed by use of a resilient manhole connector meeting the requirements of 706.14.

Brick manholes shall be built of common brick with the channel lined with vitrified brick. The brick shall be laid in a full bed of mortar with interior joints not more than 1/4 inch wide. Whole brick shall be used, except to effect closures and to "chink in" the exterior radial joints. Each seventh course shall be laid as "stretchers", the intervening courses being composed of "headers". The upper part of the manhole shall be "domed", starting at the elevation indicated on the plans and "drawing-in" evenly and equally on all sides to such diameter as will receive the casting. The interior joints shall be pointed and the exterior surface plastered with 1/2 inch portland cement mortar. No backfill shall be placed against masonry within 24 hours after construction.

Precast concrete manholes on sanitary and combination sewers shall be epoxy coated (if called for on the plans) and shall be installed with a full depth channel constructed of precast concrete (using Type II cement), pour in place concrete (using Type II cement), or vitrified brick with mortar joints not more than 1/4 inch wide. Slab top manholes shall be constructed in accordance with standard drawing MH-6.

Standard manhole steps shall be set in the masonry of brick manholes and the manhole riser sections and cones of precast manholes as indicated on the drawings. Where the ordinance grade is below the grade of an unimproved street, the brick work or last precast section shall be built to correspond with the ordinance grade, and the manhole casting and cover set to existing grade by use of a brick chimney and/or grade rings. The inside diameter of the brick masonry, grade ring, brick chimney or precast section shall be not less than 26 inches nor more than 28 inches.

The manhole frame shall be set in a full bed of mortar and, if appropriate, adjusted to conform to the surface of the roadway. Care shall be taken with setting and adjusting the frame in order to maintain a full and firm bearing on the mortar bed.

When directed by the Engineer or noted on the plans, manholes shall have locking covers.

When manholes are completed, they shall be cleared of scaffolding, centering or forms and cleaned of surplus mortar or other foreign materials.

All new and reconstructed manholes on sanitary or combined sewers shall be tested by the Contractor. Testing shall be performed in accordance with ASTM C-1244, and all costs associated with the testing considered incidental to the manhole item.

When a manhole is described in the proposal and plans by the word "modified", the item shall be constructed to conform to the details and intent of the appropriate standard drawing and in accordance with these specifications, with the exception of those modifications specifically detailed or called for by the plans or addendum specifications.

**562.04 Manhole Adjusted**. Existing brick manholes shall be adjusted to grade when it is necessary to raise or lower the manhole casting and it is not necessary to rebrick any portion of the dome of the manhole. The Contractor shall carefully remove and clean the existing casting. Existing brick masonry shall be removed, if necessary, and new brick masonry constructed to proper elevation. The upper surface of the finished brickwork and casting shall conform to the new elevation and contour of the surface. The existing casting shall be reset in a bed of mortar.

Precast manholes shall be adjusted as above, providing the cone must not be cut or the combined vertical height of the brick and grade rings above the cone section does not form a chimney more than 12 inches in height. If it is not possible to adjust the manhole to the required elevation without cutting the cone section or exceeding a chimney height of more than 12 inches, the work shall be performed and paid for as specified in 562.06 Precast manhole rebuilt.

Adjustment of a manhole to grade by adding an adjusting ring shall be paid for as "Manhole Adjusted by Adding Adjusting Ring." The ring shall be the expanding steel ring type, which mechanically locks into the manhole casting. The ring shall be furnished by the Contractor.

Adjustment of a manhole to grade by removing an existing adjusting ring shall not be a pay item. The removed ring shall be stored for pickup by the City if it is salvageable.

**562.05 Brick Manhole Rebuilt**. Existing brick manholes shall be rebuilt when it is necessary to rebrick any portion of the dome of the manhole. The Contractor shall carefully remove and clean the existing casting. The existing manhole wall shall be removed as far down as necessary to permit reconstruction of a new standard dome. The upper surface of the casting shall conform to the new elevation and contour of the surface. The existing casting shall be reset in a bed of mortar. Any steps encountered within the area of rebuild shall be reset.

**562.06 Precast Manhole Rebuilt**. When existing precast manholes can not be adjusted as described in 562.04, they shall be rebuilt. When rebuilding an existing precast concrete manhole for purposes of raising or lowering the casting elevation, the necessary cone and/or riser sections shall be removed, appropriate substitutions or additions made, and the manhole reassembled. The change in manhole casting elevation shall be accomplished such that the combined height of new brick and/or concrete grade rings on top of the cone section shall not exceed 12 inches, of which the brick height shall not exceed two courses.

**562.07 Manhole Reconstructed**. When a manhole is to be completely replaced or must be relocated, the work shall be done under this item. The Contractor shall carefully remove and clean the existing manhole casting for reuse. The cost of the removal and the disposal of any materials in the existing manhole not suitable or required to be reused, and all pipe reconnections, shall be included in the

price paid for work under this item and description. The work under this item shall be done as required in section 562.03. If the Engineer deems necessary a new manhole frame and cover, payment for the frame and cover will be made under item 561 Manhole Frame and Cover.

**562.08** Manhole Rechanneled. Under this item the existing manhole invert shall be altered as shown on the plans or as directed by the Engineer. The existing invert shall be removed as required, and new masonry constructed in accordance with 562.03.

**562.09 Manhole Steps Replaced**. When manhole steps are to be replaced or added to an existing manhole, the work shall be done as shown on plan or as directed by the Engineer. The steps shall be of size and shape shown on the standard drawings and conforming to 711.13 or 711.31. The Contractor shall carefully remove deteriorated existing steps by core drilling around it and clean the surface before placing new steps and grouting with quick set grout or as directed by the Engineer.

**562.10** Method of Measurement. The quantity to be paid for shall be the number of manholes constructed, adjusted, rebuilt, reconstructed or rechanneled as specified and accepted. The quantity of brick manholes rebuilt shall be the number of feet as determined by the difference in elevation in feet and fractions thereof between the top and bottom of the new masonry. Manhole steps replaced shall be the actual number of steps placed or replaced in existing manholes.

**562.11 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
562	Each	Manhole on" Sanitary Sewer
562	Each	Manhole Slab Top on " Sanitary Sewer
562	Each	Manhole on " Storm Sewer
562	Each	ManholeSlab Top on" Storm Sewer
562	Each	Drop Manhole on " Sanitary Sewer
562	Each	Manhole Adjusted by Adding Adjustment Ring
562	Each	Brick Manhole Adjusted
562	Each	Precast Manhole Adjusted
562	Linear Foot	Brick Manhole Rebuilt
562	Each	Precast Manhole Rebuilt
562	Each	Manhole Reconstructed on " Sanitary Sewer
562	Each	Manhole Reconstructed on " Storm Sewer
562	Each	Drop Manhole Reconstructed on " Sanitary Sewer
562	Each	Manhole Rechanneled
562	Each	Manhole Steps Replaced

Note: Where a specific item in the proposal is modified by the word brick it shall mean exclusively a manhole constructed predominantly of brick and conforming to these specifications and the appropriate standard drawing.

When a specific item in the proposal is modified by the word precast, it shall mean exclusively a manhole constructed of precast reinforced concrete sections conforming to these specifications and the appropriate standard drawing.

# **ITEM 563 INLETS**

563.01 Description
563.02 Materials
563.03 Inlets, Wingwall Inlets, Junction Boxes
563.04 Inlets Adjusted
563.05 Inlets Reconstructed
563.06 Method of Measurement
563.07 Basis of Payment

**563.01 Description**. This work shall consist of constructing, adjusting, or reconstructing inlets of the type and size indicated on the plans or as directed by the Engineer. Payment for concrete, gravel, or slag required for bedding shall be included in the price bid for the respective item requiring the bedding material.

**563.02** Materials. Specific materials shall be those listed in 562.02.

**563.03** Inlets, Wingwall Inlets, Junctions Boxes. All inlets, wingwall inlets and junction boxes shall be constructed in accordance with the plan and construction standard drawings, complete with standard casting, and inlet approach where applicable. Excavation and backfill shall be in accordance with 551. Note that the depth of inlets may vary due to the necessity of raising or lowering inlet connections to pass over or under other underground lines.

All brick work shall be pointed on the inside and finished smooth and a 1/2 inch mortar coat applied to the exterior. The top castings shall be set in a full bed of mortar and shall conform to the curb grade and shall be sloped to form a smooth junction with the sidewalk, if any. When castings are set in notches in the curbing, premolded bituminous expansion joint material shall be inserted between the ends of the castings and the notches in the curbing. The joint material shall be at least 1/2 inch thick and shall completely separate the mortar fill of the inlet castings from the concrete or stone curbing. No backfill shall be placed against masonry within 24 hours after construction.

Wingwall inlet dimensions shall be determined by the size of the pipe leading from the wingwall inlet as detailed in the plans. Except for gratings, wingwall inlets shall be constructed of concrete. However, brick masonry may be used with written approval of the Engineer. Gratings shall meet the requirements shown on the appropriate standard drawing. If brick masonry is used, the tops of the walls shall be finished with a coping of concrete not less than 4 inches in thickness.

Where an inlet, wingwall inlet or junction box is described in the proposal and plans by the word "modified", the item shall be constructed to conform to the details and intent of the appropriate standard drawing and in accordance with these specifications, with the exception of those modifications specifically detailed or called for by the plans.

New and reconstructed inlets shall include the reconnection of any existing underdrain pipes.

**563.04 Inlets Adjusted**. Existing inlets shall be adjusted to grade when it is necessary to raise, lower or alter existing inlets and a portion of the inlet masonry, including the base, is to be reused. The Contractor shall carefully remove the existing inlet casting, and when applicable, remove all the existing concrete from the wells on top of the existing casting, or replace with a new casting. The Contractor shall then fill the wells on top of the casting with class "C" concrete. Existing brick masonry shall be removed, if necessary, and new brick masonry constructed to proper elevation. The Contractor, when directed by the Engineer, shall remove as much of the old masonry as required to make the adjusted inlet structurally sound. The upper surface of the finished brick work and casting shall conform to the new line and grade. The existing casting shall be reset and adjusted as specified in 563.03 for new inlets, including the use of premolded bituminous expansion strips at the casting ends. When necessary, the top of the inlet casting shall be filled with class "C" concrete.

**563.05 Inlets Reconstructed.** Existing inlets shall be reconstructed when it is necessary to alter existing inlets and no portion of the inlet masonry, including the base, is to be reused. The Contractor shall carefully remove the existing inlet casting, and when applicable, remove all the existing concrete from the wells on top of the existing casting, or replace with a new casting. The Contractor shall then fill the wells on top of the casting with class "C" concrete. The Contractor shall also carefully remove and clean the existing cast iron support bar (T-bar). This may require the complete removal of all old masonry and the reconstruction of the inlet in a new location. Workmanship, methods and materials shall be the same as specified for a new inlet of the same type. The finished brick work and casting shall conform to the new line and grade.

The old casting shall be set in mortar upon the new masonry and adjusted to line and grade.

**563.06** Method of Measurement. The quantity to be paid for under this item shall be the actual number of inlets constructed, adjusted or reconstructed and the number of wingwall inlets or junction boxes constructed as specified and accepted.

#### 563.07

Adjustments made on new inlets, such as the readjusting of castings to conform to the new pavement, are included in the price bid for the inlets.

**563.07 Basis of Payment**. Payment for accepted quantities, complete in place including the removal of all old masonry, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
563	Each	NoInlet
563	Each	Type Inlet
563	Each	Wingwall inlet
563	Each	Junction box
563	Each	Inlet box
563	Each	Inlet reconstructed
563	Each	Inlet adjusted

## **ITEM 564 UNDERDRAINS**

564.01 Description
564.02 Materials
564.03 Pipe Underdrains
564.04 Method of Measurement
564.05 Basis of Payment

**564.01 Description**. This work shall consist of constructing pipe underdrains with granular filter, in accordance with these specifications and in reasonably close conformity with lines, grades and locations shown on the plans or established by the Engineer. The item shall include: all necessary excavations and backfill, furnishing and placing pipe, furnishing and installing all necessary pipe bends and branches of a type at least equal to the pipe of which they become a part, connection to inlets or other drainage structures, granular filter material, and all other materials necessary to complete the designated drains, and removal and disposal of all surplus excavation and discarded materials in accordance with 203.

**564.02** Materials. Pipe shall be of the size and kind listed in the proposal. When the kind of pipe is not specifically itemized in the proposal, any of the following types may be used:

Perforated Concrete Pipe	706.06
Concrete Drain Tile, extra quality	706.07
Perforated Vitrified Clay Pipe	706.08
Galvanized Corrugated Steel Pipe	707.01
Corrugated Aluminum Alloy Pipe	707.12
Perforated Plastic and Polyethylene Corrugated	
Drainage Pipe or tubing, heavy duty	707.15

Other materials shall be as follows:

Reinforcing steel	
Concrete (Class C)	499 and 511

**564.03 Pipe Underdrains**. Construction sequence for placing pipe underdrains shall be in accordance with 310.03.

Construction shall be as follows: (a) Excavation. Trench excavation shall be of such dimensions in all cases as will give ample room for construction. The trench shall be excavated to a minimum width of 12 inches to permit proper placing of the pipe. The excavation for the underdrains shall include the removal of any obstructions encountered.

Where pipe underdrains are to be placed within or beneath an embankment, the embankment shall be constructed to the elevation of the top of the subgrade before trenching for the pipe.

(b) Laying Pipe. The pipe shall be laid true to line and grade with close fitting joints. When bell and spigot pipe is used, it shall be laid with the bell end up grade. The pipe shall rest on a solid bed shaped to fit the pipe throughout its entire length. Lateral connections shall be made with suitable branches and bends. The upper ends of pipe underdrains shall be closed with suitable plugs. Connection of the underdrain to existing or proposed inlets or other drainage structures shall be included in this item.

Perforated pipe shall be so laid that the perforations are in the bottom half of the pipe.

(c) Backfilling. The underdrains shall be inspected before any granular filter material is placed. The granular filter materials shall be made from durable natural aggregates, No. 8 or No. 9, Table 703-1. It shall be placed around the pipe for the full width and depth of the trench and shall extend to the bottom of the pavement or subbase as shown on the plans. When underdrains are placed outside of the pavement or subbase area, the granular filter shall extend to within 4 inches of the finished grade. The remainder of the trench shall be backfilled with soil, placed in accordance with 203.

**564.04 Method of Measurement**. The footage of pipe underdrains to be paid for will be the actual number of linear feet of pipe with granular filter complete in place, measured as provided in 551.13.

**564.05 Basis of Payment**. The accepted quantities of pipe underdrains, measured as provided above, will be paid for under:

ItemUnitDescription564Linear Foot\_\_\_\_\_\_inch Pipe underdrains

# **ITEM 565 DROP CONNECTION ON EXISTING MANHOLE**

565.01 Description
565.02 Materials
565.03 Construction Methods
565.04 Method of Measurement
565.05 Basis of Payment

**565.01 Description**. This item shall consist of construction of a drop connection on an existing sanitary manhole.

**565.02** Materials. Materials used for construction of the drop connection shall be of the same kind and quality as specified for Item 562 - Drop Manhole on Pipe Sewer.

**565.03 Construction Methods**. Under this item, the Contractor shall construct an 8" drop connection on an existing brick manhole where none exists in accordance with the location and elevations shown on the plans and according to Construction Standard Drawing No. MH-9.

**565.04** Method of Measurement. The quantity to be paid for shall be the number of drop connections as described above, complete and accepted by the Engineer.

**565.05 Basis of Payment**. Payment for the complete work will be made at the contract price for:

ItemUnitDescription565EachDrop Connection on Existing Manhole

This price shall constitute full compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including all excavation, brick or concrete masonry, mortar and vitrified pipe bends, tees and stacks.

# **ITEM 566 - TRENCH DRAINS**

566.01 Description566.02 Materials566.03 Construction Methods

## 566.04 Method of Measurement 566.05 Basis of Payment

**566.01 Description.** This item shall consist of the construction or reconstruction of a trench drain according to the lines and grades shown on the plans or as directed by the Engineer.

566.02 Materials. Materials shall be:

Concrete, Class 'C'	
Slag or Limestone	703.02 or 703.08
Cast Frames, Grates and Covers	711.12 and 711.13
Expansion Joint Material	

**566.03 Construction Methods.** Unless otherwise shown on the plans, trench drains shall be constructed as per Standard Drawing No. S-2.

**566.04 Method of Measurement.** The quantity shall be the total number of linear feet of trench drain constructed and accepted as determined by the Engineer's final measurement. Measurements shall be horizontal centerline measurements of the end-to-end length of covers or grates in place.

**566.05 Basis of Payment.** Payment for accepted quantities, complete in place, shall be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
566	L.F.	Trench Drain

This price shall constitute full compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including excavation, furnishing and placing slag or limestone bedding, furnishing and installing frames, grates and covers, and furnishing and placing concrete and expansion joint material, and backfilling.
# **600 INCIDENTALS**

## **ITEM 601 SLOPE AND CHANNEL PROTECTION**

- 601.01 Description
- 601.02 Materials
- 601.03 General
- 601.04 Riprap
- 601.05 Crushed Aggregate Slope Protection
- 601.06 Concrete Slope Protection
- 601.07 Dumped Rock Fill
- 601.08 Rock Channel Protection
- 601.09 Paved Gutter
- 601.10 Method of Measurement
- 601.11 Basis of Payment

**601.01 Description**. This work shall consist of protecting slopes, channels and gutters with riprap, concrete, crushed aggregate or rock. Types, locations, dimensions, lines, grades, and slopes shall be as specified, including all excavating, grading and compacting of the foundation and bed, sheeting and bracing, cofferdamming, pumping, bailing and draining, furnishing, placing and compacting of gravel or slag for foundation and bedding, the furnishing and placing of grout for joints, the furnishing and placing of joint filler, backfilling and disposing of surplus materials.

**601.02 Materials**. Limestone, rock, broken concrete, and broken stone shall be sound and durable, free from earth and foreign materials. Reinforced concrete and sandstone shall not be permitted. Other materials shall be as follows:

Brick and blocks	
Cement for grout	
Concrete - Class C	
Crushed gravel, stone or slag (Nos. 1, 3, and 4).	
Joint sealer	
Preformed expansion joint	
Reinforcing steel	
Sand for grout	
5	

**601.03 General**. When specified, brick, stone or broken concrete used in riprap and gutters shall be grouted in place.

The grout filler shall be composed of a mixture of portland cement, sand and water, mixed in the proportion of one part cement and three parts sand.

Cement grout shall be prepared in a mixing machine of approved design equipped with an accurate graduated regulating device for controlling the amount of water for each batch. The quantities for each batch shall be exactly sufficient for one or more sacks of cement and shall be accurately measured and proportioned.

Brick, stone or broken concrete shall be thoroughly wet immediately before grout is applied. As soon as the grout is deposited on the surface, it shall be thoroughly worked into the joints with excess grout removed from the exposed surfaces of the brick, stone or concrete. The application of additional water to the grout after it has been deposited will not be permitted.

Grouted gutters and riprap shall be cured in accordance with 451, except that membrane cure shall be applied at the rate of not less than 1 gallon per 200 square feet of surface.

All concrete shall be Class C, mixed and placed in accordance with 511, and finished with a float. Concrete shall be cured as described in 451 except that material meeting the requirements of 705.07, Type 1 may be used. Membrane cure shall be applied at the rate of not less than 1 gallon per 200 square feet of surface.

**601.04 Riprap**. This type of protection shall be provided in accordance with one of the following three alternates:

(1) Limestone, rock, broken concrete, and broken stone, not less than one cubic foot in volume, nor less than 6 inches in width and 12 inches in depth may be used.

Prior to laying the riprap, the foundation shall be excavated to a depth 6 inches below the bottom of the riprap wall, and the bank excavated and sloped as shown on the plans. Then a foundation of 6 inches of gravel or slag shall be laid and thoroughly compacted and, if called for on the plans, a similar bed shall be prepared on the slope.

The stones shall be rough dressed, set to line and grade and firmly embedded in the gravel or slag. Stones shall be laid so as to break joints vertically. Joints, both horizontal and vertical, shall not exceed 1 inch in width. All joints in the riprap shall be filled with grout.

The height, length and thickness of the wall shall be not less than the dimensions shown on the plan. The sizes of the individual pieces of stones used for riprap shall be selected to conform to the minimum dimensions required, but they may exceed such dimensions by a reasonable amount if such over dimensions do not interfere with the general construction of the riprap.

(2) Concrete riprap in cloth or burlap bags may be used. Prior to laying the bags, the foundation shall be excavated to a depth 6 inches below the bottom of the bag wall and the bank excavated and sloped as shown on the plans. Then a foundation of 6

inches of gravel or slag shall be laid and thoroughly compacted and, if called for on the plans, a similar bed shall be prepared on the slope.

The bags shall be soaked with water and filled with approximately 2/3 cubic foot of Class C concrete, and the bags hand placed to the specified lines and grades. The nominal size of each bag of concrete shall be 6x12x16 inches. The open end of each bag shall be tied or folded under and each course of bags shall be placed to overlap the joints in the lower course. After being placed, each bag shall be pierced to permit some concrete to flow out and make bond with the overlying course. The volume of concrete used shall not be less than 1/3 cubic yard for each square yard of riprap in place. One-half inch reinforcing bars approximately 18 inches long and spaced approximately 12 inches apart shall be pushed or driven down through the top three courses. When the protected slope is 1-1/2:1 or steeper, a bed shall be placed consisting of two courses of bags placed with their long dimension parallel to the flow as stretchers and covered by a row of bags placed with their long dimension normal to the flow as headers. Succeeding courses of bags shall be placed as sheaders.

(3) A 6 inch reinforced class "C" concrete slab may be used.

The reinforcement shall consist of steel bars or fabricated reinforcement equivalent to 3/8 inch round bars spaced at 24 inch centers in two directions, or wire fabric conforming to 709.10 or 709.12, placed approximately midway between top and bottom of slab. Formed construction joints may be used, subject to the approval of the Engineer, but the reinforcement shall extend through the joint. Cutoff walls as shown on the plans shall be included for payment in the unit price bid for reinforced concrete slab.

**601.05 Crushed Aggregate Slope Protection**. No. 1 crushed gravel, stone or slag shall be placed so that the surface is flush with the embankment slopes. It shall be 12 inches thick where placed on slopes under bridges and shall extend from the face of the abutments down to the toe of the slopes or to normal water elevation, and a minimum of 3 feet beyond the outer edges of the superstructure.

**601.06** Concrete Slope Protection. A concrete slab, 6 inches thick, shall extend over the area of the embankment under a bridge from the face of the abutment down to the toe of the slope and extending a minimum of 3 feet beyond the outer edges of the superstructure. The concrete slab shall be thickened along the bottom edge from 6 inches to 18 inches in a distance of 3 feet to provide resistance to sliding.

Where pier columns extend through the slab, 1 inch preformed expansion joint material shall be placed around the columns for the full thickness of the slab.

Depressed grooves, one inch deep with rounded edges, shall be uniformly spaced at 4 to 5 foot centers in two directions. The grooves shall be truly horizontal in one direction, and parallel to the center line of the superstructure in the other direction.

**601.07 Dumped Rock Fill**. Limestone, sound and durable rock, broken concrete or stone shall be placed as a rock fill material for the protection of the slope or other surfaces. Sandstone shall not be permitted. Thin slab-like pieces or pieces having any dimension larger than 36 inches or less than 8 inches shall not be used. The material shall be dumped in place with the larger pieces at the outer face and the smaller pieces and spalls near the inner surface of the protected area. The material shall be placed so as to insure a reasonably smooth and continuous surface conforming to the slope lines shown on the plans. The completed dumped rock fill material shall be sufficiently uniform to avoid concentration of fines and small pieces at any location.

This item shall be of three types defined below:

Type A shall consist of sizes such that at least 85 percent of the total material by weight shall be larger than an 18 but less than a 36 inch square opening. The material smaller than an 18 inch square opening shall consist predominantly of rock spalls and rock fines and shall be free of soil.

Type B shall consist of sizes such that at least 85 percent of the total material by weight shall be larger than a 12 but less than a 30 inch square opening. The material smaller than a 12 inch square opening shall consist predominantly of rock spalls and rock fines and shall be free of soil.

Type C shall consist of sizes such that at least 50 percent of the total material by weight shall be larger than a 9 but less than an 18 inch square opening, and shall be free of soil. The amount of material passing a 3 inch sieve shall be not more than 15 percent by weight of the total material.

**601.08** Rock Channel Protection. Material for rock channel protection shall meet the requirements of Type A, Type B, or Type C dumped rock fill material as defined in 601.07, and shall be placed with a 6 inch bed of No. 3 or 4 crushed gravel, stone or slag as specified. Reasonable care shall be exercised in placing the rock to assure that the finished surface of the protected channel will conform with the channel cross sections as required by the plans. At no time shall individual stones project more than 25% of the largest allowable opening specified in 601.07.

**601.09 Paved Channel**. Paved channel shall be constructed to the dimensions and shape as shown on the plans or as directed by the Engineer by one of the following methods:

(a) Brick. A foundation of limestone or slag 6 inches thick shall be placed and compacted. The bricks shall be placed with their long dimension normal to the flow of the channel, and the joints filled with grout filler.

(b) Concrete. Concrete shall be mixed in accordance with 499.03 and placed in accordance with 499 and 511.08.

**601.10 Method of Measurement**. Riprap, crushed aggregate slope protection and concrete slope protection will be measured by the square yard of finished surface complete in place. Dumped rock fill and rock channel protection will be measured by the cubic yard completed in place and accepted, in accordance with the dimensions shown on the plans, or if it is not practicable to determine the amount by measurement, the yardage may be determined from tonnage of acceptable material delivered. Paved channel will be measured by the square yard complete in place.

**601.11 Basis of Payment**. The accepted quantities of specific items of slope and channel protection will be paid for at the contract price per unit of measurement designated for each of the pay items listed below that are included in the proposal. These prices shall be full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete the items as specified.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
601	Square Yard	Riprap
601	Square Yard	Crushed aggregate slope protection
601	Square Yard	Concrete slope protection
601	Cubic Yard	Dumped rock fill, Type
601	Cubic Yard	Rock channel protection, Type
601	Square Yard	Paved channel

### **ITEM 602 MASONRY**

602.01Description602.02Materials602.03General602.04Method of Measurement602.05Basis of Payment

**602.01 Description**. This work shall consist of furnishing all materials and constructing headwalls, pipe cradles, collars, encasement, and other masonry of the types and sizes specified. This work shall include all sheeting, bracing, cofferdamming, pumping, bailing and draining, pointing and plastering, the furnishing, setting and removal of forms, the furnishing and placing of vitrified brick, or concrete, where required, as well as backfilling and the restoration of existing surface areas disturbed by the work.

**602.02** Materials. Materials shall be as follows:

Brick	7	04.01
Cement for mortar	7	01.07

Concrete, (Class C)	
Reinforcing steel	
Sand for mortar	

**602.03 General**. The designated item shall be constructed at the locations and to the dimensions, lines and grades specified.

The excavation shall be of such dimensions in all cases as will give ample room for construction. The removal of any obstruction not included as a bid item under 202, which is necessary for the construction of the work, shall be done by the Contractor at no additional cost to the City.

The Contractor shall protect the sides of all excavations from caving by providing suitable sheeting, shoring, and bracing. Excavation shall be made by such methods that the original material below the bottom of footers will not be disturbed.

If the material found at grade is not suitable for foundation, a further depth shall be excavated, filled and compacted with suitable material as directed by the Engineer. If the depth excavated and backfilled exceeds 2 feet, and is not due to neglect or the fault of the Contractor, the excavation and backfill in excess of 2 feet shall be performed and paid for as specified in 203.13, c.

Adequate precautions shall be taken to prevent concrete and mortar from freezing. Brick and masonry units shall not be set with mortar until heated for a period sufficient to insure a temperature of 50°F to 80°F throughout the entire mass of the material. Water is to be free of organic materials. All material and masonry shall be kept warm and otherwise protected in a manner acceptable to the Engineer. Under no condition will the use of frozen or ice covered brick be permitted. Unless otherwise specified, a mortar for brick masonry consisting of one part portland cement and two parts damp, loose sand measured by volume shall be used. This proportion requires not less than thirteen sacks of cement for each cubic yard of mortar.

Mortar shall be mixed dry to a uniform color in a clean, tight box or an acceptable mixer and tempered with water and thoroughly mixed. Mortar shall be mixed in batches of such size as are needed for prompt use. The use of retempered mortar, or that which has received an initial set, is prohibited.

Unless otherwise specified on the drawings, brick masonry shall consist of common brick. The brick shall be free from dirt and frost, and laid truly horizontal with close mortar-filled "push" joints. Care shall be taken to "break" joints and to thoroughly bond the work. In summer months the brick shall be wetted unless otherwise directed by the Engineer.

Brick masonry shall not be laid in water, nor shall water be permitted to come in contact with such work until the mortar shall have set. It shall be protected from the weather and all disturbance, and kept well moistened until set.

In bonding new masonry to old, the old brick work shall be toothed and surfaces cleaned of dirt, grease and surplus mortar. In leaving unfinished work for the day, the masonry shall be racked or toothed back and all surplus mortar removed.

Joints for exposed faces shall not exceed 1/4 inch in width and shall be carefully pointed except where the surfaces are to be plastered unless otherwise specified. Surfaces of brick masonry which are to be plastered shall be thoroughly cleaned and wetted. Plaster shall be applied before the masonry has set, and shall receive a smooth, dense trowel finish.

Concrete headwalls, cradles, encasement, and other concrete masonry shall be constructed of the materials and by the methods as described under 499 and 511 and shall be Class C. Reinforcing steel shall be placed as prescribed under 509.

Forms or centers shall be true to dimensions, clean, rigid, and braced to prevent deflection. The construction of the forms and bracing shall be such as to insure removal without jar or injury to the brick masonry and to offer to the workmen adequate space in which to lay up the brick work. Forms or centers shall be left in place until their removal is permitted by the Engineer.

Backfilling shall follow completion of the work as closely as the type of construction will permit. Earth shall be placed around the work in layers not exceeding 8 inches thick loose measurement, and thoroughly tamped in place with suitable tampers.

After the backfilling has been completed, the Contractor shall immediately remove all surplus material and all dirt and rubbish from the site. Surplus excavation and other materials shall be disposed of as prescribed in 203.

**602.04 Method of Measurement**. The quantity to be paid for under this item shall be the number of cubic yards of masonry completed and accepted. Quantities shall be determined by measurement of the work in place or from plan dimensions as determined by the Engineer. Deductions will be made from the gross quantity for all openings or structures contained in the masonry and payment shall be made only for the actual quantity of masonry.

**602.05 Basis of Payment**. The accepted quantities of masonry, including epoxy coated reinforcing steel where specified, measured as above provided shall be paid for at the contract unit price bid, which price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals, including epoxy coated reinforcing steel where specified, required to complete the items as specified.

Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription602Cubic YardBrick Masonry

602	Cubic Yard	Concrete Masonry
602	Cubic Yard	Concrete Masonry with Epoxy Coated Reinforcing Steel

## **ITEM 603 SLAG AND LIMESTONE**

603.01 Description
603.02 Materials
603.03 Construction
603.04 Method of Measurement
603.05 Basis of Payment

**603.01 Description**. This item shall consist of excavation and the furnishing, hauling and placing of slag or limestone for bedding pipe sewers or excavation, and the furnishing, hauling and placing of slag or limestone for driveway reconstruction as specified in the plans or as directed by the Engineer.

603.02 Materials. Bedding materials shall conform to the following:

Air-cooled slag	703.02
Granulated slag	703.08
Limestone	703.02

Size shall be as directed by the Engineer. Granulated slag screenings shall be used as filler for the slag course of driveway reconstruction, as directed by the Engineer.

**603.03** Construction. Material for embedding pipe shall be in accordance with the item requiring the material or as directed by the Engineer.

Slag or limestone for driveway reconstruction shall be spread and compacted by roller or vibrator to a 6 inch thickness or as directed by the Engineer. Filler material shall be spread and broomed over compacted slag or limestone and rolled or vibrated until a satisfactory roadway is obtained. In order to assure stability, the Contractor may add cement to the choking material if so desired.

**603.04 Method of Measurement.** The quantity to be paid for as bedding materials under this item shall be the number of cubic yards in place and accepted as specified in the item requiring material. The quantity to be paid for as driveway reconstruction shall be the number of square yards of slag or limestone in place and accepted. The yardage shall be determined from the Engineer's final measurements.

**603.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
603	Cubic Yard	Slag
603	Cubic Yard	Limestone

603 Square Yard

Slag or limestone for driveway reconstruction, \_\_\_\_\_ inches thick

## **ITEM 604 BANK RUN GRAVEL**

604.01 Description
604.02 Materials
604.03 Construction
604.04 Method of Measurement
604.05 Basis of Payment

**604.01 Description**. This item shall consist of the furnishing and placing of bank run gravel for backfilling sewer and other trenches and for filling such other as may be shown on the plans.

**604.02 Materials**. Bank run gravel for this item shall be a natural or processed material composed of a mixture of hard, durable particles or fragments of stone or gravel and sand, and small amounts of silt, clay or other similar binding materials, and shall be free from excessive or detrimental amounts of clay, clay lumps, loam, roots, vegetable matter, rubbish, wood, muck or other non-stable materials.

Oversized pebbles, stones, rocks and boulders of acceptable quality, occurring in the pit may be crushed and become a part of the mixture provided the blend meets the following gradation:

Passing a 3 inch sieve:	100%
Passing a 2 inch sieve:	90 -100%
Passing a 1 inch sieve:	70 - 90%
Passing a No. 4 sieve:	25 - 70%
Passing a No. 40 sieve:	5 - 30%
Passing a No. 200 sieve:	0 - 10%

The Contractor shall give the Engineer sufficient advance notice of the source of the materials to enable tests to be made. No materials shall be delivered to the job until the Engineer has approved its use.

**604.03** Construction. The bank run gravel shall be placed and compacted as specified in the item requiring the material or as directed by the Engineer.

**604.04** Method of Measurement. The quantity to be paid for under this item shall be the number of cubic yards compacted in place and accepted and measured as specified in the item requiring the material.

**604.05** Basis of Payment. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
604	Cubic Yard	Bank run gravel

### **ITEM 605 STABILIZED BACKFILL**

605.01	Description
605.02	Materials
605.03	Construction
605.04	Method of Measurement
605.05	Basis of Payment

**605.01 Description**. This item of work shall consist of furnishing and placing dry stabilized backfill in areas designated on the plan or as directed by the Engineer.

**605.02** Materials. Backfill shall be of materials meeting the requirements of 604.02. Portland cement shall be as specified in 499.02.

**605.03 Construction**. The granular backfill material and the portland cement shall be thoroughly mixed at the ratio of one cubic yard of granular material to one sack of portland cement. The stabilized backfill material shall be placed and compacted in accordance with 503.10.

**605.04 Method of Measurement**. The quantity to be paid for under this work shall be the number of cubic yards of stabilized backfill placed and compacted as specified. Payment shall be made for only the backfill placed within the specified pay limits. The number of cubic yards of stabilized backfill shall be determined from the Engineer's measurements.

**605.05 Basis of Payment**. Payment for accepted quantities complete in place shall be made at the contract price for:

Item	Unit	<b>Description</b>
605	Cubic Yard	Stabilized Backfill

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete this work as specified.

### **ITEM 606 GUARDRAIL**

606.01 Description 606.02 Materials

606.03	Setting Posts
606.04	Erecting Rail Elements
606.05	Guardrail Rebuilt
606.06	Impact Attenuators
606.07	<b>Method of Measurement</b>
606.08	Basis of Payment

**606.01 Description**. This work shall consist of the construction or reconstruction of guardrail, guardrail posts, bridge terminal assemblies, end terminals, and impact attenuators, including the furnishing, assembling, and erecting of all component parts and materials, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

Guardrail shall be deep beam rail Type 5, 5A, or 8. Appurtenances shall include bridge terminal assemblies, end terminals, and impact attenuators. Construction of the various types of guardrail include the furnishing, assembling, and erecting of all component parts and materials, complete and in place, at the location shown on the plans or as directed by the Engineer, and according to the manufacturer's recommendations where applicable.

**606.02 Materials**. Steel posts, rails, bolts, fittings and other accessories shall be galvanized. Specific materials shall be as follows:

Deep beam rail	710.06
Galvanizing, hardware	
Pressure treated guardrail posts and spacer blocks	710.14
Steel guardrail posts	710.15
Concrete (Class C)	499 and 511
Reinforcing steel	
White paint	
Paint thinner	708.03 or 708.04

Use galvanized steel posts, rails, bolts, fittings, and other accessories.

For guardrail, use deep beam rail Type 5, 5A, or 8.

**606.03** Setting Posts. Posts shall be set plumb in holes, or driven. The manner of driving shall be such as to avoid battering or distorting of posts. Posts set or driven to within 1 inch of grade need not be trimmed. If post tops are trimmed, they shall be treated after trimming with a preservative material specified in 712.06. Post holes shall be backfilled with acceptable material placed in layers and thoroughly compacted.

Space Type 5 guardrail posts 6 feet 3 inches on center measured along the centerline of the rail and construct blockouts. Construct each end of the Type 5 guardrail barricades without blockouts and with a flared end section.

Space Type 5A guardrail posts 3 feet 1 1/2 inches on center measured along the centerline of the rail and construct blockouts. Construct each end of the Type 5A guardrail barricades without blockouts and with a flared end section.

Space Type 8 guardrail posts 6 feet 3 inches on center measured along the centerline of the rail and construct blockouts.

For flexibility, transition guardrail posts shall be spaced as detailed on the plans or as directed by the Engineer.

**606.04** Erecting Rail Elements. Erect standard design (single faced) guardrail of the type shown on the plans. Erect barrier design (double faced Type 4 or Type 5) guardrail as shown on the plans.

Rail elements shall be erected in a manner resulting in a smooth, continuous installation. Shop-curved rail shall be used on curves with radii of 5 feet to 70 feet, inclusive.

All bolts, except where otherwise required, such as expansion joint bolts, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 inch beyond the nuts. Except where required for adjustment, bolts shall not extend more than 1/2 inch beyond the nuts. For single-faced guardrail, bolts through posts shall extend from 1/4 inch to 2 inches beyond the nuts and for double-faced rail 1/4 inch to 1 inch.

All metal shall be fabricated in the shop. No burning or welding shall be done in the field. Holes for special details in exceptional cases may be made in the field when approved by the Engineer. Field punching, cutting and drilling may be permitted if approved by the Engineer after it has been demonstrated that it will not result in damage to the surrounding metal.

Galvanized surfaces which have been abraded so that the base metal is exposed, threaded portions of all fittings and fasteners and cut ends of bolts shall be repaired as specified by ASTM A 780.

Guardrail shall be erected so that the bolts at expansion joints will be located at the centers of the slotted holes. The rail elements shall be spliced by lapping in the direction of traffic. The plates at each splice shall make contact throughout the area of the splice.

**606.05 Guardrail Rebuilt**. Where so required by the plans, existing guardrail salvaged under 202 shall be rebuilt at the locations specified. Unless otherwise required by the plans, rebuilt units shall be of the same type, spacing of members, etc., as the original guardrail.

Rail element for re-erecting shall be obtained from salvage sources. The Contractor shall furnish all new posts, spacer blocks and such additional bolts, washers or incidental hardware as may be necessary to complete the guardrail, except: (1) existing steel posts and spacer blocks that are undamaged and still have a good galvanized coating may be reused, and (2) guardrail splice bolts that are undamaged and were not removed during salvage may be reused.

All salvaged painted guardrail rebuilt shall be cleaned, spot primed and given two coats of white paint in accordance with 514.07, except that sandblasting will not be required.

**606.06 Impact Attenuators.** Before installing the attenuator, the Contractor shall make all corresponding shop drawings from the manufacturer available for the Engineer's inspection. The Contractor shall include installation drawings and instructions with the shop drawings that completely describe the attenuator system.

The top of each foundation shall be graded at the same elevation as the adjacent travel lane and/or paved shoulder.

**606.07 Method of Measurement**. Guardrail, new or rebuilt, as applicable, will be measured by the linear foot from center to center of end posts, excluding anchor assemblies and transitions, except where end connections are made to masonry or steel structures, in which case measurement will be to the center of the normal post bolt slot. If rail element is used across a bridge, the measurement of guardrail will be to the first post off the bridge.

Anchor assemblies of the type specified to be paid for will be the actual number furnished and erected complete.

Bridge terminal assemblies of the type specified to be paid for will be the actual number furnished and erected complete.

Impact attenuators of the type specified to be paid for will be the actual number furnished and erected complete.

Guard posts of the kind specified to be paid for will be the actual number of posts furnished and erected.

**606.08 Basis of Payment**. The accepted quantities of new or rebuilt guardrail will be paid for at the contract unit price per linear foot for the type specified, complete in place.

Anchor assemblies, bridge terminal assemblies, and impact attenuators be paid for at the contract unit price per each for the type specified, complete in place.

Guard posts will be paid for at the contract unit price per each, complete in place.

Payment will be made under:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
606	Linear Foot	Guardrail, Type
606	Linear Foot	Guardrail, barrier design, Type
606	Linear Foot	Guardrail rebuilt, Type
606	Each	Anchor assembly, Type
606	Each	Anchor assembly, Type, barrier design
606	Each	Bridge terminal assembly, Type
606	Each	Impact Attenuator, Type
606	Each	Guardrail post

#### **ITEM 607 FENCE**

- 607.01 Description
- 607.02 Materials
- 607.03 Clearing and Grading
- 607.04 Post Assemblies
- 607.05 Horizontal Deflection
- 607.06 Line Posts
- 607.07 Post Braces
- 607.08 Fabric
- 607.09 Barbed Wire
- 607.10 Method of Measurement
- 607.11 Basis of Payment

**607.01 Description**. This work shall consist of furnishing and erecting fence and gates of the types designated in reasonably close conformance with lines, grades and locations specified on the plans or established by the Engineer. Construction shall be accomplished in a manner that will provide a rigid, taut fence closely conforming to the surface of the ground.

Fence will be designated by the following types:

- (a) Type 47 (47 inch woven wire fence fabric with steel line posts)
- (b) Type 47RA (47 inch woven wire fence fabric with wood line posts)
- (c) Type CL ( \_\_\_\_\_ inch chain link fence fabric with top rail)
- (d) Type CLT ( \_\_\_\_\_ inch chain link fence fabric with tension wire)
- (e) Type CLTTR ( \_\_\_\_\_ inch chain link fence fabric with tension wire and top rail)
- (f) Type CLBRMRTR ( \_\_\_\_\_ inch chain link fabric fence with bottom rail, middle rail(s) and top rail)

**607.02** Materials. Fence materials shall meet the following requirements:

Fence posts, braces and dimension lumber	
Woven steel wire fence	
Steel line posts and ties (Type 47 fence)	
Barbed wire	
Chain link fence	
Reinforcing steel	
Concrete (Class C)	499 and 511
Expansion shield anchors, self-drilling	

**607.03** Clearing and Grading. The Contractor shall perform such clearing and grading as may be necessary to construct the fence to the required alignment and shall provide a reasonably smooth ground profile at the fence line. Removal of trees less than 12 inches shall be considered incidental to this item. Removal of trees 12 inches and up shall be paid for separately under Item 201.

**607.04 Post Assemblies**. End, corner, gate, and pull or intermediate anchor posts shall be placed at designated locations in holes of the sizes specified. The posts shall be securely braced and the holes filled with concrete. Forms will not be required for post encasement.

Wood posts fabricated with square cut ends and set or driven within one inch of grade will not require cutting or trimming. Concrete encasement of wood posts driven to grade shall be omitted.

For Type 47 and Type CLT and CLTTR fence, the maximum spacing between intermediate anchor post assemblies, or between end post assemblies and intermediate anchor post assemblies, shall be 660 feet.

**607.05** Horizontal Deflection. At points of horizontal deflection, construction shall be as follows:

(a) For Type 47 fence, either steel line posts encased in concrete or wood posts without encasement shall be installed at all horizontal deflection points where the fence changes alignment by more than 1 degree, but not more than 4 degrees. Where the change in alignment is in excess of 4 degrees and less than 30 degrees, an intermediate anchor post assembly shall be built at the deflection point. If the change in alignment is 30 degrees or more, a corner post assembly shall be built at the deflection point.

(b) For Type CL fence, special treatment will not be required at deflection points where the fence changes alignment by 5 degrees or less. At points of deflection where the fence changes alignment by more than 5 degrees, a post brace and truss rod shall be provided in each fence panel adjacent to the post located at the angle point. The footings for all posts located at points where the change in alignment exceeds 5 degrees shall be constructed as specified for end posts.

607.06 Line Posts. The setting of line posts shall conform to the following:

(a) For Type 47 fence, line posts shall be driven to the depth called for on the plans, at intervals not to exceed 12 feet. Line posts at the bottom of digs or depressions in the ground surface shall be anchored in concrete as shown on the plans. Where channels or streams cross the fence line, crossings shall be as shown on the plans.

Posts at points of horizontal deflection shall be located so that the fence fabric will bear against the post.

(b) For Type CL, CLT and CLTTR fence, line posts shall be spaced at not more than 10 foot centers. Line posts shall be set 36 inches deep in concrete footings unless an alternate post anchor method is specified on the plan.

**607.07 Post Braces**. For all types of fences, post braces shall be in accordance with plan details.

For Type CL, CLT and CLTTR fence, a brace and truss assembly shall support each gate, corner, pull, or end post. The brace shall extend to each adjacent line post at mid-height of fabric. The truss shall extend from the line post back to the gate, corner, pull, or end post.

**607.08 Fabric.** The fence shall not be erected until after five days from the time of setting posts in concrete when regular cement is used, or until after three days when high-early-strength cement is used.

Type 47 fabric shall be stretched and securely fastened in accordance with plan details. Galvanized ties shall be used for fastening fabric to line posts. The minimum number of ties shall be one each for top and bottom horizontal wire and one for each alternate horizontal wire below the top horizontal wire.

Chain link fabric shall be fastened to the line posts with clips or bands spaced approximately 14 inches apart, and to the rails or top tension wire with bands or tie wires at approximately 24 inch internals or less.

**607.09 Barbed Wire**. Where barbed wire is specified, it shall be stretched and fastened in the same manner as woven wire fabric.

**607.10** Method of Measurement. Fence will be measured by the linear foot, complete in place. Measurement will be along the top of the fence from outside to outside of end posts, exclusive of gates and other openings.

Gates will be measured as complete units of the size and type specified.

**607.11 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item Unit Description

607	Linear Foot	Fence, Type,	inch
607	Each	Gate, Type,	inch
607	Linear Foot	Fence, Type,	inch, vinyl coated

### **ITEM 608 FENCE RECONSTRUCTION**

608.01	Description
608.02	Material
608.03	Construction Methods
608.04	Method of Measurement
608.05	<b>Basis of Payment</b>

**608.01 Description**. This item shall consist of the removal and relocation of an existing fence in conformity with the lines shown on the plans, and as directed by the Engineer.

**608.02** Material. The Contractor shall use the material from the existing fence replacing all damaged, broken, lost or stolen parts, with new or comparable parts as designated by the Engineer at the Contractor' expense.

**608.03 Construction Methods**. The existing fence shall be carefully removed and relocated to the designated location. The fence posts shall be set plumb and the fence material shall be taut between posts. Fence posts shall be set in concrete base 36 inches deep and not less than 11 inches in diameter with Class "C" concrete.

**608.04 Method of Measurement**. The quantity to be paid for shall be the number of linear feet of fence reconstructed in compliance with these specifications and accepted. The number of linear feet will be determined from the Engineer's final measurements. Measurements shall be horizontal centerline measurements of the length of relocated fence in place.

**608.05 Basis of Payment**. Payment for accepted quantities of the fence shall be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
608	Linear Foot	Fence Removal and Reconstruction

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete the work as specified herein, including all excavation, backfilling, removal, reconstruction, erection, handling of the fence materials and pouring concrete.

### **ITEM 609 ENGINEERING GEOGRID**

609.01 Description
609.02 Materials
609.03 Construction
609.04 Method of Measurement
609.05 Basis of Payment

**609.01 Description**. This item of work shall consist of furnishing all labor, materials, equipment and tools required for the installation of an engineering geogrid in accordance with details shown on the plans and these specifications.

**609.02 Materials**. <u>Geogrid</u>: Biaxial polymer grids will be manufactured from 100% polypropylene; such as Tensar BX1200 and/or BX1300 as manufactured by the Tensar Corporation, 1210 Citizens Parkway, Morrow, Georgia 30260 (Phone 1-800-843-8417) or an approved equal.

**609.03** Construction. Geogrid shall be laid at the proper elevation and alignment as shown on the plans and shall be oriented such that the roll length runs parallel to the trench.

Geogrid sections shall be overlapped as shown in the plans or as directed by the Engineer. Minimum overlap in horizontal plane shall be three (3) feet. In vertical plane the minimum overlap shall be nine (9) inches. Care shall be taken to insure that geogrid sections do not separate at overlaps during construction. Placement of geogrid around curves or corners will require cutting of geogrid product and diagonal overlapping of same to insure that excessive buckling of grid material does not occur.

Specified granular fill material shall be placed in lift thicknesses and compacted as indicated on the plans and in accordance with Item 203 Aggregate Refill for subbase application and Item 603 - Slag or Limestone for trenches. Care shall be taken to assure that the geogrid is held in desired position during and after placement of slag.

No construction equipment shall operate directly upon the geogrid. A minimum fill thickness of 6 inches is required prior to operation of any vehicles over the geogrid. Sudden braking or sharp turning shall be avoided while operating any equipment on reinforced fill.

**609.04 Method of Measurement**. Measurement of geogrid shall be based on the net surface area in Square Yards of the completed work. Overlapped areas shall be measured only once. The quantity of limestone or slag shall be the number of cubic yards of limestone or slag in place as per plan and accepted and shall be paid for under Item 203 - Aggregate Refill or Item 603 - Slag for Trench, including excavation.

**609.05 Basis of Payment**. Payment for the accepted quantities of geogrid measured as above will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment, and other items necessary and incidental to completion of work.

<u>Item</u>	<u>Unit</u>	<b>Description</b>
609	Square Yard	Engineering Geogrid for Roadways, Type
609	Square Yard	Engineering Geogrid for Trenches, Type

### ITEM 610 CELLULAR RETAINING WALLS

610.01 Description
610.02 Approval by Engineer
610.03 Material
610.04 Manufacture of Units
610.05 Excavation
610.06 Backfill
610.07 Construction Methods
610.08 Method of Measurement
610.09 Basis of Payment

**610.01 Description**. This work shall consist of constructing retaining walls composed of a series of cells formed by assembling precast reinforced concrete or galvanized metal units to form walls of satisfactory stability in reasonably close conformity with the lines, grades and dimensions specified or ordered.

(a) Concrete cellular walls shall consist of a series of rectangular or triangular cells formed by building up tiers of precast reinforced concrete units. If cells are rectangular, the units shall be known as headers and stretchers; and if the cells are triangular, the stretcher and header shall be joined into one unit at the time of manufacture and adequately reinforced with steel at this point. The face of the wall shall be closed by inserting precast concrete filler slabs between the rows of stretchers, allowing sufficient clearance between ends of slabs and headers for drainage; or in the instance of triangular type cribbing the stretcher portion of the units shall be spaced approximately 1/2 inch apart by means of lugs formed on the underside of the stretcher portion. The lugs shall act as a continuous vertical bearing between the units and same shall be spaced at a distance not exceeding 3 feet from center to center.

For header and stretcher type cribbing the headers shall have lugs formed thereon which interlock with the stretchers at the front and rear of the wall, and shall not appreciably project beyond the face of the wall. Sufficient clearance or tolerance shall be made on the lugs of headers to permit proper flexibility of movement in the interlocking joints. No metal pin or dowel connected cribbing will be permitted.

(b) Metal cellular retaining walls shall consist of a plurality of pairs of columns, one column of each pair being in the plane of the front of the wall and the other being in the plane of the rear of the wall, with the pairs of columns spaced longitudinally with overlapping S-shaped facing and rear members and transversely with overlapping U-shaped members.

All necessary bolts and appurtenances shall be furnished for complete assembly of the units into a closed-face wall of connecting bins.

The units in the wall shall conform to the dimensions and gages specified, and when assembled shall present a uniform and workmanlike appearance.

**610.02 Approval by Engineer**. The Contractor shall, within fifteen days after the award of the contract, submit drawings of the units to be furnished, together with a proposed erection plan and schedule of operations.

The drawing of the units, the erection plan and the schedule of operations shall all be approved before any material is delivered on the project.

Only walls produced by manufacturers whose type of wall and design of units have been in successful commercial use for a period of at least three years will be considered for approval. The units shall be manufactured in a plant suitable for making these units efficiently and uniformly. Plant and method of manufacture shall be approved before the units are made.

Materials shall be sampled and tested as directed by the Laboratory.

**610.03 Material**. Manufactured units shall be as follows:

(a) Concrete Cellular Wall. The units shall consist of concrete into which steel has been embedded in such a manner that the steel and concrete act together in resisting force.

Concrete shall conform to 499, Class C, except for aggregate gradation.

Reinforcing steel shall conform to 509.02.

(b) Galvanized Metal Wall. The units shall be made from galvanized metal sheets. The base metal shall conform to AASHTO M 218. The sheets shall be galvanized on both sides by the hot-dip process. The average spelter coating shall be not less than 2 ounces per square foot, nor shall the measurement of any  $2-1/4 \times 2-1/4$  inch area indicate less than 1.8 ounces per square foot of double exposed surface. The finished sheets shall be of first-class commercial quality, free from injurious defects, such as blisters, flux, and uncoated spots.

All metal sheets used in making the various units shall have a minimum thickness of 0.057 inch, unless otherwise shown on the plans.

The manufacturer shall furnish three copies of an "Analysis and Coating Test Certificate" containing the following information covering each project or order on which galvanized metal walls are furnished.

- (a) Heat or heats used for units.
- (b) Analysis of each heat.
- (c) Amount of spelter coating for each heat.
- (d) Total units of each size and gage.
- (e) Name of Contractor.
- (f) Project name.

This certificate shall be sworn to by a person having legal authority to bind the company. Two copies shall be sent to the Engineer.

Galvanized bolts shall be 5/8 inches in diameter and shall have a minimum length of 1-1/4 inches measured from the underside of the bolt head. They shall be galvanized in accordance with 711.02.

### 610.04 Manufacture of Units.

(a) Concrete cellular wall units shall be cast in substantial, unyielding steel forms. The forms shall be properly assembled, cleaned and oiled before any concrete is placed therein. During the placing and setting of the concrete, the forms shall be rigidly held in place on a smooth and level platform. The reinforcement must be securely held in the required position in the forms so that it will not be displaced during pouring of the concrete.

Sufficient vibration shall be given the fresh concrete to insure filling all space in the form, to densify the concrete, and to completely and intimately contact the reinforcement.

Over-vibration or over-spading causing segregation of the concrete materials will not be permitted, and such units with segregated areas shall be rejected.

The units shall be covered with burlap, cotton mat or jute felt cotton mats and be kept wet at least 7 days, or steam cured for a period of not less than 24 hours.

Reinforced concrete units will be subject to rejection for any of the following reasons: (1) Displacement or lack of minimum cover of the reinforcing steel. (2)

Defects which indicate imperfect mixing, placing or curing. (3) Fractures and cracks, except that small spalls or broken edges may not be considered cause for rejection.

(b) Galvanized metal cellular wall units shall be so fabricated that units of the same nominal size shall be fully interchangeable. No drilling, punching or drifting to correct defects in manufacture will be permitted. Any units having holes improperly punched shall be promptly replaced by the manufacturer free of charge.

Whenever possible in the manufacture of the units, a minimum forming radius of 1 inch shall be maintained. All units formed with less than 1 inch radius shall be hot-dipped galvanized after forming.

**610.05 Excavation**. Excavation, including accurate grading for foundation, will be measured and paid for as 203. Bearing for the foundation of the walls shall be firm and to grade and shall be approved by the Engineer before erection of the wall.

**610.06 Backfill**. Below the elevation of the proposed ground line at the face of the wall, the interior of the cell spaces formed by the units shall be filled with soil as defined in 203.02. Above the elevation of the proposed ground line at the face of the wall, the interior of the cell spaces formed by the units shall be filled with subbase material conforming to 310.02 Grading A except that the material shall contain not more than 5 percent passing the No. 200 sieve.

The material shall be placed in layers not to exceed 6 inches uncompacted depth and compacted to the density established by the Engineer. Compaction shall be obtained by means of approved tampers or compactors.

Water may be required as directed by the Engineer to assist in obtaining the desired compaction.

The space behind the wall shall be filled in accordance with 503.10, except as noted below.

Backfill, including the interior filling, shall be made simultaneously with the erection of the wall, following the progress of erection as closely as the type of construction will permit.

Rolling equipment shall not be used directly over a portion of the wall until at least a 12 inch thickness of compacted fill has been placed to prevent damage to the units of the wall.

The compacted backfill, including the interior filling, and water will be included for payment in the unit price bid per square foot of facial area of cellular retaining wall.

**610.07 Construction Methods**. The individual types of walls shall be constructed as follows:

(a) Concrete Cellular Wall. Sills shall be placed with exactness to the required grade and alignment, and be supported on firm foundation material for their entire length. Shimming with loose earth, stones, etc., will not be permitted.

The headers shall be placed perpendicular to the sills and stretchers and interlocked. Templates shall be used to insure that the members are placed in proper position.

Before placing units, two layers of asphalt impregnated paper shall be spread on all points of contact of the units to insure a uniform bedding.

When the wall has been constructed two tiers high, alignment, grade and batter shall be checked, adjusted if necessary, and backfill completed to this height before subsequent units are added. The remainder of the wall may then be completed. Templates shall be used to insure proper face batter.

(b) Corrugated Metal Wall. Foundations for the bearing plates at the corners of the bins shall be firm and to grade.

When the columns have been placed and the wall constructed two tiers high, alignment, grade and batter shall be checked, adjusted if necessary, and backfill completed to this height before subsequent units are added. The remainder of the wall may then be completed. Templates shall be used to insure that members are placed in proper position and to secure proper batter.

Members shall be handled carefully, and any which are damaged shall be removed and replaced at the Contractor's expense.

**610.08 Method of Measurement**. The quantity measured will be the actual number of square feet of facial area of approved cellular retaining wall measured complete in place. Excavation will be measured by the cubic yard as provided in 203.

**610.09 Basis of Payment**. Payment for accepted quantities of cellular retaining wall will be made at the contract price per square foot. These prices shall include compensation for all materials, backfill and disposal of surplus materials.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
610	Square Foot	Cellular retaining wall

### **ITEM 611 RETAINING WALL**

611.01 Description
611.02 Material
611.03 Approvals
611.04 Construction Methods
611.05 Method of Measurement
611.06 Basis of Payment

**611.01 Description**. This item shall consist of the construction of modular block and landscape timber walls in conformity with the lines, grades and dimensions shown on the plans or as directed by the Engineer.

**611.02 Material**. Landscape timbers shall only be used when specifically called for on the plans or when approved by the Engineer. The landscape timbers shall be made from pressure treated wood. The timbers shall be pressure treated using Ammoniacal Copper Quaternary (ACQ), per ASTM D 5654. No CCA (Chromated Copper Arsenate) treated wood shall be permitted. The timbers shall be new, free of splits, and straight, with bows not exceeding 1/2 inch in an 8 foot length. The minimum size of timbers shall be 6" x 8" x 8'-0".

For modular block walls, the Contractor shall construct the walls per the current City of Akron Standard Construction Drawing. Materials incidental to the wall shall be in accordance with the manufacturer's guidelines or as directed by the Engineer.

**611.03 Approvals**. Walls higher than 3 feet require a building permit from the City's Building Department. The Contractor shall be required to pay all plan review and permit fees.

The contractor shall submit, to the Engineer, for review and approval, six (6) copies of the installation procedures, as recommended by the manufacturer of the particular wall system chosen for the project, unless additional copies are required. Installation shall not begin until the submitted information has been approved by the Engineer.

**611.04 Construction Methods**. Construction of landscape timber walls shall conform to the applicable City standard drawing. Heights of walls shown on the plans are approximate, and may be changed at the direction of the Engineer.

For landscape timber walls, the front face shall be battered at the direction of the Engineer. The vertical joints shall be staggered. The horizontal joint alignment shall be uniform throughout the wall. Any cut timbers shall be dressed as directed by the Engineer. No timbers shall be any shorter than three feet.

For modular block walls, installation shall be in accordance with the current applicable City standard drawing and the manufacturer's guidelines. The color of the retaining wall shall be determined by the Engineer.

Any tree roots that are encountered during excavation shall be cleanly cut, leaving no jagged edges. To reduce stress on trees, this work shall be completed within five (5) working days.

**611.05 Method of Measurement**. The quantity to be paid shall be the number of square feet of wall constructed. The number of square feet will be determined from the Engineer's final measurements of the actual area of front face of wall constructed and accepted.

**611.06 Basis of Payment**. Payment for accepted quantities shall be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
611	Square Foot	Landscape Timber Wall
611	Square Foot	Modular Block Wall

The above price shall constitute full compensation for furnishing all labor, material, equipment, tools and incidentals required to construct the wall as specified herein, including all excavation, backfilling, anchors and tiebacks, geogrid, filter fabric, drainage aggregate, granular base, sealer, surface restoration, handling of the required materials, and the required permits.

### **ITEM 612 LANDSCAPE TIMBER EDGING**

- 612.01 Description
- 612.02 Material
- 612.03 Construction Methods
- 612.04 Method of Measurement
- 612.05 Basis of Payment

**612.01 Description**. This item shall consist of furnishing and placing new landscape timbers to form an edging for driveways or other purposes in areas designated by the plans or as directed by the Engineer. This work shall include all excavating, furnishing and placing timbers, as directed, cutting, staking and dressing timbers, backfilling and restoring surface.

612.02 Material. Materials shall be in accordance with 611.02.

**612.03** Construction Methods. The landscape timbers shall be laid with ends abutting and true to line and grade in accordance with the plan or as directed by the Engineer. Any cut timbers shall be dressed as directed by the Engineer. Timbers shall be staked with 1/2'' deformed reinforcing rods, 2' into existing ground at 4' intervals with a minimum of two stakes per timber.

**612.04 Method of Measurement**. The quantity to be paid for shall be the number of linear feet of new landscape timbers in place. The number of linear feet will be determined from the Engineer's final measurements. Measurements shall be taken end to end of landscape timber edging in place.

**612.05 Basis of Payment**. Payment for accepted quantities complete in place will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
612	Linear Foot	Landscape Timber Edging

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals necessary to complete the item as specified.

## **ITEM 613 UNIFORMED LAW ENFORCEMENT OFFICER**

613.01 Description613.02 Traffic Control613.03 Method of Measurement613.04 Basis of Payment

**613.01 Description**. This item shall consist of providing a uniformed law enforcement officer to maintain traffic in a safe and orderly manner.

**613.02 Traffic Control**. The Contractor shall provide the services of uniformed law enforcement officers for the exclusive purpose of controlling traffic. The officer shall be utilized for the lane restrictions, or during hours of peak traffic or as authorized by the Engineer. The officer shall constantly move with the backup of traffic so that he is always in a position near the end of the line of stopped traffic to assist in controlling traffic and informing drivers as to the nature of the delay. The Contractor's traffic safety coordinator, with the Engineer's approval, shall determine when and how many officers shall be required.

The officer will be invited to attend such meetings pertaining to traffic maintenance, to recommend and to help coordinate the safe and efficient movement of traffic during construction periods or during lane restrictions. Necessary provisions shall be made to provide the Engineer and law enforcement officer with direct radio contact whereby assistance can be furnished immediately in case of an accident or unusual condition that would tend to be conducive to a potential accident.

**613.03 Method of Measurement**. The method of measurement will be the actual hours of uniformed law enforcement officer with or without patrol car worked at the project site when directed by the Engineer.

**613.04 Basis of Payment**. Payment for providing uniformed law enforcement officer with or without a patrol car shall be made at the contract price for:

Item	<u>Unit</u>	Description
613	Hr.	Uniformed Law Enforcement Officer
613	Hr.	Uniformed Law Enforcement Officer with Patrol Car

This price shall include compensation for all labor, materials, equipment, tools and incidentals required to complete the work as specified herein.

### **ITEM 614 MAINTAINING TRAFFIC**

614.01 Description
614.02 Traffic Facilities
614.03 Traffic Control
614.04 Performance
614.05 Basis of Payment

**614.01 Description**. This work shall consist of maintaining and protecting vehicular and pedestrian traffic and the work while the contract is in force in accordance with these provisions and 104.04.

**614.02 Traffic Facilities**. General. Facilities for vehicular and pedestrian traffic as are in the street or highway, including all temporary walks, roads, bridges, culverts and traffic control devices, shall be constructed and maintained by the Contractor.

(a) Local Traffic. For local traffic, the Contractor shall provide and maintain in safe condition, including snow and ice removal, such drives, temporary roadways, bypasses, walks, temporary structures and other facilities as may be necessary to provide safe vehicular and pedestrian ingress and egress for all property adjacent to the improvements. Temporary approaches and crossings of intersecting highways shall also be provided and maintained in a safe condition.

(b) Through Traffic. When the highway under construction is being used by through traffic, including periods of suspension of the work, the Contractor shall so maintain by the use of labor, equipment and materials that portion of the highway being used, in such a manner that it is smooth, free from holes, ruts, ridges, bumps and dust. The highway being used shall be provided with the necessary outlets to drain freely. Pipe trenches or other openings left in hard surface pavements shall be maintained with material of comparable quality.

The City may enter upon that portion of a project where the Contractor is responsible for maintaining traffic through part or the entire project, to remove snow and ice and place abrasives at its own expense, as may be considered advisable. The Contractor shall be responsible for the removal of abrasives placed, for which no claim for additional compensation shall be allowed nor shall the Contractor be relieved in any way of his obligation for maintenance of traffic.

(c) The City will provide for the necessary maintenance of public highways which are used as detour beyond the work limits of the contract.

**614.03 Traffic Control**. (a) General. The installation, maintenance and operation of all traffic controls and traffic control devices shall conform to the requirements of the "Ohio Manual of Uniform Traffic Control Devices for Streets and Highways," hereinafter called The Ohio Manual, and the City of Akron Barricade and Signing Manual for Construction and Maintenance. Traffic control devices shall be provided with suitable supports of sufficient strength and stability.

Faces of construction signs, barricades, vertical panels and drum bands shall be reflectorized with Type G sheeting complying with the requirements of 730.19.

Traffic cones shall be a highly visible orange color. Pavement markings for traffic maintenance shall conform to 621 unless otherwise specified.

Channelizing devices such as barricades, vertical panels and cones shall be protected by adequate advance warning construction signs.

If equipment, vehicles and material are stored or parked on highway rights-of-way, the Contractor shall provide any lights, barricades, etc., that may be needed for the protection of pedestrian or vehicular traffic.

(b) Road Closed. When the highway is closed to traffic the Contractor shall provide, erect, maintain and subsequently remove approved traffic control devices, barricades and suitable and sufficient red or yellow lights at the following locations: (1) Work limits of the project. (2) Work limits on all intersecting roads. (3) Any other points designated in the contract.

Throughout construction, the Contractor shall furnish, erect, maintain and subsequently remove all signs, lights, barricades, watchmen, etc., for the maintenance of local traffic.

The Contractor shall furnish, erect, maintain and subsequently remove such additional traffic control devices as are required on public highways beyond the project limits which are used as detours.

(c) Traffic Maintained. Where the highway under construction is being used by through traffic, including periods of suspension of the work, the Contractor shall furnish and maintain pavement markings, lights, warning signs, road construction traffic maintained signs, end construction signs, barricades, temporary guardrail and such other traffic control devices, and watchmen and flagmen as may be necessary to maintain safe traffic conditions within the work limits.

The City will furnish and erect regulatory signs and guide signs, unless otherwise provided in the plans, within the work limits on all traffic maintained projects. The responsibility for maintenance of these signs shall rest with the Contractor. The erection and removal of all regulatory signs shall be approved by the Engineer.

Existing signs and traffic control devices within the work limits shall remain in use during the construction period unless otherwise specified on the plans. If the Contractor needs to relocate or modify existing signs and other traffic control devices as a consequence of his work, he shall provide suitable supports and may modify the devices with prior approval of the Engineer and the concurrence of the Traffic Engineer. Routine maintenance of existing traffic control devices will remain the responsibility of the City. The function of existing Stop or Yield signs shall be retained at all times although their position may be adjusted. Existing signs that must be relocated laterally shall be placed in accordance with the Ohio Manual. The Contractor shall restore relocated or modified signs to the position and condition which existed prior to construction as directed by the Engineer.

When an existing signal operation must be interrupted for a period, the Contractor shall provide a temporary traffic control method approved by the Engineer and the Traffic Engineer.

Whenever it is necessary for the Contractor to divert the flow of traffic from its normal channel into another channel, the channel for such diverted traffic shall be clearly marked by the Contractor with cones, drums, barricades, vertical panels, pavement markings, or flashing arrow barricades. This method of marking shall also be used where work is being done adjacent to the part of the highway in use by the public, or where work is being done on the shoulder where the roadway is being used by the public. During darkness hours, barricades and drums shall be supplemented with yellow flashing or steady electric warning lights in accordance with Section 7G of the Ohio Manual.

The Contractor shall obtain the approval of the Engineer and the City Traffic Engineer before closing a traffic lane, diverting traffic or establishing a one-way traffic operation.

(d) Flagmen. Whenever alternating one-way traffic is established, at least two flagmen shall be used, unless otherwise authorized by the Engineer, and signs, cones, barricades and other traffic control devices shall be erected by the Contractor in accordance with the Ohio Manual. Traffic control devices shall be reflectorized as previously noted herein. The Contractor shall maintain positive and quick means of communication between the flagmen at the opposite ends of the restricted area.

Flagmen shall be equipped according to the standards for flagging traffic contained in the Ohio Manual. The red flag or the Stop/Slow sign paddle shall be used. At night, flagmen stations shall be adequately illuminated, and flagmen shall use the reflectorized Stop/Slow sign paddle or a red light approved by the Engineer. The Contractor may, in lieu of flagmen or supplementing them, furnish, install and operate a temporary traffic signal or signals for the purpose of regulating traffic in accordance with the written approval of the Engineer and the Traffic Engineer.

(e) Temporary traffic signals. When specified on the plans, the Contractor shall furnish, erect, maintain and subsequently remove signal and signal controller equipment of a proper type and capacity to provide the required operation. Subject to the Engineer's approval, the Contractor may use new equipment which is to be installed later on the project, or may use equipment in used but good condition. Used equipment shall be reconditioned as necessary to assure a proper operation. Temporary traffic signal operation shall be subject to the approval of the Engineer and the Traffic Engineer, and also shall meet the general requirements of the Ohio Manual.

The Contractor shall be responsible for the procurement of and payment for electric power for temporary traffic signals. The operation of an approved temporary traffic signal shall not be altered by the Contractor without the approval of the Engineer in concurrence with the City Traffic Engineer. Any malfunctions or failures shall be corrected without delay. Temporary traffic signals not in use shall be covered or removed.

(f) Pavement marking operations. Moving marking operations shall be performed by a truck equipped with necessary flashers and warning signs and shall be protected by a similarly equipped trailing vehicle or vehicles separated a sufficient distance to provide adequate warning to overtaking traffic. The marking operation should use the extreme left or right lane when possible. Where three or more lanes exist, the operation shall allow traffic to pass on one side only.

Stationary marking operations in intersections, school zones, gores and other areas shall be protected with traffic control devices such as advance warning signs and cones.

When a United States Postal Service (USPS) mailbox is located within the work limits,, the Contractor shall arrange with the USPS to relocate the mailbox to a safe location during construction. Access for delivery and collection of mail shall be maintained at all times. Disturbed mailboxes shall be reset within the right-of-way upon completion of the construction activities.

**614.04 Performance**. If, in the opinion of the Engineer, proper maintenance of traffic facilities and proper provisions for traffic control are not being provided by the Contractor, the City may take the necessary steps to place them in proper condition, and the cost of

such services will be deducted from any money which may be due or become due the Contractor.

**614.05 Basis of Payment**. Payment for maintaining traffic shall include: lights, temporary traffic control devices, temporary guardrail, maintenance of portions of existing highway being used, and constructing, maintaining and removing temporary roads and structures required for this purpose, except temporary roads, pavements and bridges specifically designated under 502 and 615. Calcium chloride and asphalt concrete authorized by the Engineer and used for maintaining traffic will be paid for under 616, and 448.

Payment for accepted performance of this item will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
614	Lump Sum	Maintaining traffic
614	Sign Month	Portable Changeable Message Sign

### **ITEM 615 TEMPORARY WALKS AND PAVEMENTS**

615.01 Description
615.02 Earthwork
615.03 Guardrail
615.04 Pavement
615.05 Sidewalks
615.06 Maintenance
615.07 Removal
615.08 Method of Measurement
615.09 Basis of Payment

**615.01 Description**. This work shall consist of providing, maintaining and subsequently removing temporary walks and pavements at locations and to lines and grades specified. When the proposal does not include a pay item for temporary roads or walks as set forth in this item, such work shall be performed under 614.

**615.02 Earthwork**. Excavation and embankment construction necessary for providing and maintaining temporary walks, roads and drainage facilities attendant thereto, as well as subsequent removal of same and restoration of the areas to their original condition, shall be as prescribed in 203. Adequate side ditches shall be constructed in cut sections, and drainage pipe and culverts shall be provided where necessary. The width of the road from out to out of shoulders, unless otherwise called for on the plans, shall be not less than 30 feet and the side slopes shall be not steeper than 1-1/2:1. If sidewalks are required, the width of embankment shall be increased accordingly.

**615.03 Guardrail**. Where the height of the embankment is 5 feet or more measured at the outside edge of the berm, and the side slope is steeper than 4:1, guardrail shall be provided at a distance of at least 1-1/2 feet from the edge of the required width of surface course. The guardrail shall be in accordance with one of

the types specified in 606 except that reused material in good condition will be permitted. The guardrail shall be kept plainly visible at night by cleaning and/or painting whenever directed by the Engineer.

**615.04 Pavement**. Pavement type, width, and thickness shall be as shown on plans or noted in the proposal.

Calcium chloride shall be furnished, applied and paid for under 616. The amount of original and subsequent applications of chloride shall be as directed by the Engineer.

The temporary pavement shall conform to the specification requirements for the pertinent items except that method of measurement and basis of payment will not apply, and except as otherwise noted hereinafter.

For 403 and 448, the materials may be spread and finished by acceptable hand methods and the requirements for smoothness will be waived.

Rigid pavement shall be constructed in accordance with 452, except that tiebars or hookbolts will not be required for longitudinal joints. Materials shall conform to the quality requirements set forth in 499.02. A minimum of 400 lbs. of cement shall be used per cubic yard, otherwise materials shall be proportioned and mixed so as to provide concrete having a projected 28 day compressive strength of 3,500 psi.

**615.05** Sidewalks. When temporary walks are required, they shall be 4 inches thick and conform to the requirements as set forth in 456 or as specified.

**615.06 Maintenance**. The Contractor shall maintain all portions of the temporary facilities in good condition with respect to both safety and smoothness for travel as long as it is needed for maintenance of traffic. If, in the opinion of the Engineer, the temporary facilities are not being properly maintained, they may be put into proper condition by the City and the cost of such services will be deducted from any money which may be due or become due the Contractor.

**615.07 Removal**. When the temporary facilities are no longer needed, the Contractor shall remove them, except such portions of the embankment as are indicated on the plans to be a part of the new roadway embankment, and shall leave the area in a neat condition. All material removed, unless otherwise indicated on the plans, shall be considered the Contractor's property and shall be removed from the site.

**615.08 Method of Measurement**. The quantity of temporary walks or pavement will be the surface area placed, maintained, and removed as directed, measured complete in place.

Calcium chloride will be measured and paid for under 616.

**615.09 Basis of Payment**. The accepted quantities of specific items of temporary walks and pavement will be paid for at the contract prices per unit of measurement designated for each of the pay items listed. These prices shall be full compensation for all materials, excavation, backfill and disposal of surplus materials for completion of the specified items.

Payment for accepted quantities will be made at the contract price for: Item Unit Description

<u>Item</u>	<u>Unit</u>	<b>Description</b>
615	Square Yard	Temporary pavement
615	Square Foot	Temporary walks

### **ITEM 616 DUST CONTROL**

616.01 Description616.02 Procedure616.03 Method of Measurement616.04 Basis of Payment

**616.01 Description**. This work shall consist of applying when ordered, water or dust palliative for the alleviation or prevention of dust nuisance originating within the project right-of-way.

**616.02 Procedure**. Dust control operations shall be performed by the Contractor at the time, location and in the amount ordered by the Engineer. The application of water or dust palliative shall be under control of the Engineer at all times. The Engineer will determine if water or dust palliative is to be used to alleviate or prevent dust nuisance, and the amounts of each material to be used. Calcium chloride shall not be applied to areas that will be subsequently seeded.

Water used for dust control shall be furnished and applied by means of tanks equipped with suitable sprinkling devices and in the quantities as directed by the Engineer.

Dust palliative shall consist of calcium chloride, 712.02, or a brine solution containing a minimum of 30 percent by weight of calcium chloride. The calcium chloride shall be spread uniformly over the surface, at the rate of 1.5./S.Y. or as directed by the Engineer.

**616.03 Method of Measurement**. The quantity of water shall be the amount in thousands of gallons applied in accordance with the requirements of this item and measured in tanks, tank wagons or trucks of predetermined capacity, or by means of meters of a type satisfactory to the Engineer and furnished and installed by the Contractor at his own expense, or determined by weight conversion.

The quantity of calcium chloride shall be the number of tons by weight measurement, furnished and applied in accordance with the requirements of this item. When brine is used, the tons of calcium chloride shall be determined by multiplying the number of gallons by the factor 0.0024.

**616.04 Basis of Payment**. The quantities of water and calcium chloride measured shall be paid for at the contract unit price.

Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>	
616	M Gallons	Water	
616	Tons	Calcium chloride	

### **ITEM 617 LOW STRENGTH MORTAR BACKFILL**

- 617.01 Description
- 617.02 Materials
- 617.03 Mix Proportioning
- 617.04 Mix Adjustment
- 617.05 Alternate Mixes
- 617.06 Mixing Equipment
- 617.07 Mixing the Materials
- 617.08 Placing Mortar
- 617.09 Method of Measurement
- 617.10 Basis of Payment

**617.01 Description.** This work shall consist of the placement of a flowable material consisting of portland cement, fly ash and/or sand with an expected 28 day unconfined compressive strength less than 100 pounds per square inch. This item shall be used for backfilling conduits or at other locations as shown on the plans or as specified. The work shall be in accordance with 551 and 499 unless otherwise specified herein.

## 617.02 Materials. Materials shall be:

Cement	701.01 or 701.04
Fly Ash	
(Except where provided for under 617.	05)

Fine aggregate shall be natural sand or sand manufactured from stone, gravel or aircooled blast furnace slag. The gradation of the sand shall meet the requirements of 703.05. The sand shall be fine enough to stay in suspension in the mixture to ensure proper flow.

	Type 1 *	Type 2	Type 3
	lbs./yd. <sup>3</sup>	lbs./yd. <sup>3</sup>	lbs./yd. <sup>3</sup>
Cement	50	100	0
Fly Ash, Class F	250	**	1500
Fly Ash, Class	0	0	500
C ****			
Sand ***	2910	2420	0
Water (Target)	500	210-300	850

**617.03 Mix Proportioning.** The low strength mortar mixture may consist of the following quantities of materials per cubic yard.

\* An air entraining agent specifically designed for the use in the low strength mortar mixture may be added to this mix.

\*\* Entrained air is substituted for fly ash in this mix.

\*\*\* Saturated Surface Dry

\*\*\*\*Class C Fly Ash may be substituted for Class F Fly Ash in Type 1 mixes with an approved mix design meeting the alternate mix design criteria of this specification.

These mixtures of materials are expected to yield approximately one cubic yard of material of a flowable consistency. Small adjustments in the amounts of the materials in a mix may be required to achieve the final project. No additional compensation for a change in the material blends shall be allowed.

**617.04 Mix Adjustment.** The Contractor shall make one or more than one cubic yard trial batches at different water contents to ensure a flowable material. The mixture is too dry when cracks develop in the mixture as it flows into place.

Adjustments of the proportions shall be based on maintaining the total absolute volume. For large adjustments, see 613.05 Alternate Mixes.

In order to expedite the settlement of a Type 1 mixture without entrained air, it may be necessary for bleed water to appear on the surface immediately after the material is struck off. A delay in bleeding indicates there are too many fines in the mixture. The fly ash quantity may be reduced in increments of 50 pounds until the mixture is bleeding freely. Approximately 60 pounds of sand shall be added to replace each 50 pounds increment of fly ash to maintain the original yield.

**617.05** Alternate Mixes. Other mixes may be submitted to the Engineer for approval. The Contractor shall submit the mix design and test data from an independent test lab 30 days prior to the intended usage for approval.

This requirement is for all mixes that:

1. Vary more than 300 pounds in sand, 100 pounds in water, 20 pounds in cement, or 200 pounds in fly ash from the above mixes. These are considered large adjustments.

2. Have less than 50 pounds of cement in the Type 1 mixes or less than 100 pounds of cement in the Type 2 mixes.

3. Utilizes alternate materials.

All alternate mixes shall have an unconfined compressive strength between 50 and 100 pounds per square inch at 28 days when tested in accordance with ASTM D 4832. The long term (12 month) unconfined compressive strength shall be less than 100 pounds per square inch.

The final mix shall have the required strength, fill the voids of the intended usage and set up within 12 hours (4 hours for Type 3 or Type 3 alternate mixes). The proportioning, yield, consistency, workability, compressive strength and all other requirements are the sole responsibility of the Contractor.

**617.06 Mixing Equipment.** Sufficient mixing capacity and delivery equipment shall be provided for the material to be placed without interruption as much as practical. The Type 1 and 2 mixes or Type 1 and 2 alternate mixes shall be delivered and placed from ready mixed concrete trucks or delivered from a batch plant.

Type 3 mix shall be delivered and placed using volumetric mobile mixers. Volumetric mixers shall be properly calibrated and shall sufficiently mix the materials to produce a uniform material.

**617.07 Mixing the Materials.** The mixture shall be discharged within 2.5 hours after the water is added.

**617.08 Placing Mortar.** The flowable material shall be discharged from the mixer by any reasonable means into the space of the plan intended usage. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer. Placing of the other fill material over low strength mortar backfill material may commence as soon as the surface water is gone or as directed by the Engineer. The Engineer reserves the right to reject the mix if a flowable mixture is not produced.

Before placing the low strength mortar backfill as backfill for conduit, the Contractor shall secure the conduit to prevent it from floating during placement of the flowable material.

**617.09 Method of Measurement.** Low strength mortar backfill will be measured by the number of cubic yards computed from the plan lines and placed. No additional compensation shall be allowed for over excavated areas.
**617.10 Basis of Payment.** For the volume of material furnished and placed as computed from the plan lines, the Contractor will be paid at the contract unit price per cubic yard. This payment shall be full compensation for placing the low strength mortar backfill meeting all of the above requirements and for furnishing all materials, equipment and incidentals necessary to complete this item, unless included under other items on the plans.

Item	<u>Unit</u>	<b>Description</b>	
617	Cubic Yard	Low strength mortar backfill	
617	Cubic Yard	Low strength mortar backfill (Type	)

## **ITEM 618 COMPUTER EQUIPMENT**

# 618.01 Description 618.02 Basis of Payment

**618.01 Description.** This item shall consist of providing equipment as specified by the City in the pre-construction meeting for the exclusive use of the City for the duration of the contract. All warranties, services, and support options for the computer equipment shall be registered under the City of Akron, Akron Engineering Bureau. The Contractor shall be responsible for obtaining tax exempt certificates for the City purchases. The Contractor shall deliver the equipment in unopened boxes to the City of Akron, 166 S. High Street, Room 702. The equipment will remain the property of the City at the completion of the contract.

**618.02 Basis of Payment.** An allowance has been included in the bid schedule for the purchase of computer equipment as specified by the City. Payment shall be the actual cost of the equipment delivered plus five percent (5%) to cover administration costs for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
618	Allowance	Computer Equipment

# **ITEM 619 FIELD OFFICE**

619.01 Description 619.02 General 619.03 Basis of Payment **619.01 Description**. This item shall consist of providing, maintaining and subsequently removing a suitable field office for the exclusive use of the City of Akron for the duration of the contract.

**619.02** General. The field office shall be available at the start of the work and shall remain until subfinal acceptance of the complete project. It shall have a floor area not less than that shown on the plans, but in no case less than 150 square feet, with an inside height of at least 7 feet. The field office shall have provisions for maintaining a temperature between 68° and 80°F, with lighting and electric outlets. The Contractor shall provide and maintain one line of telephone service in the field office, and the office shall be arranged and equipped with adequate working and storage facilities. If required, the Contractor shall provide and maintain a cell phone with a local phone number.

The Contractor shall provide bottled water and also maintain convenient sanitary facilities for the use of the occupants of the field office.

**619.03 Basis of Payment**. The field office will be paid for at the contract lump sum price bid, which price shall be full compensation for furnishing, maintaining and subsequently removing the field office and all incidentals necessary to complete this item.

Payment for accepted performance of this item will be made at the contract price for:

ItemUnitDescription619Lump SumField office

# **ITEM 620 FURNISHING A VEHICLE**

## 620.01 Description 620.02 Basis of Payment

**620.01 Description.** The Contractor shall furnish the City a truck or sport utility vehicle, not more than three years old, in good operating condition with air conditioning for use by the City inspection personnel for the duration of the project. This item shall include taxes, insurance and all necessary maintenance and/or repairs including fuel for satisfactory operation of the vehicle. The Contractor shall provide a replacement vehicle during downtime.

620.02 Basis of Payment. Payment shall be made at the lump sum price for:

Item Unit Description

620 Lump Sum Furnishing a Vehicle

### **ITEM 621 PAVEMENT MARKING**

- 621.01 Description
- 621.02 Materials
- 621.03 General
- 621.04 Pavement Preparation
- 621.05 Application
- 621.06 Layout and Premarking
- 621.07 Line Placement Tolerance
- 621.08 Edge Lines
- 621.09 Lane Lines
- 621.10 Center Lines
- 621.11 Channelizing Lines
- 621.12 Stop and Crosswalk Lines
- 621.13 Transverse Lines
- 621.14 Curb and Island Marking
- 621.15 Parking Lot Stall Marking
- 621.16 Lane Arrows
- 621.17 Word on Pavement
- 621.18 Dotted Lines
- 621.19 Plastic Parking Stops
- 621.20 Removal of Pavement Markings
- 621.21 Deduction for Deficiency
- 621.22 Method of Measurement
- 621.23 Basis of Payment

**621.01 Description**. This work shall consist of furnishing and applying alkyd or water based traffic paint in accordance with the lines and dimensions shown on the plans or as described herein. All pavement markings shall conform with the requirements of the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways.

**621.02** Materials. The traffic paint shall be of a formulation identified by a manufacturer's code number and approved by the Engineer.

The paint shall comply with 708.14, Fast Dry. Glass beads shall comply with 712.05.

Plastic parking stops shall be 72" long, Model #PMP1006 as manufactured by the Plastic Lumber Co., Inc., or approved equal. Standard parking spaces shall be fitted with Yellow, C080, and handicap spaces shall be fitted with Blue, C020.

**621.03 General**. Pavement markings shall be free of uneven edges, overspray, or other readily visible defects which, in the opinion of the Engineer, detract from the appearance or function of the pavement markings. Methods and equipment used for pavement preparation, marking, and marking removal shall be subject to the approval of the Engineer.

**621.04 Pavement Preparation**. The Contractor shall clean all visible loose or foreign material from the surface to be marked. The Contractor shall power broom clean all surfaces where gore markings or edge lines are to be applied and, when required by the Engineer, other surfaces to be marked. Portland cement concrete painting shall not be done until the concrete in the areas to be painted is clean of membrane curing material and in a dry condition suitable for painting.

**621.05 Application**. The Contractor shall transfer the entire contents of each paint container to the striper tank. Pavement marking materials, as received from the manufacturer, shall be applied uniformly to the surface to be marked. The paint shall be thoroughly mixed at all times during application. Thinning shall not be permitted. Pavement markings shall be applied only when the surface is clean and dry, and when the temperature of the surface is above 40°F. Construction work such as sidewalks, driveways, topsoil, seeding and mulching shall be scheduled and performed in a manner to avoid damage to applied pavement markings.

Lines shall be applied as solid, dashed or dotted stripes, either singly or in combination, as shown on the plans. Dashed lines shall be applied in a 40 foot cycle consisting of a 10 foot dash and a 30 foot gap between dashes, unless otherwise shown on the plans. Dashed lines which are to be applied over plainly visible existing dashed lines shall begin within 6 inches of the beginning of the existing dash, unless otherwise directed by the Engineer. Dotted lines shall be applied in a 6 foot cycle consisting of a 2 foot dot and a 4 foot gap between dots.

Gallons per Mile of Line					
Width of line, in.	4	6	8	12	24
Solid line	16	24	32	48	96
Dashed line	4	6	8	12	24
Dotted line	5-1/3	8	10-2/3	16	32
Areas Word Symbols 1 Gallon per 100 square feet					

Paint shall be applied at the following rates:

When paint is applied to new bituminous pavement surfaces, the specified application rate shall be increased 25 percent. The width of line applied shall be the width specified plus or minus 1/4 inch.

Glass beads shall be applied to the wet paint so that the beads are embedded and retained in the paint and uniformly cover the paint surface. The rate of application shall be not less than 6 pounds of glass beads per gallon of paint applied.

The temperature of fast dry paint at the discharge point shall be in the range of  $140-170^{\circ}$ F for alkyd paint and  $130-150^{\circ}$ F for water-based paint.

Lines shall be sharp, well defined, and retroreflective. Fuzzy lines, excessive overspray, or nonuniform application are unacceptable. Lines will be inspected at night by the Engineer to verify proper retroreflectivity. Pavement markings which are improperly applied, improperly located, or non-retroreflective shall be corrected. Lines applied with insufficient material quantities shall be properly reapplied, or shall be subject to acceptance with deduction as provided in 621.21. Improperly located lines shall be removed by a method approved by the Engineer, and lines shall be applied in the correct locations at the Contractor's expense, including the furnishing of approved materials.

**621.06 Layout and Premarking**. The Contractor shall lay out the locations of all lines, words and other symbols to assure their proper placement. When applying longitudinal or transverse lines, the Contractor shall use existing lines, construction joints or premarking to guide his marking equipment.

On projects where resurfacing or other operations will result in obliteration of the existing pavement markings, the Contractor shall establish reference points to assure proper placement of restored markings.

"T" marking of no-passing zones shall be established by the Contractor in accordance with the contract plans or a no-passing zone log provided by the Engineer.

Premarking shall be located from survey data or reference points and offset so as to parallel the theoretical edge of the marking lines at a maximum distance of one inch. Templates are required for the layout of arrows, words and other symbols.

Premarking for longitudinal lines shall be placed at 40 foot intervals and shall not exceed 2 inches in width or 12 inches in length.

The layout and premarking lines shall be approved by the Engineer and the Traffic Engineer before marking operations are started.

**621.07** Line Placement Tolerance. Pavement marking lines shall be straight or smoothly curved, true to the alignment of the pavement, and shall not deviate laterally from the proper location at a rate of more than 2 inches in 100 feet. No deviation greater than 3 inches will be permitted.

**621.08** Edge Lines. Edge lines shall be continuous retroreflective stripes, 4 inches in width. Center of stripe shall be located 6 inches from the edge of the pavement.

**621.09** Lane Lines. Lane lines shall be dashed white retroreflective stripes between contiguous lanes of pavement carrying traffic in the same direction. They shall be offset to the left of the longitudinal joint, if present, or the theoretical line

lying between contiguous lanes, if a joint is not present. The nearer edge of the stripe shall be 2 inches to the left of the joint or line.

**621.10 Center Lines**. Center lines shall be single or double yellow retroreflective stripes between contiguous lanes of pavement carrying traffic in opposite directions. Center line marking shall also include two-way left-turn lane striping and the outline of painted left-turn islands. Each stripe shall be 4 inches wide, solid or dashed.

**621.11 Channelizing Lines**. Channelizing lines shall be continuous white retroreflective stripes 8 inches wide.

**621.12** Stop and Crosswalk Lines. Stop lines shall be solid white retroreflective stripes 24 inches wide. Crosswalk lines shall be solid white retroreflective stripes 12 inches wide.

**621.13 Transverse Lines**. Transverse lines shall be solid retroreflective stripes 24 inches wide, normally placed at an angle to the direction of travel to form all or a portion of a painted standard obstruction or road delineation marking.

**621.14 Curb and Island Marking**. Exposed surfaces of curbs and paved islands shall be prepared in accordance with 621.04. In addition to the requirements of 621.04, the Contractor shall remove all visible loose or foreign material, including vegetation, immediately contiguous to vertical surfaces to be marked. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

**621.15 Parking Lot Stall Marking**. Standard parking stall marking lines shall be continuous white stripes, 4 inches in width. Handicapped parking stall marking lines shall be blue stripes, 4 inches in width.

**621.16 Lane Arrows**. Lane arrows shall be retroreflective white markings. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

**621.17 Word on Pavement**. Words on pavement shall be retroreflective white markings. Paint shall be applied at the rate of 1 gallon to each 100 square feet.

**621.18 Dotted Lines**. Dotted lines shall be retroreflective white markings of the width specified.

**621.19 Plastic Parking Stops.** All new parking stops shall be installed in accordance with the manufacturer's recommendations, and as designated on the plans. Parking stops shall be installed at the locations shown on the plans.

The Contractor shall submit to the Engineer, for review and approval, six (6) copies of shop drawings and installation procedures, unless additional copies are requested. Installation shall not begin until the submitted shop drawings have been approved by the Engineer.

**621.20 Removal of Pavement Markings**. When indicated on the plans, pavement markings shall be removed. The markings shall be removed by high pressure water blast, sand blast, high temperature burning with excess oxygen, chemical treatment, or other methods, with the approval of the Engineer. Upon removal, any residual pavement stains shall be eradicated by the use of an approved solvent. Care shall be exercised during marking removal not to scar, discolor or otherwise damage the pavement surface. Overpainting or other methods of covering markings in lieu of removal shall not be permitted.

**621.21 Deduction for Deficiency**. The amount of paint or glass beads, applied per unit of measurement will be computed each day by the Engineer. A tolerance of 6 percent for deficiency of paint or glass beads shall be permissible without deductions. If computations reveal that the 6 percent tolerance has been exceeded and an insufficient quantity of either paint or glass beads has been applied, the contract unit price shall be reduced in direct proportion to the percent of deficiency of paint or beads as called for in 621.05, up to 20 percent for each material deficient; only the greater deficiency shall be used to compute the deduction.

If the deficiency of any material is 20 percent or more, the work shall be considered unsatisfactory and shall be repainted at full expense of the Contractor, including all labor, equipment, and material requirements.

**621.22** Method of Measurement. Pavement marking will be measured complete in place in the units designated. Dashed or dotted line quantities will be the length of completed stripe, including the gaps, but excluding intersections, and other sections of pavement not normally marked.

**621.23** Basis of Payment. Payment for accepted quantities will be made at the contract price, or price adjusted in accordance with 621.21, for:

Item	<u>Unit</u>	<b>Description</b>
621	Miles or Linear Foot	Edge lines, Type
621	Miles or Linear Foot	Lane lines, inch, Type
621	Miles or Linear Foot	Center lines, Type
621	Miles or Linear Foot	Channelizing lines, Type
621	Linear Foot	Stop lines, Type
621	Linear Foot	Crosswalk lines, Type
621	Linear Foot	Broad transverse lines, Type
621	Linear Foot	Curb marking, Type
621	Square Foot	Island marking
621	Linear Foot	Parking lot stall marking, Type
621	Each	Lane arrows
621	Each	Word on pavement, inch
621	Linear Foot	Dotted lines, inch
621	Linear Ft., Sq. Ft., or Each	Removal of pavement mark
621	Each	Handicapped symbol marking
621	Each	Plastic Parking Stops, Safety Yellow

621 Each

## **ITEM 622 MONUMENT BOXES**

622.01Description622.02Material

622.03 Construction Methods

622.04 Method of Measurement

622.05 Basis of Payment

**622.01 Description**. This item shall consist of setting, adjusting, and relocating monument boxes in cut-outs or box-outs provided by the Contractor in asphalt or concrete pavements, and shall include the cut-out or box-out, cast iron frames, cover (current date cast there-on), monument, asphalt and/or concrete and dry P.C. - sand mix within the box-out or cut-out, as shown on Standard Drawings BP-8 and BP-9, and appurtenances thereto.

**622.02 Material**. Frames and covers shall conform to Standard Drawing BP-8, equal or similar to Neenah Catalog No. R-1973-A or East Jordan Catalog No. 1574. The cast iron shall conform to ASTM Standard Specification for gray iron castings serial designation A-48. Note requirement of 1% nickel alloy cast iron on Standard Drawing BP-8. Monument rod shall be #6 rebar, 48" long, one end cut or ground square, and the other end pointed at center.

**622.03** Construction Methods. Concrete Pavements. Construction shall conform to Standard Drawing BP-9, monument box shall be set on a bed of dry P.C. - sand mix (1:3 proportions), and the box-out filled with concrete, Class "C", using due care to prevent movement of the box. The excess dry mix shall be removed from within the barrel of the monument box. Monument (#6 rebar) furnished by the Contractor shall be set by others.

Asphalt Pavements. Construction shall conform to Standard Drawing BP-9. Contractor shall remove the portion of the completed base, Item 301, within the limits as shown on standard drawing. Monument box shall be set on a bed of dry P.C. - sand mix (1:3 proportions) within the cut-out portion of the base. Concrete, Class "C", shall be carefully poured around the monument box, using due care to prevent movement of the box, level with the surface of the completed base course. Excess dry mix shall be removed from within the barrel of the monument box. Monument (#6 Rebar) furnished by the Contractor shall be set by others.

Adjusting monument box shall consist of resetting of the existing monument box casting at its existing location due to changes in grade of the surrounding roadway. Monument boxes shall be salvaged and replaced in the new or reconstructed pavement as described above in 622.03.

Relocating monument box shall consist of resetting an existing monument box casting at a new location as shown on the plans. Monument box shall be salvaged and relocated to a new location as described above in 622.03.

**622.04** Method of Measurement. The quantity to be paid for shall be the number of monument boxes in place complete as specified, and shall be determined by the Engineer's count of acceptable boxes in place.

**622.05 Basis of Payment**. The quantity measured shall be paid for at the contract unit price bid for:

Item	<u>Unit</u>	<b>Description</b>
622	Each	Monument Boxes
622	Each	Monument Box, Adjusted
622	Each	Monument Box, Relocated

The above price shall constitute full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to install monument boxes as specified, ready for monument to be set by others.

# **ITEM 623 CONSTRUCTION LAYOUT STAKES**

623.01 Description623.02 General623.03 Basis of Payment

**623.01 Description**. When this item is included in the proposal, it shall consist of furnishing, placing and maintaining construction layout stakes necessary for the proper prosecution of the work under the contract, all in accordance with these specifications. This item shall also include as-built survey of pertinent items.

When the proposal does not include a pay item for construction layout stakes, the Engineer will set construction stakes as described in 105.09.

**623.02 General**. The City will locate and reference the centerline of the project and all intersecting roads and streets and will establish benchmarks along the line of the improvement outside construction limits. One benchmark will be established by the City for use at each structure over 20 foot span. Locating and referencing the centerline shall consist of locating and referencing control points such as point of curve, point of tangent, and sufficient points on tangent to provide a line of sight. Reference points shall be set outside the construction limits in such a manner that they will be available to re-establish the control points at any time during the course of the work. Control points set by the City will be identified in the field to the Contractor and the field notes will be kept in the office of the Engineer.

The Contractor shall provide field forces and set all additional stakes for the project which are needed to establish offset stakes, reference points, slope stakes, pavement and curb line and grade, stakes for bridges, culverts, sewers and drainage structures, paved gutters, walls, monuments, fence, right-of-way lines, easements, and any other horizontal or vertical controls, including supplementary benchmarks, necessary to secure a correct layout of the work. The location of slope stakes for grading work shall be determined by a calculation method, and a copy of these calculations shall be made available to the Engineer for project records. The Contractor will not be required to set additional stakes to locate a utility line which is not included as a pay item in the contract, or to determine the property line between the properties.

Stakes shall be 2" x 2" hubs driven flush in lawn areas, or drill holes, spikes or nails in pavement. All stakes shall be marked with the station, offset, cut or fill and a cut sheet shall be supplied to the inspector.

Stakes for line and grade of pavement and/or curb shall be set at an offset of no more than 5 feet and at sufficient intervals to assure conformance to plan line and grade. Intervals shall not exceed 25 feet on grades less than 0.5%, 35 feet on grades less than 0.8% and 50 feet on all other grades. Vertical curves shall be staked at the P.V.C., P.V.I., P.V.T. and the quarter points as a minimum. Curb returns shall be staked at the quarter points. Stakes for sewers when using a laser shall include a line and grade stake behind the initial point, at the midpoint and ahead of the terminal point. Lasers shall not be used in the pipe without approval of the Engineer.

The Contractor shall be responsible for having the finished work conform to the lines, grades, elevations, and dimensions called for in the plans. Any inspection or checking of the Contractor's layout by the Engineer and the acceptance of all or any part of it shall not relieve the Contractor of the responsibility to secure the proper dimensions, grades, and elevations of the several parts of the work. The Contractor shall exercise care in the preservation of stakes and benchmarks and shall have them reset at no additional cost to the City when any are damaged, lost, displaced, or removed. The Contractor shall use competent personnel and suitable equipment for the layout work required, and shall provide that it be done under the direct supervision of a Registered Professional Engineer or Professional Surveyor. The Contractor shall not engage the services of any person or persons in the employ of the City for the performance of any of the work covered by this item.

It shall be the Contractor's responsibility to verify any survey information appearing in the plans, except for the centerline of the project, which he may use to lay out the work.

After construction is substantially complete, the Contractor shall submit, to the Engineer, an as-built survey of the following new, reconstructed or relocated items of contract-installed utility and drainage structures. The survey shall provide northing / easting coordinate locations and/or elevations (as shown below). The submitted information shall be stamped by a Registered Professional Surveyor.

- 1. Rim locations and elevations of all new or reconstructed inlets, catch basins and manholes.
- 2. Invert elevations of all pipes in the new or reconstructed manholes or new pipes in existing manholes.
- 3. Locations of all new or reconstructed water main valves, fittings, hydrants, bends, etc..
- 4. Locations of all new or relocated poles, pullboxes, junction boxes, conduit bends, etc. of any contract-installed utility, such as street lighting, traffic signals, communications, etc.

**623.03 Basis of Payment**. Construction layout stakes will be paid for at the contract lump sum bid, which price shall be full compensation for all services, materials, labor, equipment, tools and incidentals necessary to complete this item.

Payment can be made up to a maximum of 80 percent of the lump sum bid price without the submittal of the as-built information. Once the as-built information is submitted and approved by the Engineer, the remainder of the lump sum payment will be made up to 100 percent of the lump sum bid price.

Subfinal payment for the contract shall not be made until the as-built survey is submitted and approved by the Engineer.

Payment for accepted performance of this item will be made at the contract price for:

# Item Unit Description

623 Lump Sum Construction layout stakes

# **ITEM 624 MOBILIZATION**

- 624.01 Description
- 624.02 Materials
- 624.03 Construction Requirements
- 624.04 Limitation
- 624.05 Method of Measurement
- 624.06 Basis of Payment

**624.01 Description**. This work shall consist of the preparatory work and operations for the assembling and setting up necessary facilities for the project, such as shops, plants, storage areas, sanitary facilities, moving in of personnel, equipment and incidentals to the project site, and any other facilities as required by the specifications and special requirements of the contract, as well as by local or state law and regulation.

When the proposal does not include a pay item for mobilization, the work described in this section shall be performed but will not be paid for directly, but shall be considered as a subsidiary obligation of the Contractor, payment for which is included in the various items of work in the contract.

**624.02** Materials. The Contractor shall furnish all materials and furnishings required for this item. These materials and furnishings will not be considered as a part of the various items of the completed contract.

**624.03** Construction Requirements. The Contractor shall provide all tools, equipment, materials, labor and work for the construction and furnishing of the required facilities and services. All work under this item shall be performed in a safe and workmanlike manner.

**624.04** Limitation. The sum total of the two payments described in Item 1 and Item 2 under 624.06 will be limited to the amounts shown in the following table under "Maximum total of partial payments." The balance of the amount bid, if any, will be paid as described in Item 3 under 624.06.

Total Contr	The Maximum Total of Partial Payments Shall Be	
More than	Up to, inclusive	
\$ 0	\$ 50,000	\$ 1,000
50,000	100,000	2,000
100,000	200,000	4,000
200,000	500,000	7,400
500,000	1,000,000	16,500
1,000,000	2,000,000	30,000
2,000,000	5,000,000	54,000
5,000,000	10,000,000	115,000
10,000,000		200,000

If the contract lump sum amount bid for mobilization exceeds the total shown in the table above for partial payments, the excess will be paid on completion of the project.

**624.05** Method of Measurement. Work performed under this item will be measured as a unit, acceptably performed.

**624.06 Basis of Payment**. Mobilization will be paid for at the contract lump sum price, which price will include the cost of all items herein described.

The contract lump sum price for this item shall be payable to the Contractor as specified in 109.06 and in accordance with the following schedule of partial payments.

1. One half of the contract lump sum amount bid for mobilization or one half of the amount shown in 624.04, whichever is less, will be released to the Contractor with the first estimate payable, but not sooner than 15 days after the start of work at the project site.

2. The second one half of the contract lump sum bid for mobilization or the second one half of the amount shown in 624.04, whichever is less, will be released with the first regular estimate after 10 percent of the original total contract amount including payments for delivered materials but excluding mobilization, is earned.

3. Upon completion of all work on the project, payment of any amount of the contract lump sum price bid for mobilization in excess of the total amount shown in the table above for partial payments will be made.

Payment will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
624	Lump sum	Mobilization

# **ITEM 625 OUTSIDE LIGHTING**

- 625.01 Description
- 625.02 Materials
- 625.03 General
- 625.04 Working Plans
- 625.05 Light Poles and Towers
- 625.06 Foundations
- 625.07 Luminaires
- 625.08 Glare Shields
- 625.09 Ground Rods
- 625.10 Pull Boxes
- 625.11 Trench
- 625.12 Conduit
- 625.13 Cable
- 625.14 Unit Type Duct-Cable Systems
- 625.15 Concrete Poles
- 625.16 Connections
- 625.17 Service Pole

- 625.18 Control Center
  625.19 Structure Grounds
  625.20 Junction Boxes
  625.21 Electrical Tests
  625.22 Light Pole Identification
  625.23 Method of Measurement
- 625.24 Basis of Payment

**625.01 Description**. This work shall consist of furnishing and installing electrical materials and equipment complete and ready for service, in reasonably close conformity with locations, dimensions, and grades shown on the plans or ordered by the Engineer. Outside lighting includes expressway lighting; street lighting; park security lighting, walkway and sports lighting; and parking lot lighting. This work shall also include necessary excavation and backfill, and disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with 104.06 and 104.07 and also electrical testing as specified.

**625.02 Materials**. New first quality materials shall be furnished. They shall comply with the Underwriters Laboratories requirements. The materials shall also comply with the National Electrical Code and local codes for the area of installation. All electrical parts, wire, switches and other elements of the installations shall be of ample capacity to carry the required current without excessive heating or causing an excessive drop of potential.

Except as otherwise provided herein, each individual item of equipment shall bear a nameplate, or other type of indelible marking or brand that shall identify it as to type, catalog number and manufacturer.

Specific materials and items shall be as follows:

Anchor bolts and nuts	3.01, 713.21
Cable	713.02
Cable connectors and connector kits	713.15
Concrete	499, 511
Conduit	3.04, 713.07
Ground rods	713.16
Lamps	713.14
Light poles	713.01
Light towers	713.21
Luminaires 713.11, 713.12, 713	3.13, 713.21
Portable power units	713.21
Pull boxes	713.08
Reinforcing steel	
Sand	
Junction boxes	713.10
Unit type duct-cable systems	713.03
Wood service poles	713.19
Control center components	713.20

Cable splicing kits	.713.15
Structure ground cable	.713.17

**625.03** General. In general, definitions of electrical terms used shall be in accordance with Appendix F of the American National Standard Practice for Roadway Lighting ANSI D12.1. Exceptions are as follows:

(a) A luminaire shall include direct appurtenances such as a reflector, refractor, housing and supports that are integral with the housing and high intensity discharge (HID) or fluorescent ballasts when applicable. The luminaire shall include the lamp.

(b) A light pole shall be considered to include anchor or transformer base, shaft, bracket arm if required, and integral hardware to support luminaires at heights of less than 70 feet above the foundations.

(c) A light tower shall be considered to include a shaft with base plate, pole head, luminaire ring and integral lowering mechanism, internal power cable, and connecting and associated hardware, to support luminaires at heights of 70 feet and greater, above the foundation.

Items of electrical equipment shall consist of products of the same manufacturer, as far as practicable.

Each system shall conform as to voltage, amperage, frequency and type specified. Unless otherwise noted on the plans, the Contractor shall furnish and install all incidentals necessary to provide a complete and practical working unit or system.

All installations shall be in accordance with the National Electrical Code and National Electrical Safety Code, and shall also conform to local laws and codes governing such work.

The Contractor shall obtain and pay for all permits required.

In order to provide all necessary requirements for the proposed lighting system, the Contractor shall cooperate with the agency which will furnish electrical service also hereinafter referred to as the supplying agency.

**625.04** Working Plans. The Contractor shall submit to the Engineer for review and approval eight sets of detail plans, drawings, photographs, photometric curves, templates and specifications of all apparatus and equipment he proposes to furnish. They shall show clearly the design, construction dimensions, quantities and such other information as may be necessary or desirable for a proper understanding of the equipment offered. All material submittal sheets, curves, etc., defining the above shall identify the specific project to which the material applies, and if more than one catalog number, style or type is listed on one sheet, the item to be furnished must be identified clearly by circling, underlining, or otherwise marking.

The Contractor shall not install electrical material until written approval of such submissions is received from the Engineer. After approval by the Engineer, such plans shall be taken as supplemental to, but in no sense a substitute for, the original plans.

The approval of working plans by the Engineer shall not relieve the Contractor of responsibility for erroneous or inconsistent dimensions, notations, omissions or other errors, or the proper functioning of the completed installation.

**625.05** Light Poles and Towers. Light poles and towers conforming to approved shop drawings shall be erected upon the completed concrete foundations or other specified type of mounting. Poles shall be plumbed or aligned by the double nutting method. After erection, each metal light pole shall be adequately grounded as provided for in 625.09 or 625.19, and have hand hole covers or transformer base doors fastened in place.

After erection, galvanized poles shall be inspected for defects in the galvanized surfaces. Minor scratches shall be given two coats of an approved zinc-rich paint. The second coat shall not be applied until after the first coat has adequately dried. Poles having major scratches or defects in the galvanized surfaces will not be accepted.

When specified, galvanized poles shall be painted. They shall be given shop coats as specified in 713.01. After erection, two field coats of paint specified or approved by the Engineer shall be applied. Painting shall be in accordance with the applicable provisions of 514.

**625.06 Foundations**. Excavation for foundations shall be completed as nearly as practicable to the dimensions shown for the foundations. Concrete shall be cast-in-place, Class C, and construction shall be in accordance with 511 except that forms will not be required for portions of foundations extending more than 6 inches below the ground line, unless the soil does not have sufficient stability to stay in place during the placing of the concrete. When bedrock is encountered, the total depth of foundation may be reduced up to 50% of the depth of rock excavation but not less than the length of the anchor bolts. Where, in the opinion of the Engineer, an excavation for a foundation has revealed an unstable condition at the bottom of the excavation, the foundation shall be deepened or enlarged in size as directed by the Engineer. Payment for additional quantities of excavation and foundation concrete required by the Engineer for this purpose shall be made as specified in 104.02.

Reinforcing steel as specified shall be placed in accordance with 509.

Anchor bolts for light poles and towers shall be installed in the foundations in accordance with approved shop drawings and anchor bolt setting templates. The tops of foundations shall be finished smooth and even with surrounding surfaces.

Anchor bolt settings for light poles shall provide that light poles predominantly illuminating a mainline roadway shall be positioned with the arm of the pole perpendicular to the roadway.

After forms have been removed, excavated spaces around the foundations shall be backfilled with suitable material placed and tamped in thin layers as directed by the Engineer.

**625.07 Luminaires**. Light pole luminaires shall be adjusted vertically and horizontally to provide the required mounting height and the specified alignment with the roadway. At pole locations where the profile grade exceeds 4 percent, the luminaires shall be oriented so that the vertical axis of the luminaire shall be perpendicular to the longitudinal centerline of the roadway at that location. Tower luminaires shall be leveled by means of the adjustment device provided.

Floodlighting luminaires shall be aimed at night as directed by the Engineer. The Contractor shall submit aiming diagram for approval prior to aiming.

After all other work has been completed and just prior to leaving job, refractors and reflectors shall be cleaned so as to provide the maximum lumen output possible.

Lamps shall be compatible with ballasting characteristics of the specific luminaires.

Luminaires mounted on non-metallic poles shall be grounded as provided for in 625.09 or 625.19.

**625.08 Glare Shields**. Glare shields shall be furnished and installed where designated. The shield shall be obtained from the manufacturer of the luminaires with which they are to be used.

**625.09 Ground Rods**. A ground rod unit shall consist of furnishing one ground rod of the specified type and size installed as shown on the plans. Each ground rod shall be tested as specified in 625.21. If the earth resistance measurement exceeds 25 ohms for conventional light pole ground rods or 10 ohms for tower ground rods, a second ground rod shall be installed as shown on the plans. The two rods shall be temporarily connected together with ground cable and the earth resistance measured. If the earth resistance still exceeds the above values, a 10 foot rod shall be exothermically welded to the top of the second rod to constitute a continuous 20 foot long rod. After this is driven into the earth, it shall be temporarily connected to the first rod and the earth resistance measured. If the earth resistance still exceeds the acceptable value, this procedure of lengthening and driving the second rod shall continue until either an acceptable value of earth resistance is obtained or the extended rod cannot be driven further. The rods shall be permanently interconnected with a ground cable.

If the measured earth resistance still exceeds the required value after the last rod is driven and interconnected, the Engineer shall be contacted for his final determination and further instructions.

Where rock is encountered and acceptable earth grounds cannot be accomplished by driving as described above, a grounding grid utilizing direct buried messenger cable or rods exothermically welded end to end shall be used to bond light poles and structures in continuous series to some point on a type of terrain that will permit obtaining an acceptable earth ground. Payment for this change shall be made as specified in 104.02.

Connections between rods and cable shall be made by exothermic welds with two coats of insulating varnish applied over welds and exposed cable.

**625.10 Pull Boxes**. The types and sizes of pull boxes and covers furnished shall be as specified, and they shall be located where designated on the plans. Excavation shall be performed as nearly as practicable to the outside dimensions of the pull box. After boxes are set to proper grades, excavated spaces around the boxes shall be backfilled with suitable material placed and thoroughly tamped in thin layers.

**625.11 Trench**. Trenches shall have a minimum depth of 2 feet and shall not exceed 12 inches in width without prior approval of the Engineer. Trenches located adjacent to and parallel with curbs or pavements shall not deviate more than 6 inches from the lines designated, without the approval of the Engineer.

Sawcut lines in paved areas shall follow existing joints or grooves where possible, and shall be premarked and be approved by the Engineer before sawing.

Trench backfill shall be placed in layers not to exceed 4 inches uncompacted depth and compacted with mechanical tampers or other approved methods as directed.

Backfill material for trenches in areas of pavement, paved shoulders, or stabilized aggregate shoulders shall consist of granular material. Backfill material for trenches in other areas shall consist of suitable soil or granular material, except that the backfill material around and in the first 4 inches above the top of duct cable or PVC conduit not encased in concrete shall not contain pieces larger than 1/2 inch.

Direct burial cable shall be surrounded by a minimum of 6 inches of sand material conforming to 703.06. All trench for direct burial cables shall be identified with a warning tape, approved by the Engineer, placed 6 inches below final grade centered over cable.

**625.12** Conduit. Conduit of the type and size shown on the plans shall be installed at locations designated by the plans or as directed. Where the size is not specified, the Contractor shall submit to the Engineer for approval, plans showing the size and location of each conduit and the number and size of wires contained in each. Such

conduit shall comply with the National Electrical Code insofar as conduit fill is concerned.

Where underground conduits are to be encased in concrete, the concrete encasement shall be Class C and shall have a minimum thickness of 3 inches. Spacers shall be used to insure proper encasement of conduit. Conduit shall be anchored to prevent floating during concrete placement.

Bends in conduit shall be used only when absolutely necessary. The total bending between adjacent junction boxes and/or pull boxes shall not exceed 180 degrees, and the total bending between adjacent light poles shall not exceed 270 degrees. The radius of any field bend shall be not less than 12 times the internal diameter of the conduit. Bends in conduit shall be so made that the protective covering will not be injured and the internal diameter at the bend will not be reduced.

All rigid ferrous metal conduit, and fittings and appurtenances thereto, shall be galvanized inside and outside. They shall be of such size that the wires can be easily drawn into the conduit without excessive pull. All cut ends of metallic conduit shall be reamed to remove rough edges. All conduit threads shall be painted with an electrical conductive paint in such a manner that there will be no unprotected surfaces, and the joint will be watertight and will electrically bond the joined sections of conduit. A conduit on a structure shall be securely fastened or built into the structure, and properly drained using a T coupling at the low point of each concrete encased run, unless the conduit is sloped to drain into junction boxes. In the latter case, junction boxes shall be provided with drains. Expansion fittings shall be provided at all expansion joints on structures, and they shall be provided with suitable copper jumpers to assure electrical continuity of the grounding system.

All metallic conduit shall have electrical continuity and be adequately grounded. The ends shall be fitted with approved bushings and all boxes, fittings, expansion joints and other appurtenances to the conduit shall be so designed and connected that adequate electrical continuity from one conduit to another will be secured. Where boxes or fittings are not used, suitable means shall be provided to accomplish adequate electrical continuity between the several parts.

Where conduit enters a junction box through a slip hole, locknuts shall be provided to fasten the conduit to the junction box.

All PVC conduit and fittings shall be joined by means of an approved solvent welding cement to provide a watertight joint. All PVC conduit shall be terminated with end bells.

After installation, all conduit which will not have circuit wire or cable pulled into it during construction shall have an adequately secured 1/4" jet line twisted polypropylene 1100 pound tensile strength pull rope installed in it, and the ends shall be closed with capped bushings or otherwise sealed in an approved manner to completely keep all moisture and foreign matter out of the conduit. Terminal points

of all conduits containing wire or cable shall be completely sealed in an approved manner with a removable sealing compound or a molded plastic or rubber device which is compatible with the cable jacket, the insulation and the conduit material. Equivalent temporary sealing approved by the Engineer shall be provided immediately after placement of conduit where conductors or cable are not installed promptly in the conduit.

Conduit to be placed under pavements, sidewalks or paved shoulders may be installed by horizontal drilling or jacking methods subject to the approval of the Engineer. Such conduit shall be on the same grade and line, as nearly as possible, as the rest of the conduit system to avoid excessive bends. If the drilling method is used, the bore diameter shall not exceed the outside diameter of the conduit by more than 5 percent.

The Contractor shall check each conduit run by rodding or by pulling a mandrel through the conduit run. Any obstructions which may develop in the conduit shall be removed.

**625.13** Cable. Copper wire cables of the types and sizes required shall be installed as designated or as ordered.

Cable installed in light poles shall be supported by cable grips attached to J hooks at the tops of the poles or other methods approved by the Engineer.

All cables, except structure grounding system cables and pole and bracket cable, entering an accessible enclosure such as a pull box, handhole, transformer base, device housing, etc., for the purpose of being terminated or connected to another cable shall be identified in such enclosure with tags or bands as described in 713.18. No splices will be permitted between terminations. Exothermically welded joints in structure grounding systems are not considered as splices.

**625.14** Unit Type Duct-Cable Systems. Duct-cable shall not be installed when the temperature of the duct is below  $45^{\circ}$ F.

Prior to installation, the duct-cable shall be "paid-out" from its reel as the reel is moved alongside and parallel to the trench. Duct-cable shall not be pulled off a reel located in a stationary position. It shall be provided in sufficient length to be installed without splices between terminations in pull boxes, handholes, junction boxes, etc. Allowances shall also be made for extensions into pull boxes for splicing, and for extension of the conductors through the handholes in light poles.

Duct-cable shall be installed as straight as possible to facilitate cable replacement.

After backfilling over an entrenched section of duct-cable, the Contractor shall, in the presence of the Engineer, demonstrate that the conductors move freely within the duct by pulling the conductor out a minimum length of 2 feet unless the duct cable

length is greater than 2,650 feet or if the run includes more than two 90 degree bends.

All conductors or cables shall be identified as specified in 713.18.

**625.15 Concrete poles**. These specifications apply to the manufacture of multi-sided concrete lighting standards to be used for the support of lighting units.

(a) Aggregate shall be graded uniformly from 3/8 inches to #100 sieve with no more than 5% passing through the #100 sieve. Aggregates shall not contain more than 5% unsound particles such as chert, mud balls, etc.

(b) Cement shall be high early strength and shall conform to current American Society for Testing Materials specification C-150.

(c) The water shall be free from acids, alkalies, oil or vegetable matter, and cement shall be the proportion required to produce a concrete with a minimum compressive strength of 3,500 psi in 24 hours under steam curing as specified, before prestressing is released.

(d) Prestressing steel reinforcing shall have a minimum ultimate tensile strength of 240,000 psi and shall be prestressed in accordance with the provisions set forth in the "Recommended Practice for Prestressed Concrete," ACI-ASCE joint report. The steel shall conform to ASTM A-416-59T or A-421-59T requirements. The design of the steel shall be such as to offer sufficient steel area to meet load requirements for the particular type of standard specified. The steel shall be maintained in a rigid position to provide a minimum cover of at least 1/2 inch at all times. Where 1/2 inch minimum cover cannot be maintained next to cable entrance, handhole, wire outlet, etc., the reinforcing shall be protected with a non-corrosive sleeve.

(e) All standards furnished shall be cast in metal molds true to design. Time of mixing shall not be less than three minutes. Concrete shall be placed in one continuous operation. When filled, the mold shall be rotated at high speed to insure a dense concrete by centrifugal force, and produce a cable raceway throughout the length of the standard not less than 1-3/4 inches in diameter.

(f) Following the centrifugal operation, the concrete shall be cured with low temperature water saturated steam. The curing temperature should not exceed  $160^{\circ}$ F.

(g) The finish shall be as specified in the plans.

(h) The metal brackets shall consist of standard black steel pipe ASTM A-120-57T, Schedule 40, welded to fabricated steel clamps of the design and dimensions shown on the Engineer's drawing. After welding, the spatter and flux shall be removed and the entire bracket galvanized in accordance with ASTM A-123-53. All nuts and bolts shall be stainless steel or silicon bronze.

(i) All poles shall be furnished with a removable metal cap which will protect the required open cable raceway at the top from the weather. All poles shall be furnished with nonferrous inserts for securing accessories such as ornamental pole cap, ballast adapter cap, bracket brace, handhole door, etc. All metal accessories furnished on or with concrete poles shall be aluminum or hot dipped galvanized steel and/or cast iron.

(j) Tests. The Engineer may require the approval of poles to be based on complete testing, including destructive testing at the factory prior to delivery. Destructive tests shall be supervised by a representative of the Engineer and shall be performed on poles selected at random. Approval of subsequently produced poles will generally be based on the Engineer's evaluation of mill tests and factory certified test results on the materials and fabricated components.

**625.16 Connections**. Cable connections in the handholes or transformer bases of all light poles, and above pavement elevation, shall be accomplished by the use of approved factory preassembled cable connector kits and, in addition, the kit used in the hot leg shall be of a fused type. Where used in pole handholes or transformer bases, the kits shall be of a quick disconnect type. When Type II or Type III cable connection kits are specified, Type IX kits may be substituted.

(a) Cable connections in pull boxes, median mounted junction boxes, other junction boxes, and all enclosures below ground line shall be accomplished by the use of a permanent water resistant cable splicing kit. Each kit shall provide a splice in compliance with ANSI C 119.1 when applied in accordance with manufacturer's instructions.

(b) Connector kits used in cable connections installed at the last light pole or pull box on a circuit shall have the vacant wire opening plugged in accordance with the manufacturer's recommendations.

Until cable connections have been completed, all cable connector kits and exposed cable ends shall be adequately protected by enclosing in plastic bags, taping or other approved means.

**625.17** Service Pole. Where and as specified, the Contractor shall furnish and install a wood pole with all necessary equipment, devices and materials to provide a complete electrical service for the facilities.

All service equipment housing, conduit and grounded neutral service wires shall be grounded in accordance with 625.09. Ground cable shall be installed and protected on the pole with wood or plastic ground wire molding.

Where a grounded primary neutral is brought to the service pole, it may be grounded to the secondary ground rod. Primary lighting arresters shall be grounded on a

separate ground rod located a minimum of one foot from the base of the pole and all other ground rods.

A coating of an approved creosote base paint shall be liberally applied to all holes field bored in treated poles.

The Contractor shall make all arrangements with the supplying agency for connections to establish electrical service at the service pole.

**625.18 Control Center**. Where and as specified, the Contractor shall furnish and install all equipment, including equipment enclosures and the necessary wiring and wiring devices to provide a completely functional control center for the required electrical system.

If more than one enclosure is required, there shall be one enclosure designated to house the disconnecting device assembly controlling the in-coming supply circuit and such other equipment as specified. It shall be located at the base of the support upon which it is mounted and be stenciled "MAIN SWITCH" on the outside of the enclosure door in black weather-resistant paint, or other approved method.

All other disconnecting devices within the Control Center shall be connected to the load side of the main switch.

Each additional enclosure shall be identified as shown on plans, such as "PANEL A," "TRANSFORMER," or "CONTRACTOR", etc., by having the appropriate designation stenciled on the outside of the enclosure door or cover in black, weather-resistant paint, or other approved method.

All enclosures shall be grounded to a common ground. This common ground shall be a part of the service pole ground. Grounding connections for secondary lighting arresters shall be made to the secondary neutral.

At the time of installation, the "window" of the sensing device in the photo-electric cell shall be faced due north if no marking is provided to indicate aiming the device.

**625.19 Structure Grounds**. A complete grounding system shall be provided for each bridge, wall, or other structure having electrical elements contained therein or attached thereto.

The furnishing of all materials necessary to provide the entire structure grounding system including ground rods, complete in place, shall be included in this item.

In order to provide continuity in the grounding of conduit at light poles on bridge structures, ground cable shall be installed between grounding lugs of each grounding bushing and the ground lug or bolt in the pole base. Where the plans require the use of a raceway employing a junction box, the cable shall be connected between three grounding bushings through 1-1/2 inch conduit to the pole ground connection.

In order to minimize potential differences between units of a bridge structure, each unit shall be electrically tied to each adjacent unit both longitudinally and transversely, with grounding cable connecting the outside girders or beams together as shown on the plans. Transverse electrical ties need not be made when the lateral separation between sections of parallel bridges is 6 feet or greater.

Two coats of insulating varnish shall be applied over all exothermic welds and exposed cable.

**625.20 Junction Boxes**. Junction boxes of the sizes and types specified shall be furnished and installed as required. All junction boxes embedded in concrete structures shall be provided with drains.

**625.21 Electrical Tests**. The Contractor shall be responsible for furnishing all personnel and equipment required to successfully perform the following tests, and shall furnish six certified copies of complete test records to the Engineer on test reporting forms supplied to the Contractor by the Engineer or alternate certification approved by the Engineer.

Prior to the commencement of each required electrical test, the Contractor shall submit to the Engineer the types, styles, or catalog numbers of all testing equipment to be used for such tests. At the same time, the Contractor shall include a written certification that the testing equipment was last calibrated by a testing agency, whose qualifications as such are acceptable to the Engineer, not more than 90 days prior to the date when such tests are performed.

(a) Ground Test. Each ground rod, structure ground, and ground grid shall be measured for earth resistance immediately after being installed and before the ground wire is attached to pole or structure. If the earth resistance measurement exceeds 10 ohms for tower lighting ground rods or 25 ohms for all other ground rods, the Contractor shall proceed as specified in 625.09. Units of measurement for reporting shall be expressed in ohms.

(b) Cable Continuity Test. Prior to the performance of any cable insulation tests, high voltage tests or performance tests on primary feeder cable, secondary feeder cable, distribution cable or other special circuits, a continuity test shall be performed with a volt-ohmmeter or other approved instrument. Continuity tests shall be conducted with electrical loads, power sources and grounds, including earth grounds, disconnected.

Each conductor shall also be measured against every other conductor and ground, including earth ground, to assure that no short circuits, cross circuits or other improper connections exist. No voltage shall exist between any conductor and another conductor, including ground. One at a time, each circuit branch shall then be temporarily shorted at its termination and measured for continuity to assure that

no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist and that each circuit is properly identified.

(c) Cable Insulation Test. The insulation resistance shall be measured for each insulated cable, except pole and bracket cable, located in each primary feeder, secondary feeder, and distribution circuit, including duct cable used in distribution circuits. The test shall be performed on each cable of each circuit with all ballasts disconnected and all connections to earth grounds, including ground rods and grounding connections to light poles, disconnected. Units of measurements for reporting shall be expressed in megohms. The cable insulation resistance shall exceed 10 megohms. The above testing requirements are waived for those circuits on which a high voltage direct current test is to be performed.

(d) High Voltage Direct Current Test. The high voltage direct current test shall be performed separately on each circuit as follows:

a. The main disconnect device shall be locked in the open position. Pole and bracket cables shall be disconnected at each light pole. Sign lights, underpass lights, and other devices normally fed by the circuit shall be disconnected.

b. The test shall be performed on each insulated conductor of the circuit and the results recorded and plotted as directed by the Engineer.

c.Conductors shall be tested in the following sequence: (1) on the neutral conductor before it is grounded, and (2) on the power conductors with the neutral and other conductors permanently or temporarily grounded.

d. With voltage at zero, attach high-voltage lead to the circuit conductor to be tested and the low-voltage lead to ground. Ground the companion conductors of the circuit and proceed as follows: (1) Select a voltage scale that will permit continuous measurements without changing scales. (2) Slowly increase the voltage from 0 to 1500 volts and hold for one minute, then to 3000 volts, then to 4500 volts and finally to 6000 volts, reading the current at each step. Record leakage current values and plot a "Leakage vs Step Voltage Curve" on a form similar to that shown in Figure 1. (3) Maintain the voltage at 6000 volts for five minutes, taking a current reading at the end of each minute. Record leakage current values and plot a "Leakage vs Time Curve" as an extension of the "Leakage vs Step Voltage Curve." (4) Return voltage to zero and ground the tested conductor to remove any capacitive changes.

e. Determine and record temperature of the air and relative humidity at the time of testing.

f.Faulted conductors shall be replaced and the circuit retested until satisfactory test results are obtained.

g. The test results shall be considered as satisfactory if both of the following conditions are met: (1) The maximum required value of 6000 volts can be obtained

as provided in d(2) above. 2) There is no significant increase in the leakage current values during the 5 minute period described in d(3) above.

h. Six certified copies of all test records shall be furnished to the Engineer.

(e) Performance Test. Prior to acceptance, and after all other tests are performed, the Contractor shall operate the lighting system, including automatic control equipment and other specified apparatus, from sunset to sunrise for 7 consecutive days without interruption or failure. If a lamp or ballast should fail, it shall be immediately replaced.

This shall not require a restart of the test. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the 7 day test. The Engineer shall be notified at least 3 days prior to the commencement of this performance test.

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FIGURE I

The Contractor shall arrange with the supplying agency to purchase electric power necessary to conduct the performance test. Portable generating plants will not be considered a suitable source of power for the performance test.

(f) Tower Lowering Device. Prior to acceptance, the Contractor shall demonstrate to the Engineer the workability of the tower lowering devices by lowering and raising the luminaire assembly on each tower on two separate occasions during the 7 day performance test. The Contractor shall record the cause of, and the method and date of correction for each malfunction.

(g) All costs of labor, materials, equipment, electrical energy and incidentals required for performing the above electrical tests shall be included in the contract unit prices for the respective items tested.

**625.22** Light Pole Identification. Each light pole and light tower shall be identified by a number which will indicate both the circuit number and the pole number. Identifying numbers shall be as indicated on the circuit drawings, in the plans or as specified by the maintaining agency. Identification shall be located approximately 7 feet above the ground line, on the quadrant of the surface of the pole that faces oncoming traffic and shall be applied when the ambient temperature is above 40°F. Payment for furnishing and placing light pole identification shall be included in the unit price bid for light poles and light towers.

**625.23** Method of Measurement. When the contract stipulates that payment will be made for various elements of an electrical installation on a linear foot, lump sum or each basis, measurement will be made as follows:

(a) Trench. The number of linear feet of trench completed will be measured from center to center of foundations, pull boxes, etc., and shall include all excavation, sawing and removal of pavement, granular and other backfill material, compaction, disposal of surplus materials and restoration of disturbed facilities and surfaces. Trench in walks or pavements 6 inches or less thick will be measured as Type A, and in pavements greater than 6 inches will be measured as Type B.

(b) Conduit. The number of linear feet of conduit furnished and installed will be measured from center to center of pull boxes, foundations, etc., and shall include all fittings and appurtenances, joints, bends, grounds, and concrete encasement where specified.

(c) Primary Feeder Cable. The number of linear feet of primary feeder cable furnished and installed will be measured as the sum of the distances from the top of the primary cable pot head to the primary terminals on the pad-mounted transformer plus ten feet per pull box, manhole, etc., to allow for slack and splicing leads, multiplied by one of the following, as applicable:

(1) By one for single conductor cable with a concentric neutral.

(2) By two for a feeder composed of one primary cable and one neutral cable.

(d) Secondary Feeder Cable. The number of linear feet of three-wire secondary feeder cable furnished and installed will be measured as three times the distance

between the service pole and the load center being supplied plus 30 feet to allow for slack and leads.

(e) Distribution Cable. The number of linear feet of distribution cable furnished and installed will be measured as the sum of the distances from center to center of foundations, pull boxes, etc., plus 10 feet per each spacing to allow for slack and splicing leads multiplied by one of the following, as applicable:

(1) By two for two wire distribution circuits.

(2) By three for three wire distribution circuits.

(f) Pole and Bracket Cable. The number of linear feet of pole and bracket cable furnished and installed will be measured as twice the light pole mounting height plus twice the designated arm length or lengths.

(g) Duct-cable. The number of linear feet of duct-cable furnished and installed will be measured from center to center of pull boxes, foundations, etc., plus 10 feet per each spacing to allow for slack and splicing leads.

(h) Ground Rods. The number of ground rods furnished and installed will be the actual number of each 10 foot section of rod, complete in place, and shall include grounding cable and all specified tubing, fittings and connections.

(i) The number of light poles, light towers, light tower foundation pads, portable power units, luminaires, glare shields, pull boxes, connector kits, and structure grounding systems furnished and installed will be the actual number of each, complete in place.

(j) Service Pole and Control Center. The service pole and the control center will be measured as a lump sum for each of the installations specified and shall include all materials, equipment, and incidentals, complete in place.

(k) Junction Boxes. The number of junction boxes furnished and installed will be the actual number of each, complete in place.

(1) Foundations. The accepted number of light pole foundations and light tower foundations furnished and installed will be the actual number of each, complete and in place, and shall include reinforcing steel, anchor bolts, and all incidentals as specified in the plans.

When the contract stipulates that payment will be made for specific complete electrical equipment installation on a lump sum basis, the pay item stipulated will include all electrical materials, equipment and incidentals, including specified tests required at the locations and within the limits specified on the plans, complete in place. **625.24 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
625	Each	Light pole,
625	Each	Light pole foundation,
625	Each	Light tower
625	Each	Light tower foundation
625	Each	Light tower foundation pad
625	Lump Sum	Service pole
625	Each	Luminaire,
625	Each	Glare shield
625	Each	Ground rod
625	Each	Pull box,
625	Linear Foot	Trench
625	Linear Foot	Trench in paved areas, Type
625	Linear Foot	Conduit
625	Linear Foot	Conduit, jacked under pavement
625	Linear Foot	No AWG,volt primary feeder cable
625	Linear Foot	No AWG,volt secondary feeder cable
625	Linear Foot	No AWG, volt distribution cable
625	Linear Foot	No AWG, pole and bracket cable
625	Linear Foot	inch Duct-cable withNoAWG,volt cables
625	Each	Connector kit, Type
625	Each	Cable splicing kit
625	Lump Sum	Control center
625	Each	Structure grounding system
625	Each	Junction box
625	Each	Portable power unit

# **ITEM 626 GEOTEXTILE FABRIC**

- 626.01 Description
- 626.02 Construction Method
- 626.03 Materials
- 626.04 Method of Measurement
- 626.05 Basis of Payment

**626.01 Description.** This item shall consist of furnishing and installing geotextile fabric as designated on the construction plans and as directed by the Engineer.

**626.02** Construction Method. When specified, place the geotextile fabric at the bottom of the cut or at locations designated in the construction plans and as directed by the Engineer.

Place the geotextile fabric smooth and free of tension or wrinkles.

Fold or cut the geotextile fabric to conform to curves.

Overlap a minimum of 18 inches at the ends and sides.

Hold the fabric in place with pins or staples.

Place the suitable material on the fabric and do not operate the equipment directly on the fabric.

Unless stated otherwise, spread the suitable material and maintain a minimum lift thickness of 12 inches.

**626.03** Materials. All geotextile fabric shall meet the requirements of 712.09.

**626.04** Method of Measurement. This provision shall include measurement of the actual square yards of surface area covered with geotextile fabric and approved. Overlapped areas shall be measured only once. Final quantities will be determined from the Engineer's final measurement.

**626.05 Basis of Payment.** All costs to perform the above stated work including all materials, equipment, tools, labor, and all incidental and associated costs shall be paid for under:

Item	Unit	<b>Description</b>
626	S.Y.	Geotextile fabric, Type

# **ITEM 629 STREET NAME SIGNS**

629.01	Description
629.02	<b>Construction Method</b>
629.03	Materials
629.04	Method of Measurement
629.05	<b>Basis of Payment</b>

**629.01 Description**. This item shall consist of the removal, storage, disposal, resetting, or replacement of existing ground-mounted street name sign assemblies. It shall also consist of the installation of new ground-mounted and overhead mast-arm-

mounted street name sign assemblies. Replacement may consist of replacing the entire street name sign assembly or any part(s) making up the assembly.

A ground-mounted street name sign assembly shall consist of one (1) or two (2) street name signs, pole, foundation, mounting hardware, and all equipment, labor, and associated costs required to provide the assembly complete, in place, and accepted by the Engineer. No other signs shall be attached to the street name sign pole or assembly.

An overhead mast-arm-mounted street name sign assembly shall consist of one (1) street name sign, mounting hardware, and all equipment, labor, and associated costs required to provide the assembly complete, in place, and accepted by the Engineer.

**629.02** Construction Method. All existing ground-mounted street name sign assemblies to be salvaged or reset shall be carefully removed from the construction site prior to beginning any construction activities. Street name signs mounted on utility poles may remain in place during the construction activities unless otherwise directed to be removed and or replaced by the plan sheet set or Engineer.

The Contractor shall fully dismantle the street name sign assembly and store and protect the same until time to reset, unless designated for replacement, in which event, the existing street name sign assembly shall be properly disposed.

The Contractor shall remove the existing concrete foundation from the existing street name sign pole without damaging the pole.

If the City chooses to salvage a particular street name sign assembly or any part of that assembly, the Contractor shall exercise care in removing the assembly, completely dismantle the assembly, protect the salvageable assembly or part from damage, deliver to the Traffic Engineering Division at 1420 Triplett Blvd., and properly dispose of the unsalvageable parts.

The Contractor shall not reset any existing ground-mounted street name sign assemblies, or erect any new ground-mounted street name sign assemblies until just prior to surface restoration activities or as directed by the Engineer. If the surface adjacent to a street name assembly is concrete, asphalt, brick, or another surface-type other than sodding, then the assembly may be installed prior to the surface installation. The assemblies shall be protected during the surface installation and throughout the remaining construction activities. Costs to protect the assemblies shall be considered inclusive in the cost of the assembly.

The street name sign assemblies shall be placed so that the street names are clearly visible to drivers as they approach the intersection from all directions. The preferable location of a ground-mounted street name sign assembly is at the northeast or southwest corner of the intersection and within the designated curb return area, but not outside the City right-of-way. The location of the assembly shall not hinder, obstruct, or otherwise interfere with a pedestrian's use of sidewalks or

curb ramps and shall maintain minimum pedestrian clear widths in accordance with Standard Drawing BP- 5.0.

The street name signs shall be parallel to the corresponding street they represent so that as a driver approaches the intersection, the name of the approaching intersecting street can be easily read.

Overhead mast-arm-mounted assemblies shall be rigid-mounted and positioned to not interfere with visibility or operation of the signal head.

Street name sign poles shall be embedded and centered in a concrete foundation. The foundation shall be a minimum of 42 inches deep and not less than 11 inches in diameter. The pole shall be embedded a minimum of 36 inches into the foundation with the remainder of the pole exposed above-ground. When the street name signs have been mounted on the pole, the pole shall have been of sufficient length so that the street name sign measures 9 feet from the finished ground surface to the bottom of the lowest street name sign.

# 629.03 Materials.

(a) Street Name Sign. Street name signs shall be extruded aluminum blanks at least 0.080 inch thick and shall be covered with a green-reflective sheeting with white-reflective lettering. The lettering shall be upper case and "C" style. The cardinal direction and suffix may be abbreviated.

Street name signs for ground-mounted assemblies shall be double-faced, 9 inches in height, and of variable length. The street name lettering shall be 6 inches in height. The cardinal direction and suffix lettering shall be 3 inches in height and aligned evenly with the top edge of the street name lettering.

Street name signs for overhead mast-arm-mounted assemblies shall be 12 inches in height and of variable length, but not less than 48 inches. The lettering shall be 8 inches in height.

Reflective sheeting shall conform to ASTM Type III.

(b) Street Name Sign Pole. Street name sign poles shall be fabricated of 2-3/8 inch O.D., not less than 0.019 inch wall thickness, bright aluminum equal to ASTM B 241. The pole shall be 12 feet overall length.

(c) Street Name Sign Pole Foundation. Class "C" concrete.

(d) Street Name Sign Mounting Hardware. Street name sign mounting hardware shall conform to 630.06 and incidental to whichever part(s) replacement requires the use of the new mounting hardware.

**629.04 Method of Measurement**. The quantity to be paid for shall be the number of ground-mounted street name sign assemblies reset, replaced, and new assemblies installed. Quantities shall be paid for the number of replacement street name signs and poles. Final quantities will be determined from the Engineer's final measurement.

When Item 629 - Street Name Sign Assembly is bid as a separate item it shall consist of installing a new ground-mounted street name sign assembly or entirely replacing an existing ground-mounted street name sign assembly and shall include one (1) or two (2) street name signs, pole, foundation, mounting hardware, and all equipment, labor, and associated costs required to provide and assemble a new ground-mounted street name sign assembly complete, in place, and accepted by the Engineer. If this item consists of entirely replacing an existing street name sign assembly, then it shall further include the removal, salvaging, and disposal of the existing assembly.

When Item 629 - Street Name Sign Assembly on Mast Arm is bid as a separate item it shall consist of installing a new overhead mast-arm-mounted street name sign assembly and shall include one (1) street name sign, mounting hardware, and all equipment, labor, and associated costs required to provide and assemble a new overhead mast-arm-mounted street name sign assembly complete, in place, and accepted by the Engineer.

When Item 629 - Street Name Sign Assembly Reset is bid as a separate item it shall consist of resetting an existing ground-mounted street name sign assembly including any replacement part(s) designated by the plan sheet set or directed by the Engineer and shall consist of one (1) or two (2) street name signs, pole, foundation, mounting hardware and include all equipment, labor, and associated costs required to remove, dismantle, protect, store, reassemble, and reset an existing ground-mounted street name sign assembly complete, in place, and accepted by the Engineer.

When Item 629 - Street Name Sign is bid as a separate item it shall consist of replacing one (1) existing street name sign with a new street name sign on an existing assembly to be reset. It shall include all equipment, labor, and associated costs required to provide the street name sign for the existing assembly, but does not include the cost to remove, dismantle, protect, store, reassemble, or reset the existing assembly.

When Item 629 - Street Name Sign Pole is bid as a separate item it shall consist of replacing an existing street name sign pole with a new pole in an existing assembly to be reset. It shall include all equipment, labor, and associated costs required to provide the street name sign pole for the existing assembly, but does not include the cost to remove, dismantle, protect, store, reassemble, or reset the existing assembly.

**629.05 Basis of Payment**. Payment for accepted quantities shall be made at the contract price for:

Item	<u>Unit</u>	Description
629	Each	Street Name Sign
629	Each	Street Name Sign Pole
629	Each	Street Name Sign Assembly
629	Each	Street Name Sign Assembly on Mast Arm
629	Each	Street Name Sign Assembly Reset

# **ITEM 630 TRAFFIC SIGNS AND SIGN SUPPORTS**

- 630.01 Description
- 630.02 Materials
- 630.03 Working Drawings
- 630.04 Sign Fabrication
- 630.05 Foundations
- 630.06 Sign Supports
- 630.07 Sign Erection
- 630.08 Sign Storage
- 630.09 Signs Refurbished
- 630.10 Covering of Signs
- 630.11 Barrier Wall Assembly for Sign Supports
- 630.12 Removal, Storage or Re-erection of Signs and Supports
- 630.13 Traffic Signs, Each
- 630.14 Inspection
- 630.15 Method of Measurement
- 630.16 Basis of Payment

**630.01 Description**. This work shall consist of furnishing and installing reflectorized traffic signs, sign supports and foundations complete and ready for service, in conformance with the types, colors, locations, dimensions, and grades shown in the plans or as ordered by the Engineer. This work shall also include necessary excavation and backfill, and disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with 551.10

**630.02** Materials. All materials and equipment furnished shall be new, of first quality and free from defects.

Acceptance of material and products will be based on Certified Test Data, furnished in triplicate, or on test results of samples in accordance with 106.02, as required by the Laboratory.

Materials shall be:

Steel	•
Sicci	•

Structural steel	
Reinforcing steel	
Drive posts	
Tube and pipe	
Anchor bolts	
Bolts and nuts (high strength)	
Poles and arms	
Anchor bases	
Handhole covers	
Pole caps	
Arm caps	
Hardware	
Stainless steel	
Stainless steel hardware	
Messenger wire	

#### Other Materials:

Sheet and plate	730.11
Extrusions	
Tube and pipe	730.13
Castings	730.14
Forgings	730.15
Welding rods	730.16
Hardware	
Reflective sheeting, Type F	
Reflective sheeting, Type G	
Nonreflective sheeting	
Reflector units	
Silk screen paste	
Clear coating	
Plywood	
Decals	

**630.03** Working Drawings. The Contractor shall submit to the Engineer for review and approval, four sets of drawings, catalog cuts, specifications, etc., of apparatus and equipment proposed to be furnished. The material shall show clearly the design, quality, dimensions, and other such information as may be necessary for a proper evaluation of the items submitted. Submitted documents shall identify the specific project with the bid item reference number to which the material applies. If more than one catalog number or type is listed on a sheet, the item intended to be finished shall be identified by an appropriate mark.

The Contractor shall not install any material until written approval is received from the Engineer. After approval, working drawings shall be considered as supplemental to, but not a substitute for, the original plans. Approval of working drawings shall not relieve the Contractor of responsibility for omissions and erroneous or inconsistent dimensions, notations or other errors.
Sign support working drawings submitted shall cover all design types such as ground mounted, rigid overhead, span wire mounted, and overpass structure mounted supports. The drawings shall show overall height, sign clearance above foundation, span length, sign locations, sign overall heights and widths, and glare shield height and location if applicable.

Extrusheet sign working drawings submitted shall show overall dimensions including glare shield, panel type and length, overlay sign dimensions and location on the covered sign, lighting support arm notch arrangement in the glare shield if applicable, and the type and quantity of assembly and mounting hardware.

Sign legend working drawings submitted shall show all guide sign legends with copy type, character size and spacing, and reference and/or code numbers. The color of guide sign background and legend shall be indicated. Sign layout shall conform to standards maintained by the City and the Ohio Department of Transportation. Drawings of standard warning, regulatory, or route marker signs need not be submitted unless required by the Engineer.

The following code for sign materials, colors, and processes shall be adhered to on submitted sign legend working drawings. When special colors are required they shall be so indicated.

<u>Codes</u>	Description and Color
RSW	Reflective sheeting silver white
RWS-G	Reflective sheeting silver white (Type G)
RSTR	Reflective sheeting silver white, with reverse screen transparent red overlay
RSTB	Reflective sheeting silver white, with reverse screen transparent blue overlay
RSTG	Reflective sheeting silver white, with reverse screen transparent green overlay
RSTRB	Reflective sheeting silver white, with reverse screen transparent red and blue overlay
RSY	Reflective sheeting yellow
RSB	Reflective sheeting blue
RSG	Reflective sheeting green
RSBR	Reflective sheeting brown
RSO	Reflective sheeting orange
RSO-G	Reflective sheeting orange (Type G)
NRSW	Nonreflective sheeting white
NRSY	Nonreflective sheeting yellow
NRSG	Nonreflective sheeting green
NRSBK	Nonreflective sheeting black
SPBK	Silk screen paste, black
DAW	Direct applied copy, reflective sheeting silver white

- DAB Direct applied copy, nonreflective sheeting black
- DCW Demountable embossed copy, white with reflectors
- DCBK Demountable embossed copy, black
- DCFW Demountable flat copy, reflective sheeting silver white
- DCFBK Demountable flat copy, black

**630.04 Sign Fabrication**. Sign types shall include flat sheet, extrusheet and overlay. Flat sheet signs shall be one piece units made of aluminum. Legend on flat sheet signs shall be silk screened by the direct or reverse screen process, unless otherwise specified. Extrusheet signs shall be made up of a number of horizontal panels assembled to form a complete sign. Overlay signs shall be of aluminum sheet to cover portions or entire surfaces of signs when specified. Legend on extrusheet or overlay signs, except for shields described hereafter, shall be demountable embossed copy, unless otherwise specified. Letter and numeral style shall be in accordance with the FHWA Standard Alphabets for Highway Signs. Sign legend shall be in accordance with the Ohio Manual of Uniform Traffic Control Devices for Streets and Highways.

1. Sheet or Panel Fabrication.

(a) Flat sheet signs of aluminum material shall be cut complete from sheets into blanks of the thickness, size and shape specified. Bolt holes shall be drilled or punched to finish size.

Plywood flat sheet signs shall be sawed to the size and shape with mounting holes drilled. Edges and holes shall be sound, smooth and free of tears. All woodworking shall be completed before application of sheeting.

(b) Extrusheet signs consist of horizontal panels assembled to form a sign. Panels shall be continuous for the sign length.

Horizontal panels shall be fabricated of aluminum sheet and extrusions, joined by spot welding and shall be assembled by bolting or interlocking of extrusions to form tight joints. Bolted panels shall have extrusions which can be assembled by bolts through channel webs. Interlocking panels shall have extrusions which can be assembled by deformation within the elastic limit of alternate male and female shapes. Panels shall be joined or separated without damage to the joint and without the use of special tools. Interlocked panels shall be assembled with a male extrusion shape at the top of the sign. There shall be no appreciable deviation from flatness on the face of an assembled sign.

(c) Overlay signs shall consist of 0.063 inch aluminum sheeting. Overlay signs may be shop attached to cover the legend of signs or may be separate units for installation in the field. Overlay signs shall be furnished in sections no larger than 5 by 4 feet. The method of attachment shall be by blind rivets at maximum spacings of 12 inches on peripheries and 24 inches within the interior of sign or sign sections. Rivets shall be positioned so as not to disturb copy on the underlying sign.

(d) Double-faced signs shall be aluminum at least 0.080 inch thick. Double-faced signs shall be covered with reflectorized sheeting on both sides and shall be furnished with necessary mounting hardware.

2. Surface Preparation.

(a) Aluminum sign surfaces shall be thoroughly cleaned and then etched by an acid solution before painting or application of sheeting. The cleaning process shall be by total immersion in a tank containing an alkaline solution of the manufacturer's specification, followed by a thorough rinsing with running water, or steam cleaning with an alkaline solution of the manufacturer's specification, followed by a thorough rinsing with running water. The cleaning shall be followed by a surface etching. The surface shall then be thoroughly dried. Cleaned and etched surfaces shall not be allowed to become contaminated by contact with oil or grease.

(b) Plywood sign faces shall be cleaned of all grease, wax or dirt and wiped dry before application of reflective sheeting.

3. Background Sheeting and Application. Sheeting for reflectorized surfaces shall be Type F. After sign face preparation is completed, sheeting shall be cut, matched, and applied to the surface according to the manufacturer's recommendations. Background sheeting shall be cut oversize, and after application shall be trimmed to the exact size specified. The finished application shall have no blisters, wrinkles, tears or blemishes.

4. Legend Application. Copy for extrusheet or overlay signs shall conform to the type, size and arrangement specified and shall consist of letters, numbers, border portions and shields.

(a) Demountable Embossed Copy with Reflector Units. Copy units of this type shall be manufactured with beveled edges and a recess on the reverse side to accommodate the thickness of reflector units. Material shall be 0.040 inch thick aluminum sheet and shall be free of irregularities, burrs and other defects. Reflector openings shall be provided with spacing and diameter suitable for the copy size. Copy units shall be finished with at least two coats of white baked enamel and fitted with reflector units. Attachment shall be by aluminum blind rivets.

(b) Demountable Embossed Copy, Black. Copy units shall be similar to the foregoing except there shall be no openings for reflector units and the copy shall be finished with at least two coats of black baked enamel.

(c) Demountable Flat Copy, Reflective. Copy units of this type shall be cut from 0.063 inch aluminum sheet and shall be covered with Type F silver white reflective sheeting. Flat demountable copy, when used, shall be dimpled to provide a 1/32 inch minimum clearance from the sign face. Attachment shall be by aluminum blind rivets.

(d) Demountable Flat Copy, Black. Copy units shall be similar to the foregoing except units shall be finished with black nonreflective sheeting or with a minimum of two coats of black baked enamel.

(e) Shields. Ohio and U.S. Shields mounted on guide signs shall be covered with Type F silver white reflective sheeting with legend of silk screened black paste.

Interstate shields mounted on guide signs shall be covered with Type F silver white reflective sheeting with legend of reverse screened red and blue. Numbers and border shall be white demountable copy with reflector units.

Shields shall be mounted as separate and complete units and shall be attached by steel truss head bolts with standard washers used to provide a clearance from the sign face.

(f) Direct Applied Copy, Reflective. When specified, legend for extrusheet, overlay or flat sheet signs shall be direct applied. The legend shall be cut from Type F silver white reflective sheeting and applied by the adhesive backing.

(g) Direct Applied Copy, Black. Legend shall be applied in the same manner as reflective copy except black nonreflective sheeting shall be used.

5. Glare Shields. Illuminated extrusheet signs will incorporate a glare shield which shall be an extension of similar construction. The glare shield shall be below the sign unless otherwise indicated. 12 inch extrusheet glare shields shall be notched to accommodate luminaire support arms. Glare shields made of a rectangular tube and a 6 inch extrusheet portion do not require notching. Glare shields and tube shall be covered with nonreflective sheeting matching the color of the sign under daylight viewing conditions.

6. Sign Identification. Signs shall be identified on the reverse side by decals of Type F silver white reflective sheeting with silk-screened black numerals in accordance with Figure 630.04-1. Information shall be coded by punched-out numerals before decal application and shall include: quarter and year of sheeting purchase, sheeting manufacturer, and month and year of sign fabrication. Separate decals applied at time of erection shall be coded with the month and year of erection.

### Figure 630.04-1

Punched and Applied by Fabricator (\* indicates a typical punched- out numeral)

12*4	Quarter of Year Sheeting Purchased
01234567*9	Last digit of Year Sheeting Purchased
01*345	Sheeting Manufacturer's Number*
1234567*9101112	Month Sign is Fabricated
01234567*9	Last Digit of Year Sign is Fabricated

\*(from list furnished by City)

Punched and Applied by Contractor

12345678910*12	Month Sign is Erected
01234567*9	Last Digit of Year Sign is Erected

7. Sign Protection for Shipment and Storage. Signs shall be suitably protected and identified for shipment and storage. Extrusheet signs shall be kept rigid by backbracing or crating, and the sign face covered with protective material. The backbracing shall extend sufficiently below the sign's lower edge to keep the sign off the ground.

Extrusheet signs shall be identified by information in a detachable form on the sign back giving the project number and year, sign reference and/or code number, sign legend sketch, and station location. Signs shipped with an attached overlay sign shall also identify the underlying sign.

Extrusheet shall be shipped completely assembled except for signs over 8 feet in height, which may be shipped in two pieces for field assembly. Exit number signs may be shipped separated from the parent sign, if desired. Sign hardware shall be shipped in sturdy containers which will not rupture during handling.

**630.05** Foundations. Sign support foundations shall be located so the plane of the sign surface shall be at a right angle to the roadway lanes served. Foundations shall be located by the Contractor and staked with the proper elevation. When problems such as underground or overhead obstacles are encountered during staking, and to correct slope and subsurface difficulties and sign sight distance obstructions, foundation location and orientation may be changed with the approval of the Engineer. The Contractor shall be responsible for the correct location, elevation and orientation for all signs and supports installed on the foundations.

Excavation for foundations shall be made by an earth auger to specified dimensions in accordance with 503.04. Caution shall be exercised by the Contractor when excavating in areas of underground installations to avoid their disturbance or damage. If a cave-in should occur during excavation, the Contractor may continue excavating using casing, sleeving or other methods, with the approval of the Engineer. When subsurface obstructions are encountered, the Contractor may remove the obstruction or may replace the excavated material and relocate the foundation, with the Engineer's approval. When bedrock is encountered, that portion of the specified foundation depth within the bedrock may be reduced up to 50 percent.

Sign support foundation work shall conform to the requirements of 511. The concrete shall be placed against undisturbed soil or compacted embankment. Foundations shall be formed from the top to a nominal depth of six inches below the proposed finish grade.

Cylindrical foundations for embedded ground mounted supports shall have concrete placed with the support braced in a vertical position until the concrete has set. The foundation top surface shall be sloped to provide for drainage.

Anchor base foundations for overhead sign supports shall contain required reinforcing rods, anchor bolts and conduit ells. Forms shall be used for the upper foundation portion, and the anchor bolts and conduit ells shall be accurately held by a template until the concrete has set.

**630.06 Sign Supports**. Sign supports consist of ground mounted, rigid overhead, span wire, or overpass structure mounted types. Structural aspects of design and materials shall comply with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Fabrication shall be according to applicable sections of 513 and welding shall comply with 513.17. The approval of fabricators according to 501.04 will not apply. Steel structural members shall be hot dipped galvanized in accordance with 711.02. Steel hardware shall be galvanized according to 730.08.

Threaded fasteners shall be tightened by the "turn of the nut" method or by means of a torque wrench to obtain a tension of 100 percent (maximum) and 80 percent (minimum) of the proof load listed in the SAE Handbook for the size and grade of fastener used.

Anaerobic adhesive complying with Federal Standard MIL S 46163 Type II, Grade N shall be applied to anchor bolts and other threaded connections 1/2 inch diameter or larger, according to the manufacturer's recommendations. Anaerobic adhesive shall not be used with torque-limiting nuts.

1. Ground Mounted Supports. Ground mounted supports consist of structural sections of the material and weights required and shall be driven into the earth or embedded in concrete as specified. The support lengths appearing on the plans are approximate, and the Contractor shall be responsible for determining the exact length of required supports before fabrication. Sign supports may consist of two or more structural members of the nonbreakaway or breakaway type.

A. Post Supports. Ground mounted supports of the post type shall be made of channels of the section, material and of the weights indicated. Each post shall be marked with a line of paint 6 inches above the specified minimum driving depth. Two posts may be bolted together back to back to form a heavier post when specified.

Posts shall be driven to the specified minimum depth without bending, distortion or end mutilation. When the post cannot be driven at the specified location, the post may be moved with the approval of the Engineer at no additional cost to the City. Posts shall not be placed in drainage ditches.

### 630.06

Posts located in walk or paved areas shall be driven through a hole provided by sleeving or core drilling. After the post is in position, the hole shall be patched with asphaltic concrete or an approved bituminous material.

Groupings of flat sheet signs in multiple arrangements mounted on posts shall have sign backing assemblies.

One-way sign posts incorporate a square tubular top extension for mounting signs at right angles to other signs on the post.

Temporary sign posts are attached to drums or beam rail.

B. Beam Supports Assembled. Ground mounted supports of the beam type shall be rolled steel sections of the nonbreakaway or breakaway type, sizes, and weights specified.

Breakaway beam connections shall allow the beam under impact to separate at a slip base and bend at a hinge point under the sign. Beams shall consist of three parts: a bottom stub for concrete embedment and a two piece upper portion. The pieces of each beam shall be bolted together and the assembly bolts given a preload before delivery to the project. Assembled breakaway beams shall be carefully handled during transportation and erection. Upon erection, the final specified torquing shall be performed on all threaded fasteners.

2. Rigid Overhead Supports. Rigid overhead supports consist of single poles with cantilevered arms, or span types supported between end frames. Supports shall include brackets for attachment of disconnection switch enclosures and pipe couplings for sign wiring. Anchor bolts and conduit ells for installation in the foundation shall be furnished with the supports. Support poles and end frames, upon erection, shall be set on their foundations and plumbed using the leveling nuts, followed by secure tightening of the nuts on the anchor bolts. Concrete grouting shall not be used in the space between the foundation surface and support base.

Cover bases or individual anchor bolt covers shall be provided on support anchor bases located in sidewalks, traffic islands, curbed areas, and seeded areas, unless otherwise directed by the Engineer.

Overhead sign supports shall be furnished with sign attachment assemblies for the mounting of extrusheet signs to the support chords. Each sign attachment assembly shall consist of a mounting bracket, U-bolts, clamps, and hardware. When overhead signs are to be lighted, overhead sign supports shall be furnished with luminaire support assemblies. Each luminaire support assembly shall consist of a support arm, other necessary structural members, bracing rods when required, and miscellaneous hardware.

When specified, each overhead sign support shall be identified by a decal listing the County, Route, and Section Number (example: SUM-18-11.58). Decals shall be

applied only when the ambient temperature is above 40°F. The decal shall be located approximately 8 feet above groundline on the quadrant of the sign support facing approaching traffic. Sign supports spanning opposing directions of traffic shall be identified with two decals, each on a support member facing traffic.

Single pole supports may have cantilevered arms which are symmetrical or nonsymmetrical. Single arms or dual arms are made up of tapered or nontapered members.

Rigid span supports consist of a box truss supported by single plane truss end frames. Box trusses shall be fabricated of aluminum or steel tubular members with built-in camber, and each section shall be marked "TOP". Box trusses may be erected provided at least one sign is in place within 8 hours, or the trusses are fitted within the same period with damping devices approved by the Engineer.

Combination overhead sign supports with light pole extension shall provide for the attachment of a luminaire bracket arm.

3. Span Wire Supports. Span wire supports shall include strain poles of the anchor base type. Components for span wire sign supports shall consist of strain poles, messenger wire, sign hanger assemblies and 3 bolt clamps. Alternate span wire attachment will require span wire clamps, anchor shackles and thimbles. Poles shall be furnished with anchor bolts and conduit ells for installation in the foundation. Sign hanger assemblies shall consist of all parts necessary to attach an individual sign, and shall include span wire hangers, braces, lengths of post, and miscellaneous hardware.

The span wire sag under load shall not be greater than 5 percent or less than 4 percent of the span. Poles shall be adjusted so that under span wire tensioning within the above sag limits the poles will be in an essentially vertical position.

4. Overpass Structure Mounted Supports. Overpass structure mounted supports shall be designed for the attachment of extrusheet signs. The supports shall be a flush mounted type or a skew mounted type. The supports shall be mounted on the overpass structure so the bottom of signs shall be in a level position regardless of bridge slope.

5. Miscellaneous Attachment for Signs. Signs suspended from signal messenger wire or mast arms shall be attached by a sign hanger assembly consisting of all parts necessary to attach an individual sign. Signs mounted on poles or bridge parapets shall be attached by a support assembly.

**630.07** Sign Erection. Signs shall be erected on ground mounted or overhead supports in conformance with the schematic signing layout.

### 630.08

1. Flat Sheet Sign Erection. Typical placement of flat sheet signs shall use steel bolts of the specified grade and plating, wide washers, lockwashers and nuts. Bearing plates shall be placed between the sign and post at each bolt.

Flat sheet signs mounted on messenger wire or mast arms shall be field drilled to match holes in brackets.

2. Extrusheet Sign Erection. Typical placement of extrusheet signs on ground mounted or overhead supports shall be as specified. Sign attachment shall be by self-aligning aluminum mounting clips. Bolts for the clips shall be aluminum with rectangular head and hex stop nuts.

Exit number panels and supplemental guide signs, when required, shall be attached to guide signs by sign backing assemblies consisting of post members and clips. Large extrusheet signs which are delivered in two pieces shall be assembled with all demountable sign legend attached prior to erection.

3. Overlay Sign Erection. Overlay signs which are shipped separately and are to be erected on existing guide signs shall be attached according to the requirements of 630.04 Section 1(c). In preparation for erecting overlay signs, the Contractor shall remove existing demountable legend to be covered by the overlay.

4. Revised Demountable Copy on Existing Signs. When demountable copy on existing signs is to be changed, the designated existing copy shall be removed, the sign face cleaned, the remaining copy respaced as necessary, and new copy installed with aluminum blind rivets. Any single revised line of legend shall have all new copy and reflector units, or all reused compatible copy and reflector units.

**630.08** Sign Storage. When the plans state the signs are to be furnished by the City, and erected by the Contractor, the Contractor shall be responsible for the storage and care of the signs after transferral by the City. Adequate covering or shelter acceptable to the Engineer shall be provided. Extrusheet signs shall be stored in a vertical position with the sign top upward. Flat sheet signs with Type G sheeting shall be stored in a vertical position.

**630.09** Signs Refurbished. Sign refurbishment shall include cleaning, installation of overlay signs, repair of panels, replacement of damaged or missing copy, and use of clear coating.

**630.10** Covering of Signs. Temporary covers shall be installed and subsequently removed and disposed of when indicated by the plans or when directed by the Engineer. Covering material shall be a sturdy opaque material and the proposed method of covering and attachment shall be approved by the Engineer.

**630.11 Barrier Wall Assembly for Sign Supports**. Where an existing overhead sign support is located in a median in which concrete barrier is to be placed, a barrier wall assembly shall be provided as detailed on the plans.

**630.12 Removal, Storage or Re-erection of Signs and Supports**. Signs and sign supports indicated for removal shall be carefully dismantled and stored on the project for salvage by the City or for re-erection. To assure maintenance of adequate traffic control at all times, signs shall be removed only with the approval of the Engineer.

Sign supports shall be removed in a manner avoiding damage. Sign service to the support shall also be removed by disconnecting and removing cables at the service pullbox. Connection of remaining cables shall conform to 625.16. Support foundations shall be removed to at least three feet below subgrade or finished groundline. Backfilling, restoration of surfaces and disposal of surplus material shall be in accordance with 551.10.

Signs to be re-erected may require field drilling and the furnishing of mounting hardware. Anchor bolts and conduit ells for installation in the foundation shall be furnished when overhead supports are re-erected.

Overlay signs shall be removed so as not to damage the underlying sign. The legend of the underlying sign shall be inspected, and any loose or missing rivets shall be replaced.

**630.13 Traffic Signs, Each.** When ITEM 630 – TRAFFIC SIGNS is used, this item shall include removal, storage, disposal of existing signs with their supports and replacement or installation of new signs or resetting of the existing sign, which shall include mounting hardware, ground-mounted support, equipment, labor, and all other associated costs to complete this work and accepted by the Engineer.

All signs shall comply with the "Ohio Manual of Uniform Traffic Control Devices for Streets and Highways" (O.M.U.T.C.D.S.H.), including the latest revisions, according to placement, size, shape, color, and reflectorization.

All traffic signs shall be mounted on a their own new ground-mounted support. Under no circumstances shall a traffic sign be mounted on a utility pole or any other mountable surface not intended for traffic sign mounting.

If an existing traffic sign is mounted on a utility pole or any other mountable surface not intended for traffic sign mounting, then the new traffic sign shall be installed on a new ground-mounted support.

If the City chooses to salvage a particular traffic sign or any part of that traffic sign, then the Contractor shall exercise care in removing and dismantling the sign, shall protect the salvageable part from damage, deliver to the Traffic Engineering Division at 1420 Triplett Blvd., and properly dispose of the unsalvageable parts.

All ground-mounted supports shall be a combination of a green-painted U-channel post with a nominal weight before punching of 3-lb./ft. for an 8-foot post and a 2-

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lb./ft. for a 6-foot post. The 8-foot 3-lb. post shall be driven into the ground to a depth of  $3\frac{1}{2}$ -4 feet and the traffic sign shall be attached to the 6-foot post. The 6-foot post, with sign, shall then be attached to the 8-foot post at the state specified height with standard fastening devices unless otherwise designated on the plan sheet set or directed by the Engineer.

When a ground-mounted support is to be mounted in a sidewalk or otherwise finished surface, the contractor shall install a 4-inch inside diameter PVC sleeve in the sidewalk or surface prior to placing that surface. The ground-mounted support shall be driven into the ground through the sleeve and grouted full.

When a traffic sign is designated to be reset, the Contractor shall exercise care in removing the sign and shall carefully dismantle the sign. The sign to be reset shall be stored and protected until time to reset. The unsalvageable parts shall be properly disposed.

All traffic signs to be salvaged or reset shall be removed from the construction site prior to any construction activities beginning. The Contractor shall not set post any new signs or reset any existing signs until all surface restoration has been completed, but prior to sub-final inspection.

All signs shall be classified based on the following categories of types:

### Type A

All signs which have an area of 400 square inches or less. Typical:

### O.M.U.T.C.D.S.H.

Ref. number	Function
R1-3	Multiway Stop Installations
R1-4	Multiway Stop Installations
R7-1	No Parking Anytime
R7-8	Reserved Parking For Handicapped
OM4-1	Object Marker, Type 4

### Type B

All signs which have an area greater than 400 square inches, and up to and including 1000 square inches. Typical:

O.M.U.T.C.D.S.H.	
Ref. number	<u>Function</u>
R1-1	Stop Sign
R1-2	Yield Sign
R10-6	Stop Here On Red
R15-1	Railroad Crossing Signs (Crossbuck)
R2-1	Speed Limit Sign
R2-H5	Signs For Reduced Speed Ahead
S5-H5	School Speed Limit Signs

R10-11B	No Turn On Red
R10-H5a (Left)	Lane Use Control Signs
R10-H5b (Right)	Lane Use Control Signs
R5-H2b	Truck and Through Traffic Exclusion
W14-2	Dead End/No Outlet Sign
W11	Crossing Signs
S1-1	School Crossing Advance Sign

Type C

All signs which have an area greater than 1000 square inches, and up to and including 2400 square inches, and mounted on U-channel type posts. Typical:

O.M.U.T.C.D.S.H.	
Ref. number	Function
S5-H3	School Speed Limit Sign
W9-1	Lane Reduction Transition Signs

**630.14 Inspection**. After erection, signs will be inspected under both day and night conditions, and any deficiencies in lateral position or visibility shall be corrected to the satisfaction of the Engineer.

To assure a proper functioning of the breakaway feature, the Contractor shall verify bolt torques on breakaway beam connections at least four weeks following installation.

**630.15 Method of Measurement.** Measurement will be made for specific items, furnished and installed in place, complete and accepted, in accordance with the following items.

Foundation concrete will be measured as the number of cubic yards as determined by calculations from plan dimensions, including excavation, reinforcing steel, concrete, backfilling, and disposal of surplus excavation. No deduction will be made for the volume of beams, reinforcing steel, anchor bolts, conduit ells and pole butts within the concrete.

Ground mounted supports will be measured as the actual length in linear feet and shall include driving, sign backing assemblies, and the furnishing of patching materials for excavations in paved areas.

One-way sign supports will be measured in a manner similar to ground mounted supports. The linear measurement will include the tubular extension. The supports shall include the tube, spacers and necessary hardware.

Temporary sign posts attached to drums or beam rail will be measured as the length in linear feet.

### 630.15

Breakaway beam connections will be measured as the number of sets of connection parts with necessary welding and drilling of holes as required for the breakaway function in one beam. Beams shall include base plates, fuse plate, hinge plate, bolt retainer plate, and bolts assembled to specified torques.

Rigid overhead sign supports will be measured as the number of supports, including anchor bolts and conduit ells furnished for the foundation, sign attachment assemblies, luminaire support assemblies when required, and cover bases and identification decals when specified.

Sign attachment assemblies separately itemized will be measured as the number of assemblies, including one overhead sign bracket, U-bolts, clamps, and miscellaneous hardware.

Luminaire support assemblies separately itemized will be measured as the number of assemblies, including one support arm, other necessary structural members, bracing rods when required, and miscellaneous hardware.

Combination overhead sign supports with light pole extension will be measured in a manner similar to rigid overhead sign supports. Bracket arms and luminaires for roadway lighting are not included.

Span wire sign supports will be measured as the number of each support assembly, including two strain poles with span wire clamps and anchor shackles, anchor bolts, and conduit ells, furnished for foundations, messenger wire, clamps, thimbles, and sign hanger assemblies with hangers, braces, lengths of post and miscellaneous hardware.

Overpass structure mounted sign supports will be measured as the number of each support assembly, including attachment work and hardware.

Miscellaneous attachment of small signs to signal messenger wire or mast arms will be measured as the number of hanger assemblies. Hanger assemblies shall consist of all parts necessary to attach one individual sign. Attachment to poles or bridge parapets will be measured as the number of support assemblies.

Signs will be measured as the area in square feet of signs, including the furnishing of identification decals, sign backing assemblies, mounting bolts, washers, nuts, bearing plates, clips, and rivets. Measurement for square, rectangular, circular, or irregular shaped signs will be determined by multiplying the largest dimensions of width and height. Measurement for triangular shaped signs will be determined by multiplying the largest dimension of height. The area of the glare shields for lighted signs will be included with and measured as an integral part of the sign.

Double-faced signs will be measured as the number of double-faced signs, including mounting fittings and hardware.

Sign backing assemblies separately itemized will be measured as the number of assemblies, including back bracing for multiple flat sheet sign installations and backing posts for exit and/or supplementary signs attached to guide signs, with required hardware.

Existing signs revised with demountable copy will be measured as the number of signs revised. Revised copy will include the removal of existing copy, respacing of existing copy, and the furnishing of mounting hardware.

Refurbishing signs will be measured as the area in square feet of signs refurbished, and shall include the furnishing and installation of overlay signs, adjustment of demountable copy, replacement of missing or damaged copy, repair of panels, clear coating, or other required work.

Covering of signs will be measured as the area in square feet of sign face covered, including the subsequent removal and disposal of the covering.

Barrier wall assemblies will be measured as the number of assemblies.

Removal and storage or re-erection of signs and supports will be measured as the number of ground mounted signs and supports, overhead mounted signs and supports, and overlay signs, removed and stored or re-erected. Major signs are defined for measurement as being 40 square feet or larger. Support removal shall include removal of foundations and restoration of surfaces. Re-erection, when required, shall include furnishing of anchor bolts and conduit ells, necessary field drilling and hardware.

Signs erected will exclude the furnishing of signs and mounting hardware. This item will be measured as the area in square feet of signs erected. Signs erected shall include the assembly of signs delivered in more than one piece and the installation of required sign backing assemblies. Measurement for square, rectangular, circular, or irregular shaped signs will be determined by multiplying the largest dimensions of width and height. Measurement for triangular shaped signs will be determined by multiplying the largest dimension of height. The area of the glare shields for lighted signs will be included with and measured as an integral part of the sign. Overlay signs which are shipped attached to extrusheet signs and erected with the signs are included with the signs for erection payment. Overlay signs which are shipped separately and erected on existing extrusheet signs and including the removal of underlying legend will be paid for under this item.

Traffic signs designated to be removed, replaced, installed, or reset will be measured as the number of traffic signs removed, replaced, installed, and reset.

**630.16 Basis of Payment.** Quantities of specific items measured as provided above, in place, complete and accepted, will be paid for under:

<u>Item</u>	<u>Unit</u>	Description	
630	Cubic Foot	Concrete for anchor base foundations	
630	Cubic Foot	Concrete for embedded foundations	
630	Linear Foot	Ground-mounted supports, post	
630	Linear Foot	Ground-mounted supports, beam	
630	Linear Foot	One way supports	
630	Linear Foot	Temporary sign posts,	
630	Each	Breakaway beam connection	
630	Each	Overhead sign support, type, design, span feet	
630	Each	Combination overhead sign support, type,design,	
		span feet	
630	Each	Sign attachment assembly	
630	Each	Luminaire support assembly, type	
630	Each	Span wire sign support, type,	
		design, span feet	
630	Each	Overpass structure mounted sign support,	
		type, design	
630	Each	Sign hanger assembly ("span wire" or "mast arm")	
630	Each	Sign support assembly ("pole" or "bridge mounted")	
630	Square Foot	Signs ("flat sheet", "extrusheet" or "overlay")	
630	Each	Signs, double faced	
630	Square Foot	Signs erected ("flat sheet", "extrusheet" or "overlay")	
630	Each	Sign backing assembly	
630	Each	Existing signs revised with demountable copy	
630	Square Foot	Refurbishing signs	
630	Square Foot	Covering of signs	
630	Each	Barrier wall assembly, type, design	
630	Each	Removal of ground mounted (major) sign and ("storage" or "re-erection")	
630	Each	Removal of ground mounted ("beam" or "post") support	
630	Each	Removal of overhead mounted sign and	
		("storage" or "re-erection")	
630	Each	Removal of overhead sign support and	
		("storage" or "re-erection"), type	
630	Each	Removal of overlay sign	
630	Each	Traffic Sign - Type _	
630	Each	Traffic Sign Removed	
630	Each	Traffic Sign Reset	

# ITEM 631 SIGN LIGHTING AND ELECTRICAL SIGNS

631.01 Description 631.02 Materials

- 631.03 Working Drawings
- 631.04 General, Sign Lighting
- 631.05 Service Pole
- 631.06 Sign Service
- 631.07 Signs Wired
- 631.08 Disconnect Switch with Enclosure
- 631.09 Switch Enclosure Mounting Bracket Assembly
- 631.10 Transformer
- 631.11 Ballast
- 631.12 Photoelectric Control
- 631.13 Mercury Vapor Luminaire
- 631.14 Fluorescent Fixture
- 631.15 Electrical Signs
- 631.16 Removal, Storage or Re-erection of Sign Lighting Luminaires
- 631.17 Inspection and Testing
- 631.18 Method of Measurement
- 631.19 Basis of Payment

**631.01 Description**. This work shall consist of furnishing and installing sign lighting or electrical sign equipment, complete, tested, and ready for service, in conformance with the specified material quality and dimensions, and at the locations shown in the plans or as ordered by the Engineer.

**631.02 Materials**. All equipment and materials furnished shall be new, of first quality, of current design, and free from defects. The equipment and materials shall comply with the National Electrical Code and City of Akron Building Code including revisions.

All electrical parts, wire, switches and other elements of the installations shall be of ample capacity to carry the required current without excessive heating or drop of potential.

Except as otherwise provided herein, each individual item of equipment shall bear a nameplate, indelible marking or brand that shall identify it as to type, model, catalog number and manufacturer.

Materials shall conform to the following:

Service pole	
Conduit, rigid	
Conduit, flexible	
Cable and wire	
Ground rod	
Sealing, conduit	
Disconnect switch	
Switch enclosure	
Mercury vapor ballast	
Photoelectric control	

Mercury vapor luminaire	
Mercury vapor lamp	713.14
Fluorescent fixture	
Fluorescent lamp	
Changeable message sign, lamp type	
Changeable message sign, drum type	
Internally illuminated sign	
Sign flasher assembly	
School speed limit sign assembly	731.07

**631.03** Working Drawings. The Contractor shall submit to the Engineer for review and approval four sets of drawings, catalog cuts, specifications, brochures, data sheets, wiring drawings, etc., of apparatus and equipment proposed to be furnished. The material shall show clearly the design, quality, dimensions, and other such information as may be necessary for a proper evaluation of the items submitted. All submitted documents shall identify the specific project with the bid item reference number to which the apparatus or equipment applies. If more than one catalog number or type is listed on a sheet, the item intended to be furnished shall be indicated by an appropriate mark.

The Contractor shall not install any material until written approval is received from the Engineer. After approval, working drawings shall be considered as supplemental to, but not a substitute for, the original plans. Approval of working drawings shall not relieve the Contractor of responsibility for omissions and erroneous or inconsistent dimensions, notations or other errors.

**631.04 General, Sign Lighting**. Overhead sign lighting shall be by mercury vapor luminaires, and electric power shall be integrated with roadway lighting circuits.

Wire and cable shall be protected by installation entirely within support structure interiors, enclosures, junction boxes, and rigid or flexible conduit. Methods, materials and locations of splicing, and methods of connecting and identification of wire and cable, shall conform to the requirements of 625, 713 and the plans. Grounding systems shall be provided in accordance with 625.09 and will be paid for separately.

**631.05** Service Pole. Service poles shall be furnished and installed when specified. Each pole shall include all necessary equipment, devices and material to provide a complete service unit conforming to 625.17, 713.19 and plan details. Poles shall be furnished and paid for under 625.

**631.06** Sign Service. Sign service shall consist of all cable and other equipment to provide a complete electrical service from either an underground or overhead source to the disconnect switch.

Sign service cable from a pullbox shall be routed to the switch enclosure for overhead supported signs by means of underground conduit, foundation conduit ell, and the interior of the structural member supporting the enclosure. Service for overpass structure mounted signs shall be routed through underground and structure attached conduit terminating at a switch enclosure. The conduit shall be attached by 0.02 inch thick by 3/4 inch wide passivated stainless steel straps spaced at intervals of not more than 5 feet. Sign service shall include trenching, conduit, fittings, backfilling, and cable.

Sign service cable from a distribution system direct drop shall be routed to the switch enclosure by means of a conduit riser with weatherhead. The sign service shall include cable, conduit riser and fittings, weatherhead, and other hardware necessary to complete the installation. A drip loop shall be formed into the cable. The weatherhead shall be of cast aluminum or galvanized ferrous metal and shall be of threaded design. The conduit shall be attached by straps as described in the foregoing paragraph.

Cable for sign service shall be 600 volts rated, single conductor and not smaller than Number 4 AWG.

**631.07** Signs Wired. Signs wired shall complete the electrical system from the disconnect switch to the luminaires or fixtures and shall consist of wiring, connectors, junction boxes, rigid or flexible conduit, condulets, conduit clamps and miscellaneous hardware.

Wiring shall be continuous from the disconnect switch to a junction box mounted on the sign support or overpass structure. Installation of the junction box shall permit sign removal as a unit by the disconnection of the wires and the removal of sign attachment hardware. A junction box shall be installed for each sign. Wiring shall be continuous from the junction box to the first luminaire and continuous between additional luminaires.

Wire shall be 600 volts rated, single conductor and not smaller than Number 10 AWG.

Wire routing on overhead sign supports shall be from the disconnect switch enclosure through structural member interiors. Wire hanging within the interior of steel vertical members shall be supported by looping over the J-hook provided. After completion of wiring in the disconnect switch enclosure, the nipple in the enclosure back shall be sealed in accordance with 625.12.

Flexible or rigid conduit on the sign structure or lighting support arms shall be assembled with condulets and attached to structure by clamps located within 6 inches of each conduit end and separated by not more than 24 inches.

**631.08 Disconnect Switch with Enclosure**. Lighted signs shall be provided with a disconnect switch within a lockable, weatherproof enclosure. The switch shall be a

two-pole (minimum), single-throw, fused safety disconnect type, rated at 600 volts, 30 amperes with the fuse size as specified. A solid neutral bar shall be provided.

The enclosure shall be NEMA 1CS 1-110.15 Type 4 with sufficient volume to accommodate an internal transformer when specified. Space for a chase nipple shall be available in the enclosure back. The hole for the nipple shall be field drilled through the enclosure and the nipple installed. Enclosures shall also have a 1/4 inch diameter weep hole located in the bottom surface.

Each enclosure shall be furnished with at least one padlock. Padlocks shall have a corrosion resistant body and a corrosion protected steel shackle. All padlocks for a project shall be keyed alike, and the Contractor shall obtain the appropriate master key number from the City.

**631.09** Switch Enclosure Mounting Bracket Assembly. Bracket assemblies, when separately specified, shall be furnished and installed on existing overhead sign supports or on concrete structure and shall consist of all parts necessary for mounting an enclosure. Bracket assemblies shall be of steel galvanized in accordance with 711.02, or aluminum, and shall include two brackets, necessary field drilling and hardware.

**631.10 Transformer**. When fluorescent lighting is used and line voltages are other than 120 volts, a step-down transformer shall be installed in the disconnect switch enclosure. The transformer shall be of the single-phase dry type with 480/240 volt primary and 240/120 volt secondary at 60 hertz and shall be of the KVA rating specified.

**631.11 Ballast**. Ballasts for mercury vapor luminaires or fluorescent fixtures shall be located remotely in a position on the support pole or end frame. Ballast housings shall be weatherproof and of corrosion resistant materials.

**631.12 Photoelectric Control**. Photoelectric controls shall be furnished when sign lighting is fed by uncontrolled circuits.

**631.13 Mercury Vapor Luminaire**. Mercury vapor luminaires shall include a lamp of the wattage specified.

**631.14 Fluorescent Fixture**. Fluorescent fixtures shall include a lamp of the length and output type specified. Fixtures may be single or multiple mounted in a continuous row.

## 631.15 Electrical Signs.

(a) Changeable message signs shall consist of the following designs unless otherwise specified.

(1) limited message -- lamp type,

(2) unlimited message -- lamp type and

(3)drum type. Line units of these types may be used as inserts in a panel sign, used singly, or grouped to provide a multiline sign.

(b) Internally illuminated signs shall be of the single or double faced type. The signs may be mounted by span wire, mast arm, pedestal top or pole type bracket arms. Suspended signs shall hang plumb and shall be properly oriented and locked in place.

(c) Sign flasher assemblies shall consist of a pair of flashing beacons and source of illumination for a sign face. Incandescent lamps shall be included. The sign, support and foundation are furnished under other items.

(d) School speed limit sign assemblies shall consist of a sign fitted with a pair of flashing beacons with or without an internally illuminated speed limit sign display unit and shall include equipment to operate and control the sign. Mounting parts and incandescent lamps shall also be included.

**631.16 Removal, Storage or Re-erection of Sign Lighting Luminaires.** Luminaires or fixtures for sign lighting and associated ballasts shall be carefully removed and stored on the project for salvage by the City or shall be re-erected elsewhere on the project. Luminaires to be re-erected shall be cleaned and restored to an operating condition, fitted with new lamp boots, relamped with the proper type and size lamp and provided with new hardware.

**631.17 Inspection and Testing**. Sign lighting systems and electrical signs shall meet all requirements of the ground, cable insulation, and performance tests specified in 625.21. Failure of lamps, ballasts and transformers during the performance test shall be corrected by replacement of the faulty component but will not require restart of the entire test period.

During the performance test, final adjustment shall be made to sign lateral position and aiming angles of luminaires or fixtures to eliminate excessive brightness and glare, and to obtain optimum sign face reflected brightness, uniformity of illumination, visibility and legibility, to the satisfaction of the Engineer.

When a low-voltage-tap transformer is used with fluorescent fixtures, measurement of the available line voltage and current shall be made for determination of the proper tap. The result shall be reported to the Engineer with the test information required under 625.22.

**631.18** Method of Measurement. Measurement will be made for specific items, furnished and in place, complete and accepted, in accordance with the following:

Sign service shall be measured as complete units for each support, and will include conduit, fittings, cables, trenching and backfilling.

### 631.19

Signs wired will be measured as complete units of wiring for each individual sign, and will include junction boxes, rigid or flexible conduit, condulets, clamps, wires and miscellaneous hardware.

Disconnect switches with enclosure will be measured as the number of each, and will include field drilling, mounting hardware and padlocks.

Switch enclosure mounting bracket assemblies will be measured as the number of each, including two brackets, field drilling and hardware.

Mercury vapor luminaires will be measured as the number of each, and will include lamps and luminaire attachment hardware.

Fluorescent fixtures will be measured as the number of each, and will include lamps.

Changeable message signs will be measured as the number of each, and will include lamps, dimmer control and auxiliary components.

Internally illuminated signs will be measured as the number of each, and will include lamps, ballasts and support hardware.

Sign flasher assemblies will be measured as the number of each, and will include sign lighting fixtures, beacons, flasher control unit with enclosure, lamps, and mounting hardware.

School speed limit sign assemblies will be measured as the number of each, and will include sign, speed limit display, beacons, flasher control unit with enclosure, timer, lamps and attachment members.

Ballasts, transformers and photoelectric controls will be measured as the number of each. Remote ballasts will include a housing on the support and additional wiring required.

Removal of luminaires will be measured as the number of luminaires removed and stored or re-erected. Re-erection, when required, shall include cleaning, restoring, lamp boots, relamping and mounting hardware.

**631.19** Basis of Payment. Quantities of specific items measured as provided above, in place, complete, tested and accepted, will be paid for under:

Item	<u>Unit</u>	<b>Description</b>
631	Each	Sign service
631	Each	Signs wired
631	Each	Signs wired, overpass structure mounted
631	Each	Disconnect switch with enclosure, type
631	Each	Switch enclosure mounting bracket assembly
631	Each	Transformer, type

631	Each	Ballast, type
631	Each	Photoelectric control
631	Each	Mercury vapor luminaire, type, with watt lamp
631	Each	Fluorescent fixture with type lamp
631	Each	Changeable message sign ("limited message", "unlimited
		message" or "drum type")
631	Each	Internally illuminated sign, type
631	Each	Sign flasher assembly
631	Each	School speed limit sign assembly, type
631	Each	Removal of luminaire and ("storage or "re-erection")

## **ITEM 632 TRAFFIC SIGNAL EQUIPMENT**

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**632.01 Description.** This work consists of furnishing and installing traffic signal equipment, complete and ready for service. This work also includes necessary excavation and backfill, disposal of discarded materials, restoration of disturbed facilities, and surfaces to a condition equal to that existing before the work started, and electrical testing as specified.

Pull boxes, conduits, ground rods, and cable splicing kits required for traffic signal equipment installations are specified in 625.

**632.02** Contractor Personnel Requirements. Conform to the requirements of ODOT Supplement 1063 for the installation or testing of traffic signal equipment.

**632.03 Materials and Equipment.** Furnish new materials and equipment of first quality, of current design, and free from defects.

Use electrical parts, wire, switches, and other elements of the installations capable of carrying the required current without excessive heating or drop of potential.

Ensure that major items or assemblies of equipment bear a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer.

Furnish materials and equipment conforming to:

Concrete, Class C499, 511 Steel*:
Poles, supports, arms, appurtenances
and anchor bases
Pedestals
Bolts and nuts (High Strength)711.09
Hardware
Stainless steel hardware
Other Items:
Conduit, rigid
Ground rod
Pull boxes
Identifying tags or bands
Signal heads
Lamps
Pushbuttons
Detectors
Probes
Wood poles
Down guys
Conduit risers
Cable supports732.17
Messenger wire
Cable and wire
Power service
Disconnect Switch with enclosure

\* Acceptance of materials and products is based on certified test data, furnished in triplicate, or on test results of samples according 106.04, as required by the Laboratory.

Furnish vehicular signal lamps conforming to 732.04 and prequalified according to ODOT Supplement 1046.

632.04 Certified Drawings. Furnish certified drawings according to 625.04.

**632.05 General.** Ensure that major items of traffic signal equipment used in combination are compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier. Furnish electrical materials, equipment, and installations according to the National Electrical Code and the National Electrical Safety Code, and conform to local laws and codes.

Ensure that the traffic control equipment installed in controller cabinets are shop prewired according to a wiring diagram that conforms to plan and specification requirements of the specific project and intersection, and show all wire harness and field connections required, with abbreviations according to Table 632.05-1. Furnish a neat and legibly drawn wiring diagram, reproduced on durable paper, and place two copies in a plastic envelope fastened to the inside of the controller cabinet.

Identify cable and wire by tags or bands at pull boxes and controller cabinets, with size, material, and method of marking that conform to 713.18, except ensure that the identification on the tags or bands conforms to the wiring diagram with abbreviations according to Table 632.05-1. The Contractor may identify field wiring using an indelible pen on a plastic tag instead of embossed letters.

Use spade terminals for wiring connected at signal heads and the wiring connected at terminal blocks within controller cabinets. However, for incoming power wiring, use either spade terminals or bared conductor wire connected to terminal points utilizing screw or spring applied clamping surfaces compatible with both cooper and aluminum wire and providing a positive grip. Neatly lash and fasten completed wiring to interiors with clamps and/or ties.

Cable	Tag
Ground	GND
Power (2 wire)1 $\emptyset$ 120 volt	AC +AC- or CAN
Power (3 wire) 1Ø 120/240 volt AC + 2	AC + 1
Neutral wire	AC- or CAN
Phase A	ØA
Phase 1	Ø 1
Phase 1 northbound left turn lanes	Ø 1 NBLT
Phase A, pedestrian signal	$\varnothing$ A PD
Overlap, phase $A + C$	$\varnothing$ A + C
Overlap, phase $1 + 6$	$\varnothing 1 + 6$
Detector lead-in, phase A	DET A
Detector lead-in, phase 1 Detector lead-in, phase 1	DET 1
northbound left turn lanes	DET 1 NBLT
Detector lead-in, phase A	DET A CALL
(call type)	
Detector lead-in, phase 1	DET 1 CALL
(call type) northbound thru lanes	NB-THRU
Detector harness <sup>[1]</sup>	DET A
Interconnect	IC
Pre-emption, fire	PE FIRE
Pre-emption, railroad	PE RR
[1] Place the tag next to the MS plug at the detector amplifier.	

 Table 632.05-1
 Table and Wire Identification

When constructing the traffic control system, cooperate with the agency supplying the electric service. Supply 120/240 volt, single-phase, three-wire (grounded neutral) power to the disconnect switch.

After completion of the 10-day performance test in compliance with 632.26 and until acceptance, the Contractor is responsible for the care and maintenance of traffic control equipment installed or reused as part of the Contract.

Upon acceptance of the project, transfer to the City of Akron all manufacturers' guarantees or warranties covering installed electrical or mechanical equipment. Furnish two copies of wiring diagrams, service manuals, and instructions on installation and maintenance for each different type, model, or system of equipment used on the project.

**632.06 Vehicular Signal Head, Conventional.** All signal heads shall be Federal yellow polycarbonate with tunnel hood and LED lenses in all faces. Furnish heads in arrangements such that from one to a maximum of five sections assembled with the specified lens size, color, and circular or arrow configuration form a specific signal face. Mount signal faces alone as a one-way head, or combined with additional faces to form a two-way, three-way, or a maximum of a four-way head.

Furnish multi-way heads with top and bottom brackets for mounting purposes. Fit faces of lesser height in multi-way heads with pipe spacers. Close openings unused for mounting purposes with weatherproof caps.

Signals shall be rigid-mounted using cable-style Astrobrac mountings of the appropriate size.

Orient each signal face to its traffic approach, and lock faces in place by the serrated or other type device incorporated in signal housing and support hardware.

Install LED lenses of the proper wattage in each section.

**632.07 Vehicular Signal Head, Optically Programmed.** Shall not be used in the City of Akron, Ohio.

**632.08 Pedestrian Signal Head.** Furnish heads with LED Hand\Person combination Type D2. Orient each signal head to its crosswalk, and lock heads in place by the serrated or other type device incorporated in signal housing and support hardware. Close openings unused for mounting purposes with weatherproof caps. Pedestrian signals shall be field rigid mounted by use of quick-disconnects.

**632.09 Pedestrian Pushbutton.** Properly orient and install pushbuttons on poles or pedestals. Service pushbuttons mounted on steel poles by wiring inside the poles. Furnish 3/4-inch (19 mm) diameter holes through the back of the housing and the pole wall, install a rubber grommet, and route wiring through until no external wiring is visible. Plug any unused conduit attachment holes. Attach the housing by machine or self-tapping screws in the housing back wall. Service pushbutton mounted on wooden poles through conduit. Furnish pedestrian pushbutton signs of the legend and size required. All pedestrian pushbutton installations shall conform to the latest ADA requirements.

**632.10 Loop Detector Unit.** Install and tune detector units to their loops with the sensitivity set for optimum operation and any interference or cross talk eliminated between other detector units in the cabinet. Perform a field check to ensure that no extraneous detections are occurring by observing each detector unit's operation to determine that a signal occurs only when a vehicle enters its associated loop. If actuations are observed when there is no vehicle in the loop, eliminate the extraneous detections.

**632.11 Detector Loop.** Saw slots in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations required. Cut an extension from the loop to the pavement edge to allow wire routing to an adjacent pull box.

Furnish slots 1/16 to 1/8-inch wider than the outside diameter of the loop wire or tubing. Ensure that the slot depth provides a covering of not less than 3/4-inch above the uppermost detector wire tubing after the loop installation is completed. Before installing loop detector wire, brush and blow all slots clean of loose material and completely dry. Install loop detector wire according to 632.21.

Fill the slots completely with a flexible embedding sealant, prequalified according to ODOT Supplement 1048. Do not disturb slots until sealant has cured.

#### 632.12

For loop detector wire installations in new asphalt, the Contractor may saw slots and embed sealant in a subsurface course with subsequent covering by the surface course, subject to the Engineer's approval.

**632.12** Foundations. Locate support foundations, and stake with the proper elevation. If underground or overhead obstacles are encountered during stakeout, or to correct slope and subsurface difficulties, change foundation location and orientation with the approval of the Engineer. Ensure that the approved location provides a safe clearance from overhead power lines for construction operations, in compliance with the National Electric Safety Code. The Contractor is responsible for the correct location, elevation, and orientation for all poles and pedestals installed on the foundations.

Excavate for foundations using an earth auger to specified dimensions according to 503.04. Exercise caution when excavating in areas of underground installations to avoid their disturbance or damage. When a cave-in occurs, excavate using casing, sleeving, or other methods, with the Engineer's approval. If subsurface obstructions are encountered, remove the obstructions, or replace the excavated material and relocate the foundation, with the Engineer's approval. If bedrock is encountered, the Contractor may reduce that portion of the specified foundation depth within the bedrock up to 50 percent. Perform all necessary dewatering of the excavation.

Perform foundation concrete work according to 511, except that the loading restrictions in 511.14 are modified by this subsection. Place the concrete against undisturbed soil or compacted embankment. The top 12 inches of the foundations shall be formed and finished square per Traffic Engineering standard drawings.

Before placing foundation concrete for embedded supports, position and brace the supports with any necessary rake to ensure that the supports, after tensioning, assume an essentially vertical position. For foundations for anchor base type supports, provide the required reinforcing rods, and have anchor bolts and conduit ells accurately held by a template. All signal pole foundations shall have one 1" diameter, one 2" diameter, and one 3" diameter conduit installed unless otherwise specified on the plans.

Remove forms and templates once the concrete has hardened sufficiently so as not to be susceptible to damage. Remove bracing for embedded supports after 7 days. After 14 days, load embedded supports, and erect and load supports on anchor base foundations. The Contractor may erect and load supports after 7 days if the tests of two beam specimens of concrete yield an average modulus of rupture of not less than 650 pounds per square inch.

**632.13 Signal Support.** Furnish supports with mast arms with the required pole and arm length, anchor bolt circle diameter, and anchor bolt size. Signal poles and mast arms shall conform to 732.11, and shall be galvanized in accordance with 713.01 if specified on the plans.

Ensure that the combination signal supports with light pole extension provide for the attachment of a luminaire bracket arm. Support designs shall conform to ODOT Construction Standard TC-81.20 or TC 12.30, unless otherwise specified on the plans.

Furnish individual anchor bolt covers or cover bases for poles erected in sidewalks, traffic islands, curbed areas, and seeded areas, or when directed by the Engineer. Do not use concrete grouting in the space between the foundation surface and support base.

Conform to the requirements of 630.06 for threaded fasteners, anchor bolts, anchor bolt nuts, and anaerobic adhesive.

**632.14 Strain Pole.** Furnish strain poles for the attachment of messenger wire with the required pole length. Use anchor base type strain poles unless the type for concrete embedment is specified. Poles shall conform to 732.12, and shall be galvanized in accordance with 713.01 unless otherwise specified on the plans.

Ensure that the combination strain poles with light pole extension provide for the attachment of a luminaire bracket arm.

Adjust anchor base type poles, and set embedded type poles with the initial rake so that when loaded the poles assume an essentially vertical position.

Conform to the requirements of 630.06 for threaded fasteners, anchor bolts, anchor bolt nuts, and anaerobic adhesive.

Furnish individual anchor bolt covers or cover bases under conditions as per 632.13.

**632.15 Wood Pole.** Set wood poles in holes excavated by an earth auger to a minimum depth of 6 feet. Use an auger with a diameter approximately 4 inches greater than the pole butt. Hold poles with initial rake, up to a maximum of 12 inches, while tamping backfill into place, so that under messenger wire tensioning conforming to 632.20, the poles assume an essentially vertical position. Furnish backfill material no greater than 1 inch in size, and thoroughly tamp material in lifts not exceeding 6 inches, to the satisfaction of the Engineer. If concrete embedment is specified, brace the poles until the concrete has set.

Liberally coat field holes bored for the attachment of messenger or guy wire with approved creosote base paint and fitted with 5/8-inch thimble-eye through-bolts and 3-inch washers. Securely attach and protect ground wire furnished as part of another work item with a wood or plastic molding for a minimum distance of 10 feet above groundline.

**632.16 Down Guy Assembly.** Install and tension guy assemblies before erecting signals such that they will resist the major portion of the horizontal loading caused by loading of the messenger wire.

**632.17** Pedestal. Furnish pedestals for the support of traffic control equipment with a plate steel base, unless a transformer type base is specified.

**632.18 Conduit Riser.** Attach risers to poles to provide a wiring raceway and include a weatherhead, conduit, necessary fittings, and pole attached clamps. Attach risers to poles by clamps spaced at intervals not exceeding 5 feet. Paint conduit risers mounted on painted poles to match the poles.

**632.19 Cable Support Assembly.** Use cable support assemblies to eliminate strain on cables, or groups of cables up to a maximum of four, entering the interior of poles through a weatherhead or mast arm. If required, include a length of messenger wire forming a sling with ends formed of lapped wire, thimbles, and clamps as part of the assembly.

**632.20** Messenger Wire. Arrange messenger wire with accessories between two or more poles to provide support and attachment for traffic control equipment. Accessories used with messenger wire include bullrings, thimbles, preformed guy grip dead ends, and three bolt clamps. Furnish bullrings at messenger wire network corners. Use thimbles to attach messenger wire to the shackles of strain pole clamps and bullrings.

Adjust the length of the messenger wire under the load of traffic control equipment so the sag at the lowest point is not greater than 5 percent or less than 3 percent of the span. Attach signal cable to messenger wire with lengths of preformed helical lashing rod that are of a proper internal diameter to tightly secure the cable to the messenger wire. Attach interconnect cable with preformed lashing rod or spinning wire.

**632.21 Cable and Wire.** Fashion cable at traffic signal equipment weatherhead entrance fittings into a drip loop that extends at least 6 inches below the entrance. Do not allow the cable to chafe on the equipment. Support cables installed in strain poles and signal supports with cable support assemblies according to 632.19.

Do not use splices in any cable or wire, except at the following locations:

- A. At the junction of detector wire and lead-in cable.
- B. At the junction of power cable and the power supply source or service cable.
- C. On long lengths of interconnect or service cable.

For splices allowed in aerial installations, accomplish splicing in weathertight splice enclosures. For splices allowed in underground installations, accomplish splicing in pull boxes or poles where the splice is encapsulated with poured waterproof epoxy insulation according to 713.15.

Install signal cable between signal heads and controller cabinets, and install interconnect cable between controller cabinets of different intersections. Route signal and interconnect cable by aerial installation supported by messenger wire or within underground conduit. If specified, use aerial self-supporting integral messenger type interconnect cable with a figure "8" cross-section and include pole clamps and splice enclosures. Ground the supporting messenger wire of interconnect cable.

Provide loop detector wire consisting of detector wire inserted into flexible plastic tubing. Ensure that the tubing encases the wire continuously from the splice at the lead-in cable, through the entire loop turns, and back to the splice. Install loop detector wire in sawn roadway slots forming loops according to 632.11. Furnish the required number of turns of wire installed for each loop, and push the wire carefully into the slots with a blunt tool to avoid damaging the tubing. Run the wire continuously around the loop perimeter and through a slot leading to the pavement

edge and by underground conduit to a roadside pull box or pole with 5 feet at each end for slack and splice. Uniformly twist wires and tubing installed from the loop to the splice with lead-in cable at 3 to 5 turns per foot. Splice the loop ends to lead-in cable, which are connected to the controller cabinet. Join the wires by a mutually twisted in-line splice, rosin core soldered, and wrapped in vinyl or equivalent electrical tape, and encapsulate wires with an approved poured waterproof epoxy insulated splice according to 713.15. Extend and seal the tubing ends into the poured epoxy splice. Also, solder crimped terminals to the conductors and the shield for connections inside the cabinet.

For magnetometer sensor probe installations, splice the leads from the probes to the specified lead-in cable by the same method. Route lead-in cable within underground conduit or by aerial installation supported by messenger wire.

Install power cable from the power supply source to the controller cabinet. If multi-conductor power cable is specified, the Contractor may substitute multiple single conductors.

Install service cable aerially from a remote power source to the vicinity of the controller cabinet with the support cable functioning as the electrical neutral. Furnish connections used with aluminum power or service cable of an approved type for aluminum to aluminum or aluminum to copper connections, and insulate connections with an approved vinyl mastic pad.

Where called for on the plans, traffic signal interconnect cables shall be singlemode fiber optic cable as specified in ODOT Supplemental Specification 904.

**632.22 Power Service.** Furnish and install all equipment necessary to provide complete electrical service to each signal installation as shown on the plans. Make all necessary arrangements with the local electrical power company for connections to establish electrical service. The City of Akron will reimburse the Contractor by Supplemental Agreement for power company fees for establishment of service and electricity. This compensation is for invoiced cost without mark up.

Power service consists of equipment to provide a pole attached wiring raceway with power cable routed from the service entrance to the controller cabinet. The power service installation includes a weatherhead, conduit and fittings, and attachment clamps.

Bend the conduit away from the pole at the top and bottom of the riser to allow the conduit to enter straight into the enclosure, and to provide space for the weatherhead when the riser is pulled tight against the pole. Furnish watertight conduit connections to the enclosure by using conduit hubs listed on the enclosure UL label.

Paint conduit risers mounted on painted poles to match the poles.

**632.23** Covering of Vehicular Signal Heads. Cover vehicular signal heads if erected at intersections where traffic is maintained before energizing the signals. Use a sturdy opaque covering material and method of covering and cover attachment as approved by the Engineer. Maintain covers, and remove them when directed by the Engineer.

**632.24 Removal of Traffic Signal Installation.** Remove signal heads, cable, messenger wire, strain poles, cabinet, controller, or other incidental items required by the Engineer. Remove support foundations to at least 1-foot below subgrade or finished groundline. Backfill, restore surfaces, and dispose of surplus material according to 203. Store removed items on the project for salvage by the City of Akron Traffic Engineering Division, or reuse removed items as part of a new installation on the project under another item of work. Contact the City of Akron Traffic Engineering Division to arrange pickup of salvaged items. Dispose of all items not designated for salvage or reuse. As specified in 614.03, do not remove signals until a new signal system or a temporary traffic control method approved by the Engineer is in operation. Suitably protect stored equipment.

**632.25 Reuse of Traffic Signal Equipment.** Reinstall or re-erect specified traffic equipment, removed from existing signal installations within the project. Clean and restore reused equipment to an operating condition, and relamp signals with the proper type and size lamp. Furnish all additional hardware and incidentals necessary to allow reuse of the equipment.

## 632.26 Testing.

**A. General.** Furnish all personnel and equipment required to successfully perform the following tests, and furnish to the Engineer six certified copies of complete test records, test reporting forms supplied by the Engineer, or alternate certification approved by the Engineer.

**B.** Ground Test. Measure each ground rod for earth resistance according to 625.21, except that measurements are not necessary immediately after installation.

**C. Short-Circuit Test.** Before performing any cable insulation tests or performance test, perform a short-circuit test with a volt-ohmmeter or other approved instrument. Conduct short-circuit tests with electrical loads, power sources, equipment grounds, and earth grounds disconnected. Test signal cable routed to signal heads with connections made to lamp sockets without lamps installed. Measure each conductor against every other conductor and ground to ensure that no short-circuits, cross-circuits, or other improper connections exist. Ensure that continuity does not exist between any conductor and another conductor including ground.

**D. Circuit Continuity Test.** Temporarily jumper each circuit branch at its termination and the temporarily looped circuit measured for continuity to ensure that no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist, and that each circuit is properly identified. Test the lead-in cable for loop detector wire before and after splicing the cable to the loop wire. As an alternative, perform the circuit continuity testing of signal head cable by applying 120 volts to each outgoing circuit and observing that only the proper lamps are lighted.

**E.** Cable Insulation Test. Ensure that the insulation resistance measured to ground is not less than 10 megohms for each conductor of cable or wire terminating at the controller cabinet. Perform insulation testing with all conductors disconnected from their points on the terminal blocks. Measure insulation resistance for the wire

of roadway loops after the embedding of the wire with sealant in slots. Include a list of the resistance readings for each conductor in the test results. After completing the cable insulation test, connect all cabinet wiring according to the wiring diagram. Demonstrate to the satisfaction of the Engineer that all circuits are continuous and operating correctly with freedom from shorts, crosses, and unintentional grounds.

Functional Test. Before the 10-day performance test begins, make the F. following checks and demonstrate to the Engineer that the system is ready for the performance test. Ensure that the incoming AC voltage is a nominal 120 volts. If the supplied voltage under load is less than 100 or more than 130 VAC, contact the power company to arrange correction. Ensure that the cabinet ventilating fan, fan thermostat, and convenience outlet with lamp is operational. Correct timing settings on the controller as shown on the plans. Check all cabinet switches including the power on/off switch and flash switch. Check all controller functions to verify correct operation. Check the detector units to determine which pavement loop is associated with which detector unit. Check the visual indication of detector units to determine that each vehicle class (truck, car, or motorcycle) entering sensor areas is detected on the associated detector unit and that no extraneous calls occur when the sensor area is vacant. Check the flash switch to verify transfer of signal operation to flash and return to stop-and-go. Check the conflict monitor to verify that it is not activated by normal signal operations or by the manipulation of cabinet switches. If the monitor is activated, determine the cause of the problem and make appropriate changes and adjustments before beginning the performance test. Test the conflict monitor by artificially causing a number of different conflicting indications, and verify that at each test the monitor causes the signals to begin flashing and places the controller in a "stop timing" mode. Obtain artificial causation either by touching a jumper wire between two conflicting load switch outputs or by other methods approved by the Engineer. Ensure that the signal flashes when the monitor is disconnected.

**G.Performance Test.** At least 7 days before the performance test begins, notify the Engineer of the starting date. The Engineer will notify the maintaining agency. Before acceptance, operate the traffic control system continuously for 10 consecutive days without major malfunction or failure. Immediately replace or repair minor failures (such as lamps, a single detector unit, or an individual signal head, etc.) that do not cause restart of the test. Major malfunctions or failures (such as a master or local controller, interconnect equipment, etc.) will cause termination of the test and, after replacement or repair, the beginning of a new 10-day test. Monitor items that have been repaired or that are replacements for a 10-day period to provide assurance of their reliability. Record, for inclusion in the test result, the method and date of correction of each fault, and the beginning and end of the test.

**632.27 Pull Box.** Pull boxes shall be of the size specified on the plans, and shall be reinforced polymer concrete type with a bolted 20,000 lb. capacity lid, and shall be located where designated on the plans. Excavation shall be performed as nearly as practical to the outside dimensions of the pull box. After boxes are set to proper grade on a 6" min. thick bed of crushed limestone, excavated spaces around the boxes shall be backfilled with suitable material placed and compacted in thin layers. Pull boxes shall include all excavation, backfilling, grading, crushed limestone

drainage fill, ground rod, and ground wire lead. Pull boxes shall be manufactured by Oldcastle Precast and shall display the legend "TRAFFIC" or "TRAFFIC SIGNAL" on the lid.

**632.28 Method of Measurement.** The City of Akron will measure Vehicular Signal Head and Pedestrian Signal Head by the number of complete units, and will include all support or mounting hardware, disconnect hangers, closure caps, dimmers, and lamps or gas-filled grids as required.

The City of Akron will measure Pedestrian Pushbutton by the number of individual units, and will include pedestrian pushbutton signs.

The City of Akron will measure Loop Detector Unit by the number of individual units, adjusted and tuned, and will include a wiring harness. If multi-channel detector units are used, the City of Akron will consider each channel as an individual detector unit up to the number of units specified.

The City of Akron will measure Detector Loop by the number of complete detector loops installed in the pavement, and will include pavement cutting, loop detector wire with tubing in place, application of sealant, conduit, trenching, backfilling, and surface restoration from the edge of pavement to the pull box.

The City of Akron will measure Strain Pole Foundation, Signal Support Foundation, and Pedestal Foundation by the number of complete units, and will include excavation, dewatering, sleeving, casing, reinforcing steel, concrete, backfilling, disposal of surplus excavation, and installation only of anchor bolts and conduit ells.

The City of Akron will measure Signal Support, Combination Signal Support, Strain Pole, Combination Strain Pole, Strain Pole Embedded, Combination Strain Pole Embedded, Wood Pole, and Pedestal by the number of complete units of each, and will include pole arms, weather-heads and blind half couplings, anchor bolts and conduit ells furnished for foundations, and required individual anchor bolt covers or cover bases.

The City of Akron will measure Down Guy by the number of individual units, and will include messenger wire, pole clamp or thru-bolt, washer, clamps, guy grips, insulator, guy guard, and anchor.

The City of Akron will measure Conduit Riser by the number of complete units, and will include weatherhead, conduit, fittings, clamps, and hardware.

The City of Akron will measure Messenger Wire by the number of feet in place, and will include all necessary accessories such as, grips, thimbles, clamps, bullrings, and lashing rod. The City of Akron will measure from pole center to pole center, or pole center to bullring, or bullring to bullring. The City of Akron will not measure any length of messenger wire for attachment to poles, or bullrings by bending, lapping, or wrapping.

The City of Akron will measure Signal Cable, Interconnect Cable, Loop Detector Lead-In Cable, Magnetometer Lead-In Cable, Power Cable, and Service Cable by the number of feet (meters) in place. Cable inside of poles shall include cable support assemblies. Aerial cable shall include pole attachment hardware, splices, splice enclosures, and ground connection. Lead-in cable shall include poured epoxy insulated splices. The City of Akron will measure: (1) horizontally from center-to-center of pull boxes, poles, cabinets, power sources, and signal heads with an additional allowance of 5 feet at each pull box and terminating points for slack and connections; and (2) vertically between pole or conduit outlets. If single-conductor power cable is substituted for multi-conductor cable, the City of Akron will measure required length of multi-conductor cable.

The City of Akron will measure Power Service by the number of complete units, and will include weatherhead, conduit, fittings, clamps and other necessary hardware.

The City of Akron will measure Covering of Vehicular Signal Head by the number of individual signal heads covered, and will include materials and labor to erect, maintain, and remove the covering.

The City of Akron will measure Removal of Traffic Signal Installation by the number of installations removed, and will include storage when required.

The City of Akron will measure Removal of (*Item*) and (*Storage or Reerection*) by the number of specific traffic signal installation parts (such as a signal head, controller unit, or pole) removed, and will include storage when required.

The City of Akron will measure Reuse of (*Item*) by the number of traffic signal equipment items reused, and will include cleaning, restoring, and relamping.

**632.29 Basis of Payment.** The costs to arrange service by the supply agency are included under Power Cable.

The costs of personnel, materials, equipment, electrical energy, and incidentals required to conduct performance tests are included under the contract unit price for the respective items tested.

The City of Akron will pay for accepted quantities at the contract prices as follows:

**.**...

Item	Unit	Description
632	Each	Vehicular Signal Head,Section inch LensWay
632	Each	Pedestrian Signal Head, Type
632	Each	Pedestrian Pushbutton
632	Each	Loop Detector Unit
632	Each	Detector Loop
632	Each	Pull box,"x" Reinforced Polymer Concrete
632	Each	Strain Pole Foundation
632	Each	Signal Support Foundation
632	Each	Pedestal Foundation
632	Each	Signal Support, Type TC, Design
632	Each	Combination Signal Support, Type TC, Design
632	Each	Strain Pole, Type TC,Design
632	Each	Combination Strain Pole, Type TC, Design
632	Each	Strain Pole Embedded, Type TC, Design

632	Each	Combination Strain PoleEmbedded, Type TC, Design
632	Each	Wood Pole, Class, (Length) feet
632	Each	Down Guy
632	Each	Pedestal, ( <i>Length</i> ) feet
632	Each	Pedestal, (Length) feet ,Transformer Base
632	Each	Conduit Riser, inch Dia.
632	Foot	Messenger Wire, (No.)Strand inch Dia., with Accessories
632	Foot	Signal Cable, Conductor No AWG
632	Foot	Interconnect Cable, Conductor No AWG
632	Foot	Interconnect Cable, IntegralMessenger Wire Type,
		Conductor No AWG
632	Foot	Loop Detector Lead-In Cable
632	Foot	Power Cable, Conductor No AWG
632	Foot	Service Cable, Conductor No AWG
632	Each	Power Service
632	Each	Covering of VehicularSignal Head
632	Each	Removal of Traffic SignalInstallation
632	Each	Removal of (Item) and (Storage Or Reerection)
632	Each	Reuse of ( <i>Item</i> )

## **ITEM 633 TRAFFIC SIGNAL CONTROLLERS**

- 633.01 Description
- 633.02 Contractor Personnel Requirements
- 633.03 Materials and Equipment
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- 633.05 General
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- 633.07 Controllers
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- 633.11 Controller Work Pad
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- 633.14 Remote Monitoring Station
- 633.15 Telephone Service
- 633.16 Training
- 633.17 System Analysis
- 633.18 Method of Measurement
- 633.19 Basis of Payment

**633.01 Description.** This work consists of furnishing and installing traffic signal control equipment, including controllers, cabinets, auxiliary equipment, and

specified accessories, completely wired, at the locations shown on the plans and ready for service.

**633.02** Contractor Personnel Requirements. Conform to the requirements of ODOT Supplement 1063 for the installation or testing of traffic signal equipment.

**633.03 Materials and Equipment.** Furnish new materials and equipment of first quality, of current design, and free from defects.

Use electrical parts, wire, switches, and other elements of the installation capable of carrying the required current without excessive heating or drop of potential.

Ensure that each item of equipment bears a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer. Use equipment conforming to the types, models, and systems specified.

Furnish material and equipment conforming to:

Concrete (cabinet foundations and work pads)	
Conduit	713.04, 713.07
Controller unit	
Cabinet and auxiliary equipment	
Cabinet riser	
Flasher controller	733.05
Controller, master, traffic responsive	
Remote monitoring station	
Telephone service	733.08

**633.04** Certified Drawings. Furnish certified drawings according to 625.04.

**633.05** General. Ensure that major items of traffic signal control equipment used in combination are compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier.

Ensure that controller cabinets are shop prewired according to 632.05.

Before starting installation, furnish to the Engineer, two copies of each cabinet wiring diagram, service manuals, and installation and maintenance instructions for each installation, including all components and interconnections. Supply one additional copy of the cabinet wiring diagrams in a clear plastic pouch fastened to the inside of the controller door. Before beginning the 10-day performance test, replace or modify these documents as necessary to reflect current conditions. Upon completion of the work and before its acceptance, replace or modify the documents as necessary.

Transfer manufacturers' guarantees or warranties on all installed traffic signal control equipment to the maintaining agency upon completion and acceptance of the project.

If required by the plans to install equipment furnished by others, store and care of the equipment upon receipt.

**633.06 Testing and Prequalification.** For all traffic control equipment, perform functional tests and a 10-day performance test according to 632.26. Do not clear conflict monitor logs during the 10-day test. Ensure that logs note power-up to start
the test and all events until the test is complete. Restart the test upon correcting a noted event. Notify the Engineer at least 3 days before beginning the 10-day performance test. The Engineer will notify the maintaining agency of the beginning of the test. Ensure that the following testing and prequalification requirements are met:

A. For traffic control equipment required by this specification to meet NEMA Standards Publication TS-1 or TS-2/NTCIP, conform to the following:

1. Furnish a certified test report indicating compliance to all requirements of NEMA Standards Publication TS-1 or TS-2/NTCIP as applicable.

2. Furnish the name and location of the laboratory testing facility as well as the identification of the principal personnel who conducted the equipment testing and a summary of their qualifications.

3. Ensure that the laboratory provides City of Akron representatives access to those parts of the laboratory where the testing was done.

4. Upon request, furnish a copy of the actual test data results for review and analysis.

B. For traffic control equipment required by this specification to meet CalTrans specifications, use a product or manufacturer as stated in this specification that is listed on the CalTrans Qualified Products List.

**633.07 Controllers.** Install controller units, consisting of the timing unit, software, and signal timing, into the specified type of prewired cabinet.

Program controller units as shown on the plans unless otherwise directed by the Engineer. If the plan timing data or the supplemental timing data supplied by the Engineer does not exactly fulfill the timing requirements of the installed equipment, notify, in writing, the Engineer of the problem and identify the discrepancies. The Engineer will consult with the maintaining agency and notify the Contractor within 2 weeks. After programming, briefly operate controllers, with the signals turned off by means of the signal shutdown switch, to ensure that operation is reasonable and conforms to the plans.

If the plans show two or more intersection controllers operated in a progressive signal system, coordinate signals by relating the various controller cycle start times to a zero time base, or other cycle start time at an adjacent signalized intersection. Ensure that the controller unit software provides coordination capability to allow associated controllers to be operated within the progressive traffic system. Coordination equipment shall supervise the operation of its associated controller by causing the end of certain phases and the beginning of the following phases to occur at set points. Program coordination timing according to the coordination timing data shown on the plans or provided by the Engineer.

**633.08** Cabinets. Mount cabinets by attaching to pedestal or pole or by installing on a concrete foundation. Arrange foundation mounted cabinets so that control equipment, terminal blocks, or shelves are no closer than 6 inches to the top of the foundation and at least 18 inches from the ground line or sidewalk level.

Attach pole or pedestal mounted controller cabinets at a height that allows convenient access to all controller components by service personnel.

Make field connections for the conductors of signal cable, power cable, interconnect cable, and detector lead-in cable. Connect conductors so the outgoing traffic signal circuits are of the same polarity as the line side of the power supply. For traffic signal circuit common return, use the same polarity as the grounded side of the power supply. Ground the grounded side of the power supply to the cabinet in an approved manner. Neatly arrange and route all field wiring to the appropriate terminal blocks. Identify field wiring according to 713.18 except mark with either indelible pen or embossed letters.

Except for power wiring, fit field wiring entering the cabinet with spade terminals to ensure a good connection. For incoming power wiring, either use spade terminals or connect the bare conductor wire to terminal points utilizing screw or spring applied clamping surfaces compatible with either copper or aluminum wire and providing a positive grip. After completing field wiring, seal the conduit entering the cabinet in an approved manner with a removable sealing compound (no foam sealants), or a molded plastic or rubber device that is compatible with the cable jacket, the insulation, and the conduit material.

For foundation mounted cabinets, seal the joint between the controller cabinet and the foundation with a quality, clear silicon caulk.

**633.09** Cabinet Riser. Cabinet risers provide an extension of the cabinet between the ground mounted cabinet and the foundation. Bolt the riser to the foundation, and bolt the cabinet to the riser.

Use a type (size and shape) of cabinet riser compatible with the type of controller cabinets specified for the project.

Seal the joints between the controller cabinet and cabinet riser, and between the cabinet riser and foundation with a quality, clear silicon caulk.

**633.10 Foundations.** Construct foundations for controller cabinets according to 632.12, except that excavation by earth auger is not required and the foundation does not require reinforcing steel. Controller foundations shall be formed using the Traffic Engineering Division standard form, available from the Traffic Engineering Division. All foundations shall have two 3" diameter conduits for signal cable, one 2" diameter conduit for source, and one 1" diameter conduit for ground wire. Anchor bolts, conduit ells, and similar appurtenances in the proper position until the concrete has set.

**633.11 Controller Work Pad.** Construct controller work pad according to 456.03, except that transverse joints are not required. Provide the top of the pad nominally 1 inch above ground line. If the controller cabinet has both front and back doors, the work pad shall encompass three sides of the cabinet foundation to include the non-hinged cabinet door side of the foundation.

**633.12 Flasher Controller.** Furnish and install a flasher controller with cabinet and mounting hardware when indicated. The flasher controller is for the operation of flashing beacons.

**633.13** Controller, Master, Traffic Responsive. The traffic responsive master controller supervises and controls the operation of an interconnected system of local controllers. Ensure that the master controller is able to communicate with a remote monitoring station. Locate this master controller in a local intersection controller cabinet unless otherwise shown on plans. If the local controller cabinet size is not sufficient to accommodate the master controller and its associated wiring, furnish the proper size cabinet for the local intersection controller to house the local controller, master controller, modem, and all auxiliary devices.

**633.14 Remote Monitoring Station.** Install, test, and operate the remote monitoring station, consisting of computer equipment, communications equipment, and software, in one or more locations in the maintaining agency's facilities as shown on the plans. The maintaining agency shall furnish telephone service at these stations.

**633.15 Telephone Service.** Make arrangements with the local telephone company to have telephone service furnished to intersection cabinet locations shown on the plans. Maintain the telephone account until the signal system has been tested and accepted by the Engineer. After acceptance of the signal system, transfer the telephone account to the maintaining agency.

Furnish and install a minimum size 1-inch conduit, twisted pair, shielded telephone cable, and conduit risers necessary to bring the telephone line from the telephone company service location into the controller cabinet. Furnish and install the modem and the lightning protection for the telephone lines in the controller cabinet.

**633.16 Training.** Furnish training for the traffic signal control equipment installed as part of the Contract. Furnish all handouts, manuals, and product information. For the training, use the same models of equipment furnished for the project. The maintaining agency shall furnish the facilities in which the training will take place. Furnish all media and test equipment needed to present the training. Unless otherwise shown on the plans, the minimum training requirements are as follows:

A. Sixteen hours on how to operate the system, analyze system performance, and revise critical operating parameters.

B. Eight hours of field trouble-shooting and maintenance procedures.

C. Eight hours of follow-up training after the maintaining agency has operated the system for a minimum period of 30 days.

D. Four hours for preemption device training if emergency vehicle preemption is shown on the plans.

### 633.17 System Analysis.

**A.** General. Prepare signal timing and traffic progression programs, load the programs into the signal system, evaluate the performance of the system, and refine the programs as necessary to optimize traffic flow and operation. Collect and evaluate traffic data, analyze traffic signal progression and timing, develop traffic adjusted pattern selection parameters, perform the system evaluation and refine the

system operation, and prepare and submit a summary report for review and approval by the Engineer.

If a project contains individual sub-systems that are connected to the remote monitoring station, perform all work as outlined in this subsection for each subsystem. If required, analyze signal "sub-systems" together and coordinate traffic progression programs to optimize the overall traffic flow between the various subsystems.

Optimize only the cycle lengths, phase splits, permissives, and offsets without changing the actual controller phasing provided in the plan.

**B.** Systems Engineer or Technician. Employ a systems engineer or technician to perform the work required by this subsection and submit to the Engineer for approval three copies of a resume documenting the following qualifications:

1. A minimum of 5 years experience in traffic engineering or traffic engineering technology.

2. The systems engineer or technician's education including training in traffic engineering technology and signal system design.

3. The systems engineer or technician's familiarity with the closed loop system installed and experience in setting up and fine tuning a system of that type. Furnish a list of other closed loop systems that the systems engineer or technician has programmed into the traffic responsive mode for documentation purposes.

Also, submit to the Engineer for approval a brief description of proposed methodology of data collection and analysis of:

a.System parameter usage in system evaluation.

b.Frequency and measurement of travel time and delay.

c.Comparison of actual versus system measurements of delays (level of service).

The systems engineer or technician, under authority of the Contractor, is responsible for the operation of the system from the completion of the signal system acceptance until completion and acceptance of the final summary report by the Engineer. The systems engineer or technician shall provide a 24-hour emergency phone number and shall respond to system related problems as deemed necessary by the Engineer 24 hours a day, 7 days a week. If there is a guarantee period, the Engineer reserves the right to request a systems analysis throughout the entire duration of this period, if new or continuing problems occur with the operation of the traffic responsive system.

The Engineer reserves the right to request that the Contractor furnish a new systems engineer or technician if the current systems engineer or technician fails to perform the required duties in a timely and professional manner or fails to have a firm understanding of the operation and programming of the closed loop system constructed.

**C. Traffic Programs.** The systems engineer or technician shall develop signal progression and timing programs from count and occupancy data obtained from the

local intersection and system loop detectors, supplemented by field counts and measurements as required. The systems engineer or technician shall develop the following signal progression programs and parameters:

1. Three inbound preferential (a.m. peak).

2. Three outbound preferential (p.m. peak).

3. Three average (off peak).

The three average programs should utilize varying cycle lengths based on traffic volume, density, and occupancy to minimize overall intersection approach delay time.

4. Two special programs for either high congestion or queue backup.

5. A minimum of three timing plans for a back up time base coordinated system. The systems engineer or technician shall program the timing plans into the system, to supplement the timing plans shown on the plans.

6. Define system parameters that enable the system to automatically transfer into a "free operation" mode during light traffic volume periods and to automatically transfer to a computer selected coordinated mode during heavy traffic volume periods. The systems engineer or technician shall establish the following system parameters:

- a. Volume, occupancy and directionality thresholds.
- b. Transition smoothing factors.
- c. System detector assignment.
- d. System detector weighting.

The systems engineer or technician may use the software provided with the remote monitoring station to help assist in the analysis of the operation of the closed loop system.

**D.** System Travel Time Studies. The systems engineer or technician shall conduct a series of travel time studies for each system or sub-system artery constructed as part of the project, to measure the time it takes to travel from 0.25 mile) in advance of the beginning of each system or sub-system to 0.25 mile (0.4 km) after the end of that system or sub-system, in each direction. Ensure that the travel time study parameters are based on the posted speed limit; however, be aware that during peak periods it may not be possible to obtain the posted speed due to larger traffic volumes.

The systems engineer or technician shall conduct four separate sets of travel time studies for each of the following field conditions:

1. Before beginning construction, with the existing signal system in operation (no lane closures shall be in effect during this analysis).

2. Before implementing the traffic responsive mode, while the new traffic signal system is operating under the "time of day" mode (as is shown on the plans).

- 3. After placing the system(s) in the traffic responsive mode.
- 4. After the system operation meeting and making final system adjustments.

Each set of travel time studies shall include a minimum of five runs through the system per direction. The systems engineer or technician shall conduct travel time studies during good weather conditions (i.e., no snow, rain, or fog). The Engineer may omit the pre-construction travel time studies if the project includes substantial changes to the roadway geometrics (i.e., roadway widening, reconfiguring of pavement markings, etc.) that would affect the results of a comparison of the level of improvement over preexisting conditions.

The four separate sets of travel time studies shall include the following:

1. Conduct the first set of travel time studies between the hours of 7:00 a.m. and 9:00 a.m. on weekdays.

2. Conduct the second set of travel time studies between the hours of 11:30 a.m. and 1:00 p.m. weekdays.

3. Conduct the third set of travel time studies between the hours of 4:00 p.m. and 6:00 p.m. weekdays.

4. Conduct the fourth set of travel time studies during any of the following non-peak hour periods:

- a. 9:00 a.m. to 11:00 a.m. Monday through Saturday.
- b. 7:00 p.m. to 10:00 p.m. Monday through Saturday.
- c. 7:00 a.m. to 10:00 p.m. Sunday.

The systems engineer or technician shall furnish a written report documenting, at a minimum, the date of travel time study, day of week, time of day, total time of travel, and total time the vehicle was stopped for each trip.

The systems engineer or technician shall use the reports furnished from each of the four field conditions for which system travel time studies are prepared as one means of measuring the efficiency of the new system.

**E. Draft System Summary Report.** The systems engineer or technician shall prepare a draft system summary report after travel time studies for the first three field conditions are performed. Submit two copies each to the Engineer and the maintaining agency(s) of the signal system for the evaluation and review of the system programming, operation, and efficiency.

The report shall summarize the signal progression and timing programs that were entered into the system. The report shall also include a copy of the systems log after operating in the traffic responsive mode to verify the number of programs used throughout the day as well as the frequency of program changes. The systems engineer or technician shall provide a minimum of at least 4 days of systems logs. The systems engineer or technician shall limit three of the four logs to the weekdays of Monday through Friday; the fourth log shall be on a Sunday. The systems engineer or technician shall include copies of all data and analysis calculations for the system timing in the report. The draft system summary report shall include an evaluation of the system operation, efficiency, and performance and copies of all travel time study data.

**F.** System Operation Meeting and Final System Summary Report. After the draft system summary report has been submitted, the Engineer will schedule a meeting that includes the systems engineer or technician, the Contractor, the Engineer, and representative(s) from the maintaining agency(s) to discuss the operation of the traffic responsive closed loop signal system. This meeting shall occur within 4 weeks after the draft system summary report has been submitted to the Engineer and maintaining agency(s).

The purpose of this meeting is to discuss the operation of the traffic responsive closed loop signal system and to receive comments and recommendations from the Engineer and/or the maintaining agency(s) regarding potential modifications to the operation of the system. The systems engineer or technician shall answer questions regarding the system summary report as well as the operation of the closed loop system.

The systems engineer or technician shall make final adjustments to the system as directed by the Engineer to address any concerns discussed at this meeting. The systems engineer or technician shall perform the final travel time study before submitting the final report. The systems engineer or technician shall submit one copy of a final system summary report to the Engineer and one additional copy for each maintaining agency for review and approval. The final report shall include any revisions to the draft report that are required as a result of the system operation meeting.

**633.18 Method of Measurement.** The City of Akron will measure Controller Unit, Type \_\_\_\_, with Cabinet, Type \_\_\_\_ by the number of each complete unit, and will include controller unit with software, all required auxiliary equipment, loop detector units, and a prewired cabinet, with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware.

The City of Akron will measure Controller Unit, Type \_\_\_\_ by the number of each controller timing unit with software, and will include any signal timing programming or installation. The City of Akron will measure Controller Unit, Type \_\_\_\_, Furnish Only by the number of each controller timing unit with software, and will exclude any signal timing programming or installation.

The City of Akron will measure Cabinet, Type \_\_\_\_ by the number of each complete prewired cabinet installed, and will include all required auxiliary equipment and loop detector units (excluding controller unit), with all items completely wired and tested. Ground mounted cabinets will include anchor bolts and conduit ells for installation in the foundation. Pole mounted cabinets will include pole mounting hardware. The City of Akron will measure Cabinet, Type \_\_\_\_\_, Furnish Only by the number of each complete prewired cabinet, and will include pole mounting hardware and anchor bolts, but will exclude installation, controller unit, and detector units.

The City of Akron will measure Cabinet Riser by the number of each unit, and will include materials, mounting hardware, and installation.

The City of Akron will measure Cabinet Foundation and Controller Work Pad by the number of each complete unit, in place, complete and accepted, and will include excavation, concrete, backfilling, and disposal of surplus excavation. One complete Controller Work Pad unit may encompass several sides of a controller cabinet installation.

The City of Akron will measure Flasher Controller by the number of each complete flasher assembly with cabinet installed and tested.

The City of Akron will measure Controller, Master, Traffic Responsive by the number of each unit, and will include installation, signal system software, programming, and any increase in cabinet size to house the master controller in the local intersection cabinet. The City of Akron will measure Controller, Master, Traffic Responsive, Furnish Only by the number of each unit, and will include software, but exclude any programming or installation.

The City of Akron will measure Remote Monitoring Station by the number of each location shown on the plans, and will include all equipment, testing, and software.

The City of Akron will measure Telephone Service by the number of each location shown on the plans for furnishing telephone service to an intersection controller, and will include the modem, conduit, trenching, and wiring.

The City of Akron will measure Training on a lump sum basis, and will include providing the instruction materials, instructor travel expenses, and test or media equipment for presenting the training material.

The City of Akron will measure System Analysis on a lump sum basis, and will include providing all materials, labor, software, printing reports, and incidentals to analyze all traffic responsive sub-systems included in the project.

**633.19 Basis of Payment.** If a project contains individual sub-systems that are connected to the remote monitoring station, the cost for performing work, as specified in 633.17 is incidental to the bid item price for System Analysis.

The costs to obtain and maintain telephone service by the supply agency are included under Telephone Service.

The City of Akron will pay for accepted quantities at the contract unit prices as follows:

Item	Unit	Description
633	Each	Controller Unit, Type, with Cabinet, Type
633	Each	Controller Unit, Type
633	Each	Controller Unit, Type, Furnish Only
633	Each	Cabinet, Type
633	Each	Cabinet, Type, Furnish Only
633	Each	Cabinet Riser
633	Each	Cabinet Foundation

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633	Each	Controller Work Pad
633	Each	Flasher Controller
633	Each	Controller, Master, Traffic Responsive
633	Each	Controller, Master, Traffic Responsive, Furnish Only
633	Each	Remote Monitoring Station
633	Each	Telephone Service
633	Lump	Training
633	Lump	System Analysis

# 650 LANDSCAPING

#### 650.01 CERTIFICATION

Contracts dealing with landscaping items will be awarded to a general contractor that employs, or has a sub-contractor that employs, an Ohio Certified Nursery Technician (OCNT). OCNT is offered by the Ohio Nursery and Landscape Association (ONLA). An OCNT must be on site during all aspects of landscape construction. The OCNT must have the status of either Landscape or Master Technician. This person shall have a signed statement certifying they are an Ohio Certified Nursery Technician as recognized by the Ohio Nursery and Landscape Association (ONLA). The signed statement is to include the signature and expiration date of the Ohio Certified Landscape Technician on the staff who will be supervising the Installation of the landscape contractor. Beginning January 1, 2010, the OCNT certification will be voided and landscape contracts or subcontracts will be awarded to a landscape contractor who employs a Certified Landscape Technician (CLT), offered by the Professional Landscape Network (PLANET). A CLT must be on site during all aspects of landscape construction. The CLT must have the status of CLT-Exterior with the specialty of Installation. This person shall have a signed statement certifying they are a Certified Landscape Technician-Exterior as recognized by the Professional Landscape Network (PLANET). The signed statement is to include the signature and expiration date of the Certified Landscape Technician on the staff who will be supervising the Installation of the landscape contractor.

## **ITEM 651 TOPSOIL STOCKPILED**

- 651.01 Description
- 651.02 Certification
- 651.03 Stripping and Lifting
- 651.04 Method of Measurement
- 651.05 Basis of Payment

**651.01 Description**. This item shall consist of stripping topsoil from selected areas within work limits, transporting and storing in piles at locations designated by the Engineer.

**651.02** Certification. Certification shall conform to the requirements of 650.01.

**651.03 Stripping and Lifting**. The contractor shall cut vegetation to a 1-inch height, remove cuttings from the site, and treat per the manufacturers recommendations with an approved nonselective herbicide two weeks prior to stripping. Topsoil shall be kept separate from other excavated materials and shall be completely removed to the required depth from any designated area prior to the

#### 651.04

beginning of regular excavation or embankment work in the area. Topsoil depth shall be determined in the field by the Engineer before topsoil is stripped. Topsoil shall not be stripped while wet or frozen. Stockpiled topsoil shall be placed in such a manner as not to pond water or cause flooding. Silt fencing or seeding of the stockpiled topsoil mound shall be performed at the discretion of the Engineer, depending on the duration of the project. If topsoil is removed to a greater depth than directed by the Engineer, payment will be made only for the amount of topsoil directed to be removed.

**651.04 Method of Measurement**. Measurement shall be the cubic yards of topsoil measured in the original place, acceptably stripped and stored in stockpiles as herein prescribed.

**651.05 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription651Cubic YardTopsoil stockpiled

## **ITEM 652 PLACING STOCKPILED TOPSOIL**

- 652.01 Description
- 652.02 Certification
- 652.03 Preparation of Subgrade
- 652.04 Screening, Placing and Spreading Topsoil
- 652.05 Method of Measurement
- 652.06 Basis of Payment

**652.01 Description**. This item shall consist of preparing the subgrade, and hauling and spreading topsoil from stockpiles.

**652.02 Certification.** Certification shall conform to the requirements of 650.01.

**652.03 Preparation of Subgrade**. Preparation of subgrade shall be performed in accordance with 653.05.

**652.04** Screening, Placing and Spreading Topsoil. Topsoil shall be placed and spread in accordance with 653.06.

**652.05 Method of Measurement**. Measurement shall be the number of square yards in place.

**652.06 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
652	Square Yard	Screening/ Placing stockpiled topsoil, 4" thick

### **ITEM 653 TOPSOIL FURNISHED AND PLACED**

- 653.01 Description
- 653.02 Certification
- 653.03 Topsoil
- 653.04 Stripping Topsoil / Stockpiled Topsoil
- 653.05 Preparation of Subgrade
- 653.06 Placing and Spreading Topsoil
- 653.07 Method of Measurement
- 653.08 Basis of Payment

**653.01 Description**. This item shall consist of furnishing and spreading topsoil and preparing the subgrade for same.

**653.02** Certification. Certification shall conform to the requirements of 650.01.

**653.03 Topsoil**. The material shall be natural field or farm type soil or field/farm type soil with admixtures such as sand, clay or composted organic matter and free of stones, plants, roots, sticks and other foreign materials.

Topsoil shall be a sandy loam or loam soil as defined by the Soil Conservation Service, U.S.D.A., Soil Classification System. Mechanical analysis shall be as follows:

Particle Range (Diameter)	Percent Range	Average Percent
Sand (0 05 - 2.0 mm)	35 - 75%	55%
Silt (0 002 - 0.05 mm)	15 - 50%	32%
Clay (less than 0.002 mm)	5 - 20%	13%

All topsoil shall be screened with at least 95 percent passing a 3.0 mm sieve (1/2) to 5/8 harp screen). The retained material shall be free of stones, gravel, earth clods, and debris greater than 1-inch in longest dimension.

Available phosphorous (P) shall not be less than 10 nor more than 200 pounds per acre.

Available potassium (K) shall not be less than 100 nor more than 650 pounds per acre.

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The topsoil shall have an organic matter content of not less than 4%, nor more than 15% as determined by loss on ignition of samples oven dried to constant weight at 100°C.

The acceptable acidity range of the proposed topsoil shall be pH5.8 to pH7.2. The topsoil shall be corrected to a pH 6.5 to pH7.0 using lime or sulfur to achieve these results. Should lime or sulfur requirements exceed 50 lbs./1000sf (2150 lbs./acre), 50 lbs./1000sf shall be applied during the seeding/sodding operation with the balance applied immediately before final acceptance with the follow-up fertilizer.

Contractor shall submit to the Engineer, in writing, at least 30 days in advance of intended use, the location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped and crops grown during the past two years.

Topsoil shall be sampled and tested by the Engineer for phosphorous (P), potassium (K), pH, organic matter and analysis of soil make up, i.e.: particle range, percent range and average percent.

**653.04** Stripping Topsoil. After approval of topsoil by the Engineer, and prior to stripping, the Contractor shall remove all grass, roots, brush, etc., from the area to be stripped. Commercial suppliers utilizing stockpiled topsoil or amendments shall use customary sanitation prior and subsequent to stripping to eliminate noxious weed seeds and plant parts from contaminating topsoil. The presence of Quack Grass, Canadian Thistle, etc., are grounds for rejection of a material.

**653.05 Preparation of Subgrade**. The Contractor shall complete all subgrading within the areas to be covered with topsoil under this item, to four inches below and parallel to typical cross-section and proposed finished grades. The Engineer shall determine the limit of the topsoil installation. The designated edge shall be cut cleanly whether sidewalk, retaining wall, curb, existing turf, etc., and excavated to four a (4) inch depth. The surface of the subgrade, immediately prior to being covered with topsoil, shall be free of all weeds, grasses, rocks, roots, concrete, and scarified to a depth of two (2) inches. All rock greater than two (2) inches in any dimension along with any foreign material, including roots uncovered during and as a result of scarification shall also be removed. The City Arborist or his/her designee shall be contacted 5 days prior to the installation of the topsoil for approval of the subgrade and cut back of the slopes.

**653.06 Placing and Spreading Topsoil**. Topsoil shall be placed and spread over the areas designated to a depth sufficiently greater than that shown on the plans so that after natural settlement the completed work will conform to elevations shown on the plans. The placement of topsoil shall be in compacted lifts to prevent settling. If settlement exceeds one half (1/2) inch against hard surfacing or causes puddling, the contractor shall correct the condition by placing topsoil to grade and re-turfing

the area. If the work schedule does not permit time for natural settlement of the placed topsoil, the use of a plate tamper or a method approved by the Engineer shall be used before lime, fertilizer, seeding or sodding operations begin. Stockpiled topsoil, depending on the end use, and at the discretion of the Engineer, shall be screened, rock hounded or by other approved methods, worked to remove rocks, gravel, roots, debris, etc., in excess of one inch.

**653.07 Method of Measurement**. Measurement shall be the number of square yards in place.

**653.08 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
653	Square Yard	Topsoil furnished and placed, 4" thick
653	Cubic Yard	Topsoil furnished and placed, variable depth

The unit price shall include full compensation for furnishing all labor, materials, tools, topsoil and equipment necessary to complete the item as specified.

### **ITEM 654 LAWN RENOVATION**

- 654.01 Description
- 654.02 Certification
- 654.03 Soil Testing
- 654.04 Commercial Fertilizer
- 654.05 Organic Material
- 654.06 Lime
- 654.07 Preparation, Seeding and Mulching
- 654.08 Maintenance of Renovated Areas
- 654.09 Method of Measurement
- 654.10 Basis of Payment

**654.01 Description**. This item shall consist of excavating existing lawn areas, furnishing and placing topsoil, lime and fertilizer, seeding and mulching or sodding as noted herein.

**654.02 Certification.** Certification shall conform to the requirements of 650.01.

**654.03** Soil Testing. Soils shall be tested and approved by the Engineer for phosphorous (P), potassium (K), pH and organic content. The soil shall be corrected to a pH of 5.5 to 6.5. The organic content shall not be less than two percent nor more than twelve percent as determined by loss on ignition of samples oven dried to

constant weight at 100°C. Contractor shall incorporate organic material into existing soil where organic content is less than two percent.

**654.04 Commercial Fertilizer**. "Starter" fertilizer, if required as a result of a soil test analysis, shall be of the type noted and applied at the rate specified. Incorporation shall be as noted in 659.14. "Follow-up" fertilizer shall be of the type and rate specified in 659.05. Time of application is as noted in 659.14.

**654.05 Organic Material**. The organic material shall be composted organic matter.

**654.06 Lime**. Lime shall be of the type noted and applied at the rate specified in the soil test analysis. Incorporation shall be as noted in 659.14.

**654.07 Preparation, Seeding and Mulching**. All soil, rock, roots and any other foreign material shall be removed to a full two inch depth below specified finish grade. Topsoil shall then be placed to finish grade, then raked, limed and fertilized as per soil test results and incorporated as noted in 659.14. On approval of the Engineer, prepared areas shall then be seeded and mulched as per 659 or sodded as per 660. Any overexcavated area shall be filled with topsoil at no cost to the City.

**654.08** Maintenance of Renovated Areas. All renovated areas shall be maintained until acceptance (minimum of thirty days) by the City, including reseeding, aerating watering, mowing, weeding, fertilizing, and disease and pest control, etc., as noted in 659.15 or 660.11. On acceptance by the City, a "follow-up" fertilizer, as noted in 659.05, shall be applied at the rate of one pound of actual nitrogen per 1,000 square feet.

**654.09** Method of Measurement. Measurement of lawn renovation shall be the number of square yards renovated in accordance with these Specifications.

**654.10 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
654	Square Yard	Lawn Renovation with Seeding
654	Square Yard	Lawn Renovation with Seeding and Excelsior Matting
654	Square Yard	Lawn Renovation with Sodding

#### ITEM 655 RENOVATING EXISTING TURF (TOPDRESSING)

655.01Description655.02Certification655.03Topsoil

- 655.04 Fertilizers
- 655.05 Seed 655.06 Mulch
- 055.00 Mulch
- 655.07 Mowing, Raking and Aerating
- 655.08 Placing and Spreading Topsoil
- 655.09 Liming and Fertilizing
- 655.10 Seeding
- 655.11 Maintenance of Renovated Turf
- 655.12 Method of Measurement
- 655.13 Basis of Payment

**655.01 Description**. This item shall consist of renovating and seeding of existing turf by lightly scarifying, aerating, raking, topdressing, fertilizing, seeding, mulching, mowing and rolling areas indicated on the plans or as directed by the Engineer.

**655.02** Certification. Certification shall conform to the requirements of 650.01.

**655.03 Topsoil**. The topsoil used in this item shall conform to 653.03 unless topsoil is to be furnished by the City from topsoil stockpiled under 651.

**655.04 Fertilizers**. Commercial fertilizers, "starter" and "follow-up" shall conform to 659.05.

655.05 Seed. Seed shall conform to 659.07.

**655.06** Mulch. Straw mulch shall conform to 659.12 and be applied in accordance with 659.14.

**655.07** Mowing, Raking and Aerating. Turf areas shall be mowed to a height of one inch and all clippings over two inches in length removed. Contractor shall then use a verticut to scarify the top 1/4 to 1/2 inch of soil until a proper seedbed is provided. Clippings and thatch shall be removed, then aerated to a depth of 3-1/2 inches.

**655.08** Placing and Spreading Topsoil. Topsoil shall be spread over the entire area at an approximate depth of one half inch except in low areas where the depth of topsoil shall be as required to eliminate said low area.

**655.09 Liming and Fertilizing**. Liming and fertilizer shall be accomplished in two separate operations. Lime shall be added as determined by soil analysis results and recommendations and lightly incorporated into the top 1/4 inch by matting or raking. A "starter" type fertilizer shall, as a result of the soil test analysis, be of the type and rate specified, then lightly incorporated into the top 1/4 inch of topsoil by hand raking or dragging. A "follow-up" fertilizer shall be of the type and rate specified in 659.05. Time of application is as noted in 655.11.

**655.10 Seeding**. Before seeding, the surface of the soil shall be raked. Grass seed shall be sown on the prepared seedbed at the rate of two pounds per 1,000 square feet. The seed shall be covered and the area mulched as specified in 659.14.

**655.11** Maintenance of Renovated Turf. All renovated turf areas shall be maintained until acceptance (minimum of thirty days) by the City, including reseeding, aerating watering, mowing, weeding, fertilizing and disease and pest control, etc., as noted in 659.15. On acceptance by the City, a "follow-up" fertilizer, as noted in 659.05, shall be applied at the rate of one pound of actual nitrogen per 1,000 square feet.

**655.12 Method of Measurement**. Measurement of seeding and renovating existing turf shall be the number of square yards seeded and renovated in accordance with these Specifications.

**655.13 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
655	Square Yards	Renovating Existing Turf (Topdressing)

## **ITEM 656 ROADSIDE CLEANUP**

656.01 Description
656.02 Certification
656.03 Intensity of Cleanup
656.04 Cleaning
656.05 Pruning
656.06 Disposal of Refuse
656.07 Method of Measurement
656.08 Basis of Payment

**656.01 Description**. This item shall consist of cleanup outside the excavated and filled areas and disposing of undesirable plants and other vegetative growth, rubbish, stumps, conspicuous stones, all down timber, dead brush, logs and timbers, the felling and destroying of all snags, and such trees as are designated by the Engineer. It shall also include the pruning of trees 6 inches or less and native shrubs and similar vegetation in areas indicated, but not inclusive of any work required to be performed under 201.

**656.02 Certification.** Certification shall conform to the requirements of 650.01.

**656.03 Intensity of Cleanup**. The intensity of cleanup shall be graduated so as to effect a natural transition in cleanup treatment from the edge of the pavement outward to the limits of the right-of-way and to a avoid a sharp demarcation between the artificial and the natural.

**656.04 Cleaning**. After removal of large objects, the designated areas shall be cleaned with grubbing rakes or wide-spaced tooth rakes, unless otherwise directed, using care, however, not to disturb or injure desirable grass, vines, wild flowers, etc.

**656.05 Pruning**. Pruning methods shall be in accordance with 666. Caliper measurements shall be taken as specified in 201.05(b).

**656.06 Disposal of Refuse**. All stumps, roots, brush, timbers, logs, felled timber, limbs, branches, tops or other debris resulting from the clean up operations or occurring within the construction limits shall be removed and disposed of outside the limits of the project.

**656.07** Method of Measurement. Measurement of roadside cleanup shall be the number of 1000 square feet units of roadside area outside the excavated and filled areas which have been cleaned up and accepted. The Engineer will determine the boundaries of the area to be cleaned up, and the number of units for which payment is to be made.

**656.08 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription656M Square FeetRoadside cleanup

## **ITEM 657 RIPRAP FOR TREE PROTECTION**

657.01 Description
657.02 Certification
657.03 Materials
657.04 Tree Wells in Fill
657.05 Walls in Cut
657.06 Hand-Laid Stone Riprap
657.07 Earthwork
657.08 Method of Measurement
657.09 Basis of Payment

**657.01 Description**. This item shall consist of the protection of selected trees or shrubs by tree wells, retaining walls, aeration and subdrainage as shown on the

plans or as directed by the Engineer. Tree wells and retaining walls shall be hand-laid stone riprap constructed as specified.

**657.02** Certification. Certification shall conform to the requirements of 650.01.

**657.03 Materials**. Stone shall be Ohio sandstone ledge rock, buff color range, sizes of 3 to 6 inch thickness, 9 to 12 inch depth, random length and irregular sized.

Mortar shall conform to 602.02.

The aggregate for the tree root aeration, subdrainage, and protection shall be No. 4 or No. 467 washed gravel.

The perforated tubing shall be 4 inch corrugated, perforated, plastic drainage tubing (C.P.P.D. tubing) with nylon screen. Fittings shall be 4 inches and made of the same plastic material. This item shall conform to ASTM F 405.

Non-perforated tubing and fittings shall be 4 inch corrugated, plastic, drainage tubing (C.P.D. tubing). Fittings shall be 4 inches and made of the same plastic material. This item shall conform to ASTM F 405.

**657.04 Tree Wells in Fill**. Where a fill around a tree or shrub not marked for removal will be 12 inches or more in depth over the feeding root areas or ground surface lying within the periphery (outer branch tips) of the tree, a hand laid stone riprap tree well shall be constructed. A wall of the same height as the fill shall be constructed circling the tree or shrub and shall be 3-1/2 feet from the tree trunk or as specified. The top of the wall shall follow the contour on the finished grade in a neat line.

Tree wells shall be constructed prior to placing the fill over the root area.

Before fill material is placed over the root area, the Contractor shall:

- A. Remove all vegetation, organic matter, wood, brush and debris.
- B. Loosen the top several inches of soil without injuring the tree roots.
- C. Request and obtain a soil analysis from the Engineer.
- D. Apply lime, commercial fertilizer or organic material, if required by the soil tests.
- E. Install aeration and subdrainage tubing. Ends of C.P.P.D. tubing under the tree well shall be terminated with perforated caps. The C.P.P.D. tubing that radiates out from the tree trunk shall drain water from the tree well,

from the vertically installed tubing, into the outer ring of tubing, and then drain water through C.P.P.D. tubing down slope from the tree.

Tree well stone shall be supported by adjacent stone when bridging tubing. After construction of tree well and tubing system, and after approval by the Engineer, the Contractor shall fill the tree well with aggregate up to within 1 foot of the proposed finish grade. Other areas over the tree roots and within the outer dripline of the tree shall receive a 6 inch depth of aggregate for each 12 inches of earth fill, but with a minimum depth of 6 inches. After approval of the aggregate installation by the Engineer, the aggregate shall be covered with 1 inch of clean dry hay, straw or pine needles. The entire area shall be backfilled with topsoil except for the dry well and the capped ends of vertically placed aeration tubing which shall be terminated at the proposed finished grade of fill.

**657.05** Walls in Cut. Unless otherwise shown on the plan, where the top of the slope in cut is within 6 feet of the trunk of a tree not marked for removal, hand laid stone riprap wall shall be constructed. The bottom of the wall shall be toed into the ground 2 inches unless otherwise shown on the plans, and the top of the wall shall be even with the original ground line at the base of the tree. The length of the wall shall extend far enough from the tree to amply cover the roots, or in accordance with the shape and size as called for on the plans. The ends of the wall shall flare back and taper or fade out into the finished grade of the slope in a neat line.

**657.06 Hand-Laid Stone Riprap**. Unless otherwise shown on the plan, the earth bed on which riprap is to be placed shall have a slope of 1 foot vertical to 2 inches horizontal and shall be dressed to a true plane. Where riprap is to rest against a fill, the embankment shall be tamped against the back of the stone. If existing 2 inch or greater viable roots are encountered, the stone work shall bridge the root.

Riprap for walls or wells shall be constructed in conformity with the lines and dimensions specified, each course of which shall be laid with the long dimensions of each stone perpendicular to the slope or batter. Each stone course shall be installed level. Individual stones shall be roughly rectangular in cross section and shall not be less than 3 inches in thickness, 9 inches in width, and the top course shall not be less than 12 inches in width.

The individual stones shall be placed by hand, one upon the other so that they will break joints with the stone in the course below. Where it is necessary to use more than one stone to provide the specified thickness or depth of the wall, thereby resulting in joints parallel to the face of the wall, such stones shall be placed so as to break joints with the adjacent stones.

The top two courses of stone shall receive full beds of mortar, and the exposed joints shall have a 2 inch rake. The space between the larger stones shall be filled with spalls rammed into place. The surface of the finished riprap shall not vary more than 3 inches from that shown on the plans, and shall present an even, tight surface, pleasing in appearance.

**657.07 Earthwork**. Excavation necessary in connection with this item shall be completed and paid for in accordance with 203. Any necessary embankment shall be performed in accordance with 203 using the material from the excavation. In the event borrow is necessary, it shall be completed and paid for in accordance with 203.

**657.08 Method of Measurement**. Measurement of riprap for tree protection shall be the number of square yards of riprap of the specified thickness, in place, completed and accepted. Measurement shall be made parallel to the face of the wells or walls.

Measurement of aeration and subdrainage tubing shall be the number of linear feet of tubing in place, completed and accepted. Measurement shall be made parallel to the centerline of the tubing.

Measurement of aggregate for use in conjunction with aeration and subdrainage tubing installation to be paid for shall be the number of cubic yards measured in the carrier, of aggregate furnished, placed, completed and accepted.

Fertilizer, if required, shall be paid for under 659.

**657.09 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
657	Square Yard	Riprap for tree protection
657	Linear Foot	Aeration and subdrainage tubing
657	Cubic Yards	Aggregate for drainage

## **ITEM 658 TREE ROOT AERATION**

658.01 Description
658.02 Certification
658.03 Materials
658.04 Preparation
658.05 Aeration
658.06 Earth Embankment
658.07 Method of Measurement
658.08 Basis of Payment

**658.01 Description**. This item shall consist of furnishing and placing the necessary aggregate or performing pressurized liquid injection and fertilization on compacted soils, for the protection and aeration of the roots of trees and shrubs as specified or as directed by the Engineer.

**658.02** Certification. Certification shall conform to the requirements of 650.01.

**658.03 Materials.** Aggregate. The aggregate for tree root aeration and protection shall be No. 4 or No. 467 washed gravel. Fertilizer. The fertilizer for the pressurized liquid injection method of aeration shall be a soluble type slow release such as Arborgreen or an equal approved by the Engineer.

**658.04 Preparation**. The feeding root area to be protected and aerated shall be the ground surface area lying within the dripline, or outer branch limits, plus one third the distance from the tree trunk to the outer branch limits of the tree or shrub to be retained. Such areas shall be first thoroughly cleared of all vegetation, wood, brush and debris. The top 2 to 4 inches of soil shall be loosened without injuring the tree roots before installation of aggregate. When using the pressurized liquid injection method the foregoing preparation is not necessary.

**658.05** Aeration. Where the earth fill is less than 12 inches and more than 4 inches over the feeding root area, an aggregate aeration course of one-half the height of fill, but not less than 3 inches, shall be spread loosely over the area on original soil grade, except that at the tree trunk the thickness shall be increased to the height of the fill and extend outward from the tree trunk in collar form for a distance of 15 inches. A two inch layer of straw or hay shall be placed over the aggregate.

Where no earth fill is proposed the pressurized liquid injection method shall be utilized, fracturing compacted soils using pressurized water containing two-year slow release fertilizer. The pressure applied and probe depth shall be determined by soil texture, degree of soil compaction and site considerations. This work shall be performed with equipment designed and manufactured for this application and by a firm with three years experience in soil aeration.

**658.06 Earth Embankment**. Any necessary earth embankment shall be performed in accordance with 203 using the material from the excavation. In the event borrow is necessary, it shall be completed and paid for in accordance with 203.

**658.07** Method of Measurement. The cubic yardage of aggregate for tree root aeration to be paid for shall be the number of cubic yards, measured in the carrier, of aggregate furnished, placed, completed and accepted.

The square yardage of surface area as defined by section 658.03 shall be used to quantify the pressurized liquid injection method.

**658.08 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

ItemUnitDescription658Cubic YardTree root aeration

658 Square Yard Tree Root Aeration, Pressurized Liquid Injection Method

# **ITEM 659 SEEDING AND MULCHING**

- 659.01 Description
- 659.02 Certification
- 659.03 Soil Testing
- 659.04 Agricultural Liming Materials
- 659.05 Lawn Fertilizers
- 659.06 Crownvetch or Bird's-Foot Trefoil Fertilizers
- 659.07 Seed
- 659.08 Water
- 659.09 Sticker
- 659.10 Crownvetch or Bird's-Foot Trefoil Inoculant
- 659.11 Sticker Cover
- 659.12 Mulching Material
- 659.13 Asphalt Mulch Tie-down
- 659.14 Fertilizing, Seeding and Mulching Lawn Seed Areas
- 659.15 Maintenance of Lawn Seed Areas
- 659.16 Fertilizing, Seeding and Mulching Crownvetch or Bird's-Foot Trefoil Seed Areas
- 659.17 Maintenance and Guarantee of Crownvetch or Bird's-Foot Trefoil Seed Areas
- 659.18 Weed Control After Suf-Final Acceptance
- 659.19 Method of Measurement
- 659.20 Basis of Payment

**659.01 Description**. This item shall consist of furnishing all seed, agricultural liming materials, fertilizer, inoculant, water, sticker, sticker cover, mulching materials, asphalt mulch tie-down, and placing, incorporating and maintaining as specified or directed.

The areas to be fertilized, seeded, mulched and paid for under this item shall include all areas as described on the plans. All areas outside of construction limits where the vegetative growth has been injuriously disturbed or destroyed by the Contractor, including those areas defined in 104.06, shall be restored and seeded in accordance with these specifications by the Contractor at no cost to the City.

**659.02** Certification. Certification shall conform to the requirements of 650.01.

**659.03** Soil Testing. The Contractor shall request a soil analysis from the Engineer when topsoil is provided under Items 651 and 653, a minimum of 30 days prior to proposed seeding. After receiving soil test results from the Engineer, the

Contractor shall make fertilizer, lime and other material applications or perform procedures in accordance with such tests and as directed by the Engineer.

**659.04** Agricultural Liming Materials. Agricultural liming materials may only be used at the rates determined by soil analysis test results or as determined by the Engineer. In the absence of a soil test, pH shall be determined by a pH meter provided by the Engineer. pH shall be corrected to 6.5 as directed by the Engineer.

**659.05 Lawn Fertilizers**. "Starter" fertilizer for lawns shall be a dry type with a ratio as noted in the soil test analysis results and applied at the rate specified in those analyzes and incorporated as noted in 659.14.

The "follow-up" fertilizer shall be a dry type fertilizer such as an 18-5-9 or 25-5-10 or similar ratio, applied at the rate of one pound of actual nitrogen per 1,000 square feet unless otherwise directed by the Engineer. Fifty percent of the total nitrogen shall be water insoluble (W.I.N.). Other analysis requires approval of the Engineer. Contractor shall apply the "follow-up" fertilizer upon acceptance.

**659.06** Crownvetch or Bird's-Foot Trefoil fertilizers. "Farm-grade" fertilizer shall be dry. Analysis shall be a 1-2-2 ratio, such as 10-20-20, or as otherwise approved by the Engineer. "Farm-grade" fertilizer shall be applied at the rate of 12 pounds per each 1000 square feet of surface soil area (500 pounds per acre), or equivalent to 12 pounds of 10-20-20 for that area.

**659.07** Seed. All seed shall meet the following requirements:

98 percent purity85 percent germination

The Contractor shall furnish to the Engineer a letter of certification that all seed to be used comes from a source approved by the City, and meets the requirements of these specifications. Seed which is wet, moldy or otherwise damaged in transit shall not be acceptable. The seed mix shall be delivered in clean sealed bags bearing certified analysis as follows (percentages are by weight):

Lawn seed mix:

Sunny seed mix (Relatively Low Maintenance)

Fairlawn Brand
35% Kentucky Bluegrass
10% Baron Kentucky Bluegrass
15% Pennlawn Red Fescue
10% Brightstar II Perennial Ryegrass
10% Pizzazz Perennial Ryegrass
10% Seville II Perennial Ryegrass

Or an equal approved by the Engineer. Apply seed at the rate of 5 pounds per 1000 square feet.

Alternate Sunny Seed Mix (Low Maintenance)

Fescue Plus Mixture
25% Millenium Tall Fescue
25% Plantation Tall Fescue
25% Crossfire II Tall Fescue
15% Brightstar II Perennial Ryegrass
10% Kentucky Bluegrass

Or an equal approved by the Engineer. Apply seed at the rate of 6-7 pounds per 1000 square feet.

Shady Seed Mix

Fairlawn "Shady" 15% Shadow Chewings Fescue 15% Pennlawn Red Fescue 15% Intrigue Chewings Fescue 15% Creeping Red Fescue 10% Shademaster II Red Fescue 20% Seville II Perennial Ryegrass 10% Kentucky Bluegrass

Or an equal approved by the Engineer. Apply seed at the rate of 5 pounds per 1000 square feet.

Alternate Shady Seed Mix (Low Maintenance)

> Fescue "Plus" Mixture 25% Millenium Tall Fescue 25% Plantation Tall Fescue 25% Crossfire II Tall Fescue 15% Brightstar II Perennial Ryegrass 10% Kentucky Bluegrass

Or an equal approved by the Engineer. Apply seed at the rate of 6-7 pounds per 1000 square feet.

Athletic field seed mix (Relatively High Maintenance) 50% Kentucky Bluegrass20% Seville II Perennial Ryegrass15% Brightstar II Perennial Ryegrass15% Applaud Perennial Ryegrass

Or an equal approved by the Engineer. Apply seed at the rate of 5 pounds per 1000 square feet.

(Medium Maintenance)

Akron Lawn Seed Mix
30% Pennlawn Creeping Red Fescue
17% Baron Kentucky Bluegrass
17% Blue Chip Kentucky Bluegrass
16% Nassau Kentucky Bluegrass
10% Brightstar II Perennial Ryegrass
10% Pizzazz Perennial Ryegrass

Or an equal approved by the Engineer. Apply seed at the rate of 5 pounds per 1000 square feet.

Low maintenance mixture

Utility Field Mix 50% Fawn or Kentucky 31 Tall Fescue 40% Annual Ryegrass 10% Kentucky Bluegrass

Or an equal approved by the Engineer. Apply seed at the rate of 6-7 pounds per 1000 square feet.

Alternate Low Maintenance Mixture: (Very Slow Growth)

"No-Mow" Mixture 50% MX-86 Sheep Fescue 50% Minotaur Hard Fescue

Or an equal approved by the Engineer. Apply seed at the rate of 4 pounds per 1000 square feet.

Crownvetch Seed mix:

50 percent Crownvetch (Coronilla varia) 50 percent Annual Ryegrass (Lolium multiflorum)

Bird's-Foot Trefoil mix:

50 percent Empire Bird's-Foot Trefoil (Lotus Corniculatos) 50 percent Annual Ryegrass (Lolium Multiflorum)

Crownvetch and Bird's-Foot Trefoil shall be applied at the rate of 1 pound (0.50 pound for each of the seed varieties) for each 1,000 square feet of area.

Where Crownvetch or Bird's-Foot Trefoil are specified in existing turf, the seed shall be applied at one (1) pound for each 1,000 sq. Ft., but without annual rye.

**659.08 Water**. Water shall be potable water metered from hydrants in accordance with standard rules and regulations of the City of Akron Public Utilities Bureau, or an approved equal. Newly seeded areas shall receive a minimum of 1 inch of water each week.

**659.09** Sticker. Molasses (table syrup) or sweet soda pop shall be used. A mixture of 9 parts water and 1 part sticker shall be used to coat the Crownvetch or Bird's-Foot Trefoil seed for dry seeding.

**659.10** Crownvetch or Bird's-Foot Trefoil Inoculant. The inoculant for treating Crownvetch or Bird's-Foot Trefoil seeds shall be a pure culture of nitrogen-fixing bacteria selected for maximum vitality, not more than one year old. (Temperatures above 75°-80°F weaken bacteria and make inoculant less effective). All cultures shall be subject to the approval of the Engineer. Only inoculant that has been specifically manufactured for the seed being treated shall be used. The amount of inoculant to use shall be as specified by the manufacturer. Sticker-coated seed shall be completely coated with inoculant for dry seeding. If seed is hydraulically applied, the inoculant shall be 10 times the normal rate specified by the manufacturer for dry seeding.

**659.11** Sticker Cover. Cornstarch shall be mixed at the rate of 0.50 lb. of cornstarch to 100 pounds of inoculated Crownvetch Or Bird's-Foot Trefoil seed for dry seeding.

**659.12** Mulching Material. All materials shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or injurious to desired plant growth.

Straw: Straw shall be new crop-cut, reasonable free of weeds or crop seed. It shall be applied at the rate of 90 pounds for each 1,000 square feet of seeding.

Excelsior Matting: Natural wood fiber matting, manufactured with nylon mesh netting, shall be installed as erosion control on slopes 3:1 or steeper, or as directed by the Engineer. Excelsior matting or equals approved by the Engineer shall be secured by steel staples and installed per manufacturer's recommendations, as specified in 668.

Hydro mulch: Mulch shall contain a blend of no greater than 30 percent paper and a minimum of 70 percent wood fiber. The mulch shall be applied at a minimum rate of 34 pounds (dry weight) for each 1,000 square feet of seeding if the area is 4:1 or flatter. If the area is steeper than 4:1, mulch shall be applied at a minimum rate of 46 pounds (dry weight) for each 1,000 square feet of seeding.

Hydro mulch shall be applied in the spring from the time the ground is workable to the first week of May. During the fall season, hydro mulch shall be applied from the second week of August to the second week of September, unless otherwise approved by the Engineer.

**659.13 Asphalt Mulch Tie-Down**. Rapid curing (RC-70, RC-250 and RC-800), medium curing (MC-250 and MC-800) and emulsified asphalts (SS-1, CSS-1, CMS-2) can be used to hold mulch in place. The rate of application shall be 0.25 gallons for each 1,000 square yards.

**659.14 Fertilizing, Seeding and Mulching Lawn Seed Areas**. Topsoil, if specified, whether new or removed from stockpile, shall be placed and spread in accordance with 653.

Lime, if required as a result of soil test or as required by the Engineer, shall be incorporated into the soil by disc, harrow or tiller to a depth of six inches or as otherwise directed.

"Starter" fertilizer shall be incorporated into the soil to a depth of 4 inches, unless otherwise directed by the Engineer. "Starter" fertilizer shall be incorporated separately from lime incorporation.

Seedbed shall then be prepared removing all rock and foreign material greater than one inch in any dimension and fine graded by raking to a grade level consistent to and as noted in 653.06 and quality to the satisfaction of the Engineer.

The Contractor shall perform core aeration to a minimum depth of three (3) inches with a minimum of twenty (20) holes per square foot prior to the application of a "follow up" fertilizer.

A "follow-up" fertilizer shall be applied to the newly established lawn after acceptance, as noted in 659.05.

In the event a properly completed and approved seedbed has crusted due to moisture or for any reason prior to the actual seeding application, the surface shall be lightly scarified prior to broadcasting of seed.

Seed shall be evenly broadcast, drilled or as otherwise approved by the Engineer within two hours of completion and approval of seedbed preparation. Seed/soil contact, defined as at least 75% of the seed being evenly incorporated into the top  $\frac{1}{2}$ ° of topsoil, is necessary to insure seed hydration from contact with the soil

until germination is complete. Acceptable methods include drilling seed in with a seeder, hydraulically applying seed at a 90 degree angle from the nozzle to the ground or broadcasting and dragging the seed in the top  $\frac{1}{2}$ " of topsoil. The application of seed will not be permitted on a hard or crusted seedbed surface.

Straw mulch shall be manually applied within two hours after seeding, or as otherwise approved by the Engineer.

Asphalt mulch tie-down, if required by the Engineer, shall be applied after mulch installation.

Water seeded/mulched areas immediately after completion. Contractor shall supply appropriate hose, couplings and/or sprinklers to reach all newly seeded areas. Natural rainfall shall be supplemented to provide a minimum of moisture necessary for proper seed/root development.

**659.15 Maintenance of Lawn Seed Areas**. All seeded and mulched areas shall be maintained until acceptance. Maintenance shall also include furnishing and installing approved barricades and signs to protect newly seeded and mulched areas. All areas damaged following seeding or mulching operations due to wind, water, fire, or other causes, shall be repaired. Such damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding. It then shall be refertilized, reseeded and remulched, as directed by the Engineer.

Contractor shall maintain seeded areas until acceptance, minimum of 30 days after a satisfactory stand of grass in vigorous and thriving condition is established. Maintenance shall include watering, mowing, weeding, aerating, reseeding, fertilizing and disease and pest control, etc. Water shall be applied, under sufficient pressure, with a nozzle that will produce a spray pattern that will adequately water but not dislodge the mulching material, every seven days during the maintenance period unless otherwise determined by the Engineer, at a rate of 120 gallons per 1,000 square feet. Mow to a height of two inches whenever grass becomes three inches high. Not more than one-third of the grass height shall be removed with each mowing. Areas which do not show a satisfactory stand of grass shall be reserved at intervals of ten to fifteen days until a satisfactory turf is established. In turf areas that have settled, topsoil shall be added and the entire area re-seeded at the rate specified for that seed mix. In turf areas that have not settled, a slit seeder shall be used. This will salvage the existing turf and incorporate the seed into the soil. The seed shall be applied at half the rate specified for that seed mix. An acceptable lawn shall be defined as having a close stand of specified grass, 6-12 plants per square inch depending on the specified variety, in a vigorous and thriving condition. It shall be reasonably free of weeds and undesirable coarse grasses. Reasonably free of undesirable weeds and coarse grasses shall mean weeds and/or coarse grasses exist in less than five percent of the total seeded area. A weed control program will be required when weeds and/or coarse grasses surpass five percent of any given area, or five percent of total area seeded. Control may be exercised manually or through chemical control. When chemicals are used to control undesirable grasses or broadleafed weeds insects, or diseases, the Contractor will be required to possess a commercial applicator's license with the State of Ohio and apply chemicals according to manufacturer's recommendations. Disease and pest control shall include, but not be limited to, damage by fungus, bacteria or insects, etc., as identified by the Engineer.

**659.16 Fertilizing, Seeding and Mulching Crownvetch or Bird's-Foot Trefoil Seed Areas**. Seedbed shall be rough and cloddy with stones and soil in place, where no mowing is planned. On slopes steeper than 2:1, or where the existing finish grade is too fine, the slope shall have horizontal furrows cut across the slope. Beginning at the top of the slope, 3 inch deep furrows 2 feet apart shall be made. The Engineer may vary these dimensions to meet site conditions. Seedbed must be approved by the Engineer before Crownvetch or Bird's-Foot Trefoil seed installation.

When seeding Crownvetch or Bird's-Foot Trefoil in existing turf, seedbed preparation shall include mowing existing vegetation to a height of 3", and slitseeding or loosening the top 1/4" of soil by using an aerator, flail mower or equal approved by the Engineer. Dormant season seeding shall not require loosening the soil since the soil is opened by the freeze thaw cycle.

Lime and "farm grade" fertilizer shall be incorporated into the soil by disc, harrow, rake or other method approved by the Engineer. Lime shall be incorporated to a depth of 6 inches, and fertilizers to a depth of 4 inches, unless otherwise directed by the Engineer.

Crownvetch or Bird's-Foot Trefoil shall be sown after April 1st to August 31st, or during the dormant season which shall be from November 1st to March 31st.

Crownvetch or Bird's-Foot Trefoil seed shall be thoroughly coated with the sticker, and then rolled into the inoculant. After coating the inoculated seed with the sticker cover, the seed mix should be immediately incorporated into the top 1/4 inch of soil, unless hydraulically applied, or otherwise directed by the Engineer. Hydraulic application seed shall be combined in a water slurry with agricultural liming materials (if required by soil test), fertilizers, inoculant, and mulching materials; however, mulching materials may be applied separately. Seed shall not remain more than an hour in a water slurry with lime or fertilizers. Water for hydraulically applied seeding materials shall be provided in sufficient quantity to make a flowable slurry.

Straw mulch may be applied manually or by a mechanical blower. Mulch shall be held in place by applying a light asphalt mulch tie-down, twine, soil mulch stabilizer, or by watering. Straw mulch shall be applied within 2 hours after area has been seeded.

Mulch shall not be required when seeding Crownvetch or Bird's-Foot Trefoil in existing live turf.

Water hose, couplings, and sprinklers shall be provided to reach all areas of the newly seeded areas to receive water. Natural rainfall shall be supplemented to provide a sufficient moisture for seed germination.

659.17 Maintenance and Guarantee of Crownvetch or Bird's-Foot Trefoil Seed Areas. Areas which do not show a satisfactory catch of Crownvetch or Bird's-Foot Trefoil shall be reseeded at intervals of 30 days until a satisfactory Crownvetch cover is established. Companion grass seed shall not be applied in the reseeding work. If dry seeded, Crownvetch shall be inoculated before seeding. If hydraulically applied, inoculant shall be added to the water slurry. All seeded and mulched areas shall be maintained by the Contractor until sub-final acceptance. Seeded areas shall not receive sub-final acceptance until each square foot of area contains at least one living plant 3" or more in height or width. Maintenance shall include watering, mowing, and weed control. Maintenance shall also include furnishing and installing approved barricades and signs to protect newly seeded and mulched areas. Any areas damaged following seeding or mulching operation due to wind, water, fire or other causes shall be repaired. Such damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding, and shall be refertilized, reseeded, and remulched, as directed by the Engineer. During the growing season after seeding, areas shall be mowed to a height of 6 inches whenever vegetation becomes 10 inches high. Mowing will not be required if slope is greater than 2:1 or exceedingly rough.

Final acceptance of Crownvetch or Bird's-Foot Trefoil seeded areas shall occur when specified legumes reach six (6) to twelve (12) inches in height or width and cover a minimum of seventy-five (75) percent of 659.01 the specified planted area. Areas not vegetated with the specified legumes which are larger than two and one quarter (2.25) square feet (an area  $1.5' \times 1.5'$ ) shall be reseeded as noted above, without the nurse grass.

Acceptable Crownvetch or Bird's-Foot Trefoil areas shall have a minimum of 5 living plants for each square foot of area.

**659.18 Weed control after sub-final acceptance.** When directed by the Engineer, weeds shall be eradicated in designated areas of seeded Crownvetch or Bird's-Foot Trefoil using physical, mechanical or chemical methods, or a combination thereof, as approved by the Engineer. Herbicides shall be applied in accordance with manufacturer's recommendations using care to protect desirable plants and other improvements. Restricted herbicides shall be applied by a licensed applicator.

Payment for weed control ordered by the Engineer after sub-final acceptance shall be made for the number of square yards of weeds successfully eradicated. When eradication is ordered by the Engineer more than one time, payment shall be made each time that eradication so ordered is successfully completed. **659.19** Method of Measurement. Measurement of seeding and mulching shall be the number of square yards seeded and mulched in accordance with these specifications. Measurement of weed control shall be in accordance with 659.18.

**659.20 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	Description
659	Square Yards	Lawn seeding and mulching
659	Square Yards	Crownvetch Seeding and Mulching
659	Square Yards	Bird's-Foot Trefoil Seeding
659	Square Yards	Weed Control After Sub-Final Acceptance

### **ITEM 660 SODDING**

- 660.01 Description
- 660.02 Certification
- 660.03 Materials
- 660.04 Submittal
- 660.05 Lifting Sod
- 660.06 Soil Testing
- 660.07 Preparation of Areas to be Sodded
- 660.08 Placing Sod
- 660.09 Placing Sod in Ditches
- 660.10 Watering
- 660.11 Maintenance of Sodded Areas
- 660.12 Clean up
- 660.13 Method of Measurement
- 660.14 Basis of Payment

**660.01 Description**. This item shall consist of furnishing, hauling and excavating for preparing the bed and placing topsoil, fertilizer and sod. It shall also include watering, mowing and maintaining sod, all as specified herein.

**660.02** Certification. Certification shall conform to the requirements of 650.01.

**660.03** Materials. Topsoil shall be in accordance with 653.03.

Water shall be potable water metered from hydrants in accordance with standard rules and regulations of the City of Akron Public Utilities Bureau, or an approved equal.

Sod shall be a first grade certified mixture grown by a sod producer, exhibiting a vigorous healthy root system not less than two years old, free of weeds and

#### 660.03

objectionable grasses, grubs, diseases or injurious insects and grown on mineral soil, unless otherwise accepted by the Engineer.

Provide sod composed of the following:

Sunny sod mixture (Medium Maintenance)

> Akron Mix 30% Pennlawn Creeping Red Fescue 17% Merit Kentucky Bluegrass 17% Liberty Kentucky Bluegrass 16% Nassau Kentucky Bluegrass 10% Manhatten II, Pizzazz or Seville II Perennial Ryegrass 10% Brightstar Perennial Ryegrass

Or an equal approved by the Engineer.

Alternate Sunny Sod Mixture (Medium Maintenance)

> Tall Fescue 90/10 Seed Mix 30% Stetson Tall Fescue 30% Lancer Tall Fescue 30% Bravo Tall Fescue 10% Shamrock Kentucky Bluegrass

Sunny Sod Mixture: (High Maintenance with Irrigation System)

> Kentucky Bluegrass 20% Merit Kentucky Bluegrass 20% Blue Chip Kentucky Bluegrass 20% Denim Kentucky Bluegrass 20% Nassau Kentucky Bluegrass 20% Midnight Kentucky Bluegrass

Alternate Sunny Sod Mixture: (High Maintenance with Irrigation System)

Sod Blend 30% Abbey Kentucky Bluegrass 30% Raven Kentucky Bluegrass 20% Washington Kentucky Bluegrass 20% Goldrush Kentucky Bluegrass

Alternate Sunny Sod Mixture:

(High Maintenance with Irrigation System)

Superiors Sod Blend 30% Shamrock Kentucky Bluegrass 30% Impact Kentucky Bluegrass 30% Wildwood Kentucky Bluegrass 10% Limousine Kentucky Bluegrass

If this or an acceptable approved equal is not available, the sod grower can upon approval by the Engineer, slit seed acceptable into the sod field six weeks prior to cutting sod.

> Shady sod mixture (Low Maintenance)

> > Fescue "Plus" Mixture 25% Millenium Tall Fescue 25% Plantation Tall Fescue 25% Crossfire II Tall Fescue 15% Brightstar II Perennial Ryegrass 10% Kentucky Bluegrass

Or an equal approved by the Engineer.

Copies of the sod certification label clearly stating varieties or blend of grass seed used in developing the sod which is to be supplied, shall be submitted for the Engineer's approval thirty days in advance of anticipated installation, along with the grower's name, field location of sod being grown and proposed for cutting and certificate of inspection by the Ohio Department of Agriculture. No substitutions of varieties shall be permitted, except where proof is submitted in writing that sod specified is not obtainable. A proposal shall be submitted in writing to the Engineer for his consideration of the use of another variety or blend. Root systems shall be protected from wind and sun and protected against dehydration, contamination and heating during transportation and delivery. Stored sod shall be kept moist and under shade or covered with moistened burlap and piled not more than two feet in height or depth. Sod shall be placed within 24 hours after delivery to the project site.

**660.04 Submittal**. The City reserves the right to inspect sod in the grower's field prior to cutting and lifting, deliver or at any other time. The Engineer, either in lieu of or in addition to the above, may require a pad of sod of the size that is proposed for the project delivered to the project site for approval.

**660.05 Lifting Sod**. The sod shall be recently mowed uniformly at a height of 1 to 2 inches and the sod shall be machine cut at a uniform soil thickness of 3/4 inches at the time of cutting. Measurement of thickness shall exclude top growth of thatch. Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable

#### 660.06

deviations from standard widths and lengths shall be plus or minus 1/2 inch of width and plus or minus 5% of length. Broken pads and torn or uneven ends shall not be acceptable. Sod shall not be transplanted when moisture content (excessively wet or dry as determined by the Engineer) may adversely affect its survival. Sod shall be harvested, delivered, and transplanted within a period of 36 hours unless a suitable preservation method is approved prior to delivery.

**660.06** Soil Testing. Soil testing and material incorporation shall be performed in accordance with 659.03.

**660.07 Preparation of Areas to be Sodded**. The joint between sod and existing turf shall be a clean smooth vertical cut 4" deep made with a powered lawn edger. Areas to be sodded shall be excavated to such a depth that when the topsoil and sod are in place (after rolling), the top of the sod root system will be flush with surrounding grade and in accordance with the typical cross-section and proposed grades. The subgrade, shall be prepared in accordance with 653.05 and topsoil spread in accordance with 653.06. Grade level and quality of workmanship shall be approved by the Engineer prior to placement of sod. "Starter" fertilizer shall then be applied in accordance with 659.05 and 659.14.

During periods of higher than optimal temperature for species being specified and after all unevenness in the soil surface has been corrected and approved by the Engineer, the sod bed shall be lightly moistened immediately prior to laying the sod.

**660.08 Placing Sod**. Installation of sod may take place any time grass is in a growing stage, normally between April 15 and November 1, providing ground is in a workable condition and temperature is above 35°F. The Engineer shall determine when the ground is in workable condition. At no time will sod installation be permitted on frozen soil. During periods of drought conditions or high temperatures, soil shall be watered prior to sod installation to a soil depth of two inches. Soil surface, once approved for installation, shall be kept loose, not compacted, nor having a crust, such as normally occurs after a rain.

Sod placed on slopes shall be laid with the long edges of the strip parallel to the contour starting at the bottom of the slope. Sod shall be watered immediately after placing to prevent excessive drying during progress of work.

The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause air drying of the roots. On 3:1 or steeper slopes, sod shall be pegged after being placed using a minimum of 2 stakes per pad not more than 3 feet apart. Soft wood stakes shall be approximately  $1/2 \times 3/4 \times 12$  inches and shall be placed on "up slope" edge with the upper 2 inches of the stakes exposed.

As sodding is completely rolled out in any one section (one block), trimming shall be completed, sidewalks, aprons and curbing cleaned, and sod watered to approval. Within twenty four hours of a thorough watering, sod shall be rolled with a 200 pound roller, except in the pegged areas. Sod remaining high after rolling, specifically related to sidewalks, aprons and curbs shall be hand tamped until flush. Sodding laid on slopes shall be hand tamped to bring the sod into firm contact with the sod bed and to insure tight joints between pads of sod. After sod has rooted into the sod bed the exposed wood stakes shall be driven slightly below flush with the finished grade.

As soon as practicable following the initial water but in every case prior to the second watering the entire area shall be examined for open joints or other signs of surface imperfections. All open joints or other voids shall be carefully filled with topsoil to prevent air drying of the roots and to eliminate undulations in the surface. Topsoil shall be as specified in 653.03.

**660.09 Placing Sod in Ditches**. Sod shall be placed transversely in ditches with successive strips neatly matched, and transverse joints staggered. The sod shall be held in place securely with wooden stakes as described in 660.08.

**660.10 Watering**. The Contractor shall keep all sodded areas, including the subgrade, thoroughly moist from the time of initial installation and throughout the maintenance period.

Watering shall be done as frequently as necessary to maintain grass blades in a turgid condition, but not as to saturate the soil beneath. Saturated soil will promote sod injury and depressions if trafficked by foot or vehicle. The Contractor shall furnish potable water, watering hose and apparatus necessary for this work.

**660.11 Maintenance of Sodded Areas**. All sodded areas shall be maintained for a minimum of 30 days or until acceptance by the City, including watering, mowing, aerating, weeding, fertilizing and disease and pest control, etc. Maintenance shall also include furnishing and installing approved barricades and signs to protect newly sodded areas. All damaged areas shall be repaired to re-establish the condition and grade of the area prior to sodding and then shall be resolded as directed by the Engineer. After sodding, the areas shall be mowed to a height of two inches whenever grass becomes three inches high. Not more than 1/3 of the grass height shall be removed with each mowing.

On acceptance by the City, a "follow up" fertilizer, as noted in 659.05, shall be applied at a rate of one pound of actual nitrogen per 1,000 square feet.

All sod which fails to become established 30 days after installation shall be removed and replaced with new sod as directed by the Engineer. New sod shall be installed and maintained in accordance with the requirements of these specifications.
#### 660.12

Acceptable lawn areas shall be defined as 100 percent of the area having a close stand of the specified grass in a vigorous and thriving condition. It shall also be reasonably free of weeds and undesirable coarse native grasses as well as damage by insects, diseases, etc. When chemicals are used to control undesirable grasses or broadleafed weeds, insects, or diseases, the Contractor will be required to possess a commercial applicator's license with the State of Ohio and apply chemicals according to manufacturer's recommendations. Disease and pest control shall include, but not be limited to, damage by fungus, bacteria or insects, etc., as identified by the Engineer.

**660.12** Clean up. All temporary barricades and signs shall be removed from sod areas. All debris from the sod bed, wood pallets, protective coverings from temporarily stored sod, equipment and excess sod shall be removed from the site. Adjacent areas disturbed by this work shall be restored at no cost to the City.

**660.13** Method of Measurement. Quantities to be paid for shall be the number of square yards of sod installed in accordance with these specifications.

**660.14 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
660	Square Yard	Sodding

The unit price shall include full compensation for furnishing all labor, materials, tools, topsoil and equipment necessary to complete the item as specified.

# **ITEM 661 PLANTING VINES AND BULBS**

- 661.01 Description
- 661.02 Certification
- 661.03 Topsoil
- 661.04 Fertilizer
- 661.05 Lime
- 661.06 Soil Testing
- 661.07 Organic Material
- 661.08 Mulching Material
- 661.09 Vines and Bulbs
- 661.10 Nursery Stock
- 661.11 Container
- 661.12 Location and Source of Supply
- 661.13 Inspection
- 661.14 Labeling

- 661.15 Certificates of Inspection
- 661.16 Progress Plant Inspection
- 661.17 Rejection of Plants
- 661.18 Digging and Packing of Plants
- 661.19 Water Loss Preventive Spray and Temporary Storage
- 661.20 Layout of Planting
- 661.21 Beds
- 661.22 Planting Holes
- 661.23 Surplus Excavation
- 661.24 Backfill
- 661.25 Herbicide
- 661.26 Planting
- 661.27 Planting Potted Vines
- 661.28 Pruning
- 661.29 Mulching
- 661.30 Watering
- 661.31 Weed Control After Sub-Final Acceptance
- 661.32 Maintenance and Guarantee
- 661.33 Final Inspection and Final Acceptance
- 661.34 Method of Measurement
- 661.35 Basis of Payment

**661.01 Description**. This item shall consist of furnishing and planting vines and bulbs including crown vetch on areas, and in the arrangement shown on the planting plan, and as specified or as directed by the Engineer. Included in this work is the layout of planting areas and holes; digging and preparation of vine and bulb planting holes, or planting beds if specified; furnishing and incorporating required lime, fertilizer, topsoil and peat moss; installing plants, mulch, water and topsoil; pruning, applying chemicals and water loss preventive spray; clean-up and all incidentals necessary to complete this item.

**661.02** Certification. Certification shall conform to the requirements of 650.01.

**661.03 Topsoil**. Topsoil shall conform to 653.03

**661.04 Fertilizer**. On all vines and bulbs except crown vetch, fertilizer shall, as determined by the soil analysis recommendations, be applied both in type and rate as noted in the recommendations. In the absence of a soil analysis, a 20-6-12 or 18-6-12 (3-1-2 ratio) 100% slow release, sulfur coated urea or approved equal shall be applied at planting at the rate of 3 pounds of <u>actual nitrogen</u> per 1000 square feet, or 5 cups of fertilizer per cubic yard of backfill. Unless otherwise specified, this fertilizer shall be thoroughly and evenly incorporated into the soil backfill at planting. Rates of application and fertilizer ratios shall not vary unless approved by the Engineer.

#### 661.05

Fertilizer for crown vetch shall be a 10-20-20 "farm grade" fertilizer applied at the rate of 500 pounds per acre, or 12 pounds per 1,000 Square feet, or equivalent as approved by the Engineer. Apply fertilizer uniformly over the entire newly planted area prior to mulching.

**661.05 Lime**. Contractor shall apply lime according to the rate and method determined by the soil analysis and recommendations.

**661.06 Soil Testing**. Soil testing and material incorporation shall be performed in accordance with 659.03

**661.07 Organic Material**. Organic material shall be composted municipal sludge as processed by the City of Akron under the Trade Name EarthPro<sup>TM</sup> or approved equal.

**661.08 Mulching Material**. Mulch for all vines except crown vetch shall be a processed shredded hardwood bark consisting of a minimum of 90 percent hardwood bark and a maximum of 10 percent wood material of which no dimension is greater than 4 inches nor smaller than 1/2 inch. Bark shall be clean, free of mold, soil, clods, debris, insects or any other noxious matter.

The Contractor will be required to submit a one cubic foot sample for approval prior to intended use. The Engineer also reserves the right to inspect the source of the shredded bark.

Mulch material for crown vetch shall be straw in accordance with 659.12, or existing vegetative material approved by the Engineer.

**661.09** Vines and Bulbs. All vines and bulbs furnished under this item shall be true to name and shall follow standard names of vines, bulbs, shrubs, and trees as set forth in Horticultural Standards as adopted by the AAN.

**661.10** Nursery Stock. All vines and bulbs, except crown vetch shall be nursery grown for a period of one year under the same climatic conditions as exist at the location to be planted, and shall be well developed, healthy, free from insects and diseases, and possess a normal unbroken root system. All vines shall meet the standards as set forth in ANSI Z 60.1-2004 or most current. In all cases where grades are indicated in those standards as Number 1, Number 2, etc., the Number 1 or top grade will be furnished.

Crown vetch shall be grown for a period of six months minimum and may be specified as bare root, peat pots or cell packs.

**661.11 Container**. Plants specified to be container grown shall conform to the requirements of ANSI Z 60.1-2004 or most current. Container plant material which shows evidence of being root bound, recently canned or which has girdling

roots shall be rejected. Plants shall remain in the containers until immediately before planting.

**661.12** Location and Source of Supply. The Contractor shall supply, within 15 days after receipt of the notice of award of the contract, complete and detailed information concerning the source of supply for each of the materials included in the planting list, including mulching. Plants shall be from sources in the same or colder hardiness zone as the location of the project.

**661.13 Inspection**. All nursery stock to be purchased under this specification shall be subject to inspection and sealing by the Engineer, in the nursery, before digging and shipping. All stock must be inspected and approved before the start of the planting season, unless otherwise directed by the Engineer. Final acceptance of all plant materials will be given only after the materials are planted, and after meeting all the requirements prescribed herein. The seals shall remain on the vines until after final acceptance is made and shall then be removed. The Contractor shall bear all costs incurred by the nursery if a tagging fee is charged.

**661.14 Labeling**. Legible labels must be attached to all specimens, or boxes, bundles, bales, or other containers, indicating the necessary detailed information covering botanical genus and species name, the common name, size or age of each species or variety and the quantity contained in the individual bundles, boxes or bales.

**661.15** Certificates of Inspection. All plants must be properly inspected before removal from the nursery by authorized Federal, State, City or other authorities as may be required in the area where the nursery involved is located. Each shipment, invoice or order of plants must be declared and certified free of diseases and insects of any kind with such necessary inspection certificates accompanying each shipment, invoice or order of plants as may be required.

**661.16 Progress Plant Inspection**. All nursery stock furnished by the Contractor shall be subject to inspection, within 48 hours after delivery of said stock, by the Engineer. The plants shall also be subject to such inspection during the entire life of the contract, and infestations occurring on the stock as a result of conditions existing prior to the receipt of the plants on the project shall be cause for rejection.

**661.17 Rejection of Plants**. Any plant not approved by the Engineer, and plants not meeting the requirements will be cause for rejection. All rejected plants shall immediately be removed and disposed of by the Contractor and approved nursery stock of like variety, size, age, etc., shall be replaced without additional compensation. Replacement stock shall meet all the requirements herein prescribed.

**661.18 Digging and Packing of Plants**. All plants shall be dug with reasonable care and skill, immediately before shipping, avoiding all possible injury to, or loss of, roots. After plants are dug, their roots shall not be permitted to dry out. The stock shall be properly packed in sphagnum moss, moist straw or other

suitable material that will insure the arrival of plants in acceptable condition. Stock which has heated or "sweated" by reason of tight packing or poor ventilation will be rejected. Plants shall not be exposed to artificial heat nor freezing temperatures.

**661.19** Water Loss Preventive Spray and Temporary Storage. Immediately following delivery and inspection at the job, all plant material shall be sprayed in the storage areas, before being planted, heeled in or stored, with an appropriate anti-desiccant at the rate specified by the manufacturer. The spray coverage shall be complete on both the upper and lower surfaces of the branches and foliage to the point of run-off. Spray nozzles shall be the type to produce a fine mist.

Evergreens and broadleafed evergreens shall be sprayed prior to planting at all seasons; however, deciduous trees, shrubs or vines, which normally shed their leaves during the fall season, need not be sprayed if dug in the nursery during the period of September 15 to April 1. In the event planting is delayed until after April 1, and substantial growth has begun, deciduous trees, shrubs, or vines shall be sprayed as specified prior to removal from heeling beds, when directed by the Engineer.

Following spray treatment and after delivery, all bare root plants which cannot be planted promptly shall be heeled in, in a trench, spread, and the roots covered with soil and thoroughly watered. If plants are not to be stored for a period longer than 10 days, they may be placed in an approved well ventilated, but cool, moist storage shed and the roots completely covered with moist straw. All plants heeled in or stored shall be properly maintained by the Contractor until planted. In the event heeled in plant material must be held over until the next planting season, such heeled in materials shall be lifted and replanted in a satisfactory manner in nursery rows.

The balled and burlapped plants, if not immediately planted after delivery and inspection, shall be adequately protected by moist mulching material applied to amply cover the balls of earth in a manner satisfactory to the Engineer. Mulch will be placed immediately after each individual shipment is received and unloaded, unless plants are scheduled for immediate planting. Root systems (balls, containers) shall not be allowed to dry below an acceptable reading on a moisture meter approved by the Engineer. Plants allowed to dry below this level will become stressed and therefore will be rejected. Watering methods shall be adequate to soak the entire root ball (interior) and are subject to approval of the Engineer.

Crown vetch not planted within 2 hours of delivery shall be set in shade and kept watered until planted.

**661.20** Layout of Planting. Before the digging of planting holes, the Contractor shall lay out, by suitable staking, the location of all planting holes and arrangement of all planting beds. The layout of planting shall be approved by the Engineer.

Unless otherwise noted on the plans or as directed by the Engineer, crown vetch shall be planted two (2) feet on center, in staggered rows.

**661.21 Beds**. The beds and defined bed edges shall conform to the areas specified or as directed by the Engineer, and shall be excavated uniformly to a specified depth. A defined (beveled) bed edge shall be excavated to a depth of 3 inches and a width of 6 inches by mechanical or other approved methods, to define and retain mulch.

Crown vetch areas shall be cleared and grubbed in accordance with 201.03 with all vegetation being cut to a height of 2-3 inches. All herbaceous vegetation shall be killed by applying a nonselective herbicide a minimum of seven (7) days before planting. Reapplication before planting may be necessary if vegetation is not controlled by first application.

When directed by the Engineer, an alternative method of planting crown vetch on erodible slopes may be used. This method includes application of an approved plant growth regulator to the existing vegetation rather than the nonselective herbicide. Methods and materials shall be applied in accordance with the manufacturer's recommendations and approved by the Engineer.

**661.22 Planting Holes**. When planting areas indicated on the plans are not shown in beds, holes shall have a level bottom, be excavated with a horizontal diameter of not less than 12 inches, and have a depth of not less than 12 inches measured vertically at the lower side of the pocket hole. The hole shall be of sufficient size to provide for not less than 6 inches of backfill beneath and around the root system.

Bulb planting holes shall be dug, or augured, to the specified depth for the specified varieties, see Figure 661-1. Hole width shall be adequate to place bulbs and allow for a minimum of  $\frac{1}{2}$  inch backfill placed around each bulb.

Crown vetch planting holes shall be vertically created with a Mattock, dibble bar, pick axe or other approved tool. The hole shall be of sufficient size to accept the entire peat cube or root system.



**Figure 661-1** 

**661.23** Surplus Excavation. Surplus and unacceptable excavation shall be disposed of in accordance with 203.

**661.24 Backfill.** Backfill for planting beds and planting holes shall consist of 80% of acceptable excavated soils and 20% of moist EarthPro<sup>TM</sup> compost. If soil taken from the planting holes or planting beds is unacceptable to the Engineer as backfill material for the plants, topsoil in accordance with 653 (without additional compensation) shall be used as backfill without the addition of compost. Acceptable excavated soils shall consist of friable sandy loam or sandy clay loam site soils, not soils with a high content of rock or gravel, heavy clay, construction debris, or unacceptable organic material.

Approved backfill shall be added in 6 inch lifts to the plant holes around the sides of the plant root system and then followed with tamping. All soils used for backfill shall be tested to determine fertilizer and lime requirements for the plant materials.

Backfill for bulbs shall consist of bonemeal in accordance with the manufacturer's recommendations, along with 20% EarthPro<sup>TM</sup> as stated above.

Compost shall not be added to the soil sample until after soil has been tested. Soils shall be corrected in accordance with soil test recommendations and shall have moist compost mixed with the corrected soil. Backfill shall be placed and tamped to a depth of 6 inches beneath the root system of all vines and small shrubs except crown vetch unless otherwise directed by the Engineer. Backfill for crown vetch shall consist of existing soil.

**661.25 Herbicide**. An approved herbicide (pre-emergent) shall be applied to newly completed areas, prior to mulching, in accordance with manufacturer's recommendations and as directed by the Engineer. Herbicide shall be applied by a licensed applicator.

**661.26 Planting**. Spring planting shall be performed during the time the soil is in a workable condition, until May 15th. Fall planting may be performed from September 15th until the ground is no longer in a workable condition. The Engineer shall determine when the ground is in a workable condition. No vines shall be planted when the temperature is below  $33^{\circ}$ F or the ground is frozen or muddy.

Prior to planting, crown vetch shall be immersed into a dilute solution of Rapid Gro and inoculant for one hour.

Plant installation shall proceed after approval by the Engineer of the finish grading and the preparation of planting areas. After placing and tamping backfill in bottom of planting hole, plant shall be installed upright in center of planting hole, and backfill carefully placed and tamped around the root system. Sufficient backfill shall be installed around the plant crown to meet adjacent finish soil grade with the planting standing in a natural position, at the same depth as it grew in the nursery. The soil shall be thoroughly watered so that no air pockets remain around the roots. Leave a depression or rain pocket to catch water.

Spring bulbs shall be fall planted and performed from October 15<sup>th</sup> to when the soil becomes unworkable, or December 15<sup>th</sup>. The Engineer shall determine when the soil conditions are workable. Before placing bulbs in the planting holes, bonemeal shall be placed in the bottom of the hole, then the bulb placed in the hole, with the growing tip upright in each hole. Backfill can then be placed and firmed in each hole. Mulch to specified depth can then be placed over the entire bed area.

**661.27 Planting Potted Vines**. Potted vines shall be of the size and condition specified and shall conform to ANSI Z 60.1-2004 or most current. Vines shall be delivered to the project in pots which shall be removed just prior to planting unless otherwise directed by the Engineer.

**661.28 Pruning**. Plants shall have dead or broken runners removed. Hand pruners shall be used for pruning work. All tools shall be in good condition, kept sharpened and dipped or sprayed with an appropriate disinfectant to keep plants healthy.

All clippings shall be removed from the site before application of the mulch.

**661.29** Mulching. Mulching material shall be uniformly placed between the vines and over the entire planting area within 24 hours after planting a given area and to the depth of 2 inches minimum unless otherwise shown on the plans.

Broadcast 2 bales of hay or straw per 1,000 Square Feet around completed crown vetch planting.

**661.30 Watering**. All plants shall be watered during the planting operation in accordance with 661.26 and 663.16. Crown vetch crowns shall be watered 2 days after planting to the satisfaction of the Engineer. Water shall be potable water metered from hydrants in accordance with standard rules and regulations of the City of Akron Public Utilities Bureau, or an approved equal.

**661.31 Weed control after sub-final acceptance.** When directed by the Engineer, weeds shall be eradicated in designated planting beds using physical, mechanical or chemical methods, or a combination thereof, as approved by the Engineer. Herbicides shall be applied in accordance with manufacturer's recommendations using care to protect desirable plants and other improvements. Restricted herbicides shall be applied by a licensed applicator.

Payment for weed control ordered by the Engineer after sub-final acceptance shall be made for the number of square yards of weeds successfully eradicated. When eradication is ordered by the Engineer more than one time, payment shall be made each time that eradication so ordered is successfully completed.

**661.32 Maintenance and Guarantee**. All vine plantings shall be maintained for a minimum of 30 days following satisfactory completion of planting or until sub-final acceptance by the City, including watering, weeding, litter and debris, and disease and pest control. At 30 days, the Contractor shall replace all dead and dying plants, raise or lower any improperly planted vines and eliminate any and all weeds, paper and other foreign debris.

Bulbs shall be fertilized after blooming, during new bulb development with 5-10-10 agricultural fertilizer at the rate of 3 pounds per 100 square feet.

All plant materials shall be guaranteed for one year after preliminary acceptance of the plant material. Should replacement fall due during a non-planting season, the Contractor may request the City's permission to defer planting until the proper season.

Contractor shall replace all dead crown vetch plants during the one year guarantee period, when 3 or more plants within any 100 Square Foot area have died.

**661.33 Final Inspection and Final Acceptance**. Upon completion of the one year guarantee period, the Engineer shall make a final inspection. All plants not found in a healthy viable condition, free of insects and diseases shall be replaced by the Contractor as well as pruning dead and broken branches. The Contractor on being notified in writing shall complete replacements and other noted work in a reasonable period of time as determined by the Engineer. Completion of correctional work to the satisfaction of the Engineer will constitute final acceptance.

**661.34** Method of Measurement. Quantities to be paid for shall be the number of vines or crown vetch planted and mulched, complete in place, as measured by the Engineer. Quantities to be paid for weed control shall be in accordance with 661.31.

**661.35 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
661	Each	Planting vines
661	Each	Planting Bulbs
661	Each	Planting crown vetch
661	Sq. Yd.	Weed control after subfinal acceptance (crown vetch)
661	Sq. Yd.	Weed control after subfinal acceptance (vines)

# **ITEM 662 PLANTING SHRUBS**

- 662.01 Description
- 662.02 Certification
- 662.03 Material
- 662.04 Soil Testing
- 662.05 Shrubs
- 662.06 Nursery Stock
- 662.07 Specimen Stock
- 662.08 Container
- 662.09 Ball and Burlap
- 662.10 Source of Supply
- 662.11 Inspection, Labeling, Certificates and Rejection of Plants
- 662.12 Water Loss Preventive Spray and Temporary Storage
- 662.13 Layout of Planting
- 662.14 Planting Beds
- 662.15 Planting Holes
- 662.16 Surplus Excavation
- 662.17 Backfill
- 662.18 Pre-Emergence Herbicide
- 662.19 Planting
- 662.20 Pruning
- 662.21 Mulching
- 662.22 Dead, Stressed, Diseased or Injured Shrubs
- 662.23 Watering and Maintenance
- 662.24 Weed Control After Subfinal Acceptance
- 662.25 Maintenance and Guarantee
- 662.26 Method of Measurement
- 662.27 Basis of Payment

**662.01 Description**. This item shall consist of furnishing and planting deciduous and evergreen shrubs on the areas and in the arrangement specified or as directed by the Engineer, including the digging and preparation of planting holes, furnishing and placing the necessary topsoil, peat, mulch, water, commercial fertilizer and all other incidentals necessary to complete this item.

**662.02** Certification. Certification shall conform to the requirements of 650.01.

662.03 Material. Material shall be:

Topsoil	
Organic Material	
Mulching	
Fertilizer	
Lime	

Water shall be potable water metered from hydrants in accordance with standard rules and regulations of the City of Akron Public Utilities Bureau, or an approved equal.

**662.04** Soil Testing. Soil testing and material incorporation shall be performed in accordance with 659.03 and 659.14 except that soils for ericaceous shrubs shall have a pH of 5.5.

**662.05** Shrubs. All shrubs furnished under this item shall be true to name and shall follow standard names of vines, shrubs, and trees in accordance with Horticultural Standards as adopted by the AAN.

**662.06** Nursery Stock. All plants shall be nursery grown for a period of at least one year under same climatic conditions as exist at the location to be planted. All shrubs shall meet the standards as set forth in ANSI Z 60.1-2004 or most current. In all cases where grades are indicated in those standards, as Number 1, Number 2, etc., the Number 1 or top grade will be furnished.

**662.07** Specimen Stock. Whenever specimen stock is specified in connection with any species or variety of plants, they shall be nursery grown, but are not to be the ordinary nursery-run grade, and they shall be fully developed, bushy and better branched to the ground or at a natural height above the ground typical of the species.

Specimen plants shall have been grown individually so that they have at no time been in contact with or crowded by adjacent plants. These plants shall have been transplanted in accordance with the accepted nursery practice in Ohio for specimen plants for the various species and varieties of plants. **662.08 Container**. Plants specified to be as container grown shall conform to the requirements of ANSI Z 60.1-2004 or most current. Damaged plants in containers will be rejected by the Engineer. Plants shall remain in the containers until immediately before planting.

**662.09 Ball and Burlap**. Whenever plants are specified B & B, they shall be balled and burlapped, with the shape and size of ball in proper proportion with the type and size of plant. The wrapping of the ball shall be performed carefully and firmly. Whenever a figure in parentheses is used following "B & B", this indicates the diameter of the minimum size ball which will be acceptable. These plants shall be handled by the ball only and not by the plant itself. The slightest indication of manufactured earth balls or handling of the plant itself will be cause for the rejection of such plants. Otherwise, the ball sizes shall be as specified for the size and type of plant in ANSI Z 60.1-2004 or most current.

**662.10** Source of Supply. Sources of supply shall meet the requirements of 661.12.

**662.11 Inspection, Labeling, Certificates and Rejection of Plants**. All shrubs to be furnished shall conform to 661.13 through 661.17.

**662.12 Water Loss Preventive Spray and Temporary Storage**. Spraying and storage of plants shall conform to the requirements of 661.19.

**662.13 Layout of Planting**. Before the digging of planting holes or beds, the Contractor shall lay out, by suitable staking, the location of all planting holes and beds. The layout of planting shall be approved by the Engineer.

**662.14 Planting Beds**. Planting beds shall conform to the requirements of 661.21.

**662.15 Planting Holes**. Planting holes shall be dug with vertical sides to a depth such that when balled and burlapped shrubs are planted in the hole, the top of the ball shall be at the height above ground line specified in 662.19. Diameter of the hole shall be 18 inches greater than the root system or ball. If an auger is used for digging planting holes and polished sides occur in clay or heavy soils, the use of the auger shall be discontinued and the holes dug with a backhoe or other approved method.

**662.16** Surplus Excavation. Surplus excavation from the bed and pocket holes shall be disposed of in accordance with 203.

662.17 Backfill. Backfill shall conform to the requirements of 661.24.

**662.18 Pre-Emergence Herbicide**. Herbicide and applications shall conform to the requirements of 661.25.

**662.19 Planting**. The plants shall be the species, variety and size specified. The operation of the spring planting shall be performed during the time the soil is in a workable condition until May 15th. Fall planting shall be performed from September 15th until the ground is not workable. The Engineer shall also approve the location of each individual plant, taking into consideration its size and shape, in order that the best possible arrangement will result. One plant shall be planted in the center of each planting hole and in the arrangement shown on the plans. The top of root ball shall be two inches above the normal ground line in average soils, three inches in heavy clay soils, and six inches where impermeable soil is encountered. The roots of bareroot stock shall be carefully spread out in their natural position.

Upright plants shall be kept in a vertical position. After placing the plant in the hole, the backfill shall be carefully made, tamping with the worker's feet and with round-end rods or other approved tamping devices to insure backfill in and about all roots. At no time shall tamping or further backfill be made while the backfill is wet or a consistency that would permit it to become over-compacted or puddled by so doing. All compaction shall be such that no plants will settle lower than the depth specified. No air pockets shall be left around the roots of any plant.

**662.20 Pruning**. Shrubs shall have dead or broken branches removed. When two branches are in contact, one of the branches shall be removed below the point of contact. Plants that are so severely pruned as to spoil their form and usefulness shall be removed and replaced at no cost to the City.

Scissor-type hand pruning shears shall be used for pruning work up to one inch in diameter and scissor-type lopper shears or a hand saw used for larger pruning work. Pruning cuts shall be made flush to the collar, with no branch stub remaining. All tools shall be in good condition, kept sharpened and dipped or sprayed with an appropriate disinfectant, both before use on City projects, and between pruning each tree, to discourage spreading disease and insects. Anvil-type shears are not acceptable.

**662.21 Mulching**. Mulching material conforming to 661.08 shall be placed to a uniform depth over the entire planting area within 24 hours after planting. The depth of application for wood chips and shredded bark shall be not less than three inches, in place and after settling. For individual plants the mulch shall be spread to cover the plant hole and an area of four inches outside the periphery of the plant hole or as detailed on the plans.

**662.22 Dead, Stressed, Diseased or Injured Shrubs**. Before completion and final acceptance of the project, all dead, stressed, diseased or injured shrubs with dieback or injury of more than 20 percent of height or width, or less than 70 percent of leaf density shall be replaced by the Contractor at no cost to the City. Replacement shrubs shall be of the specified variety, size and quality and shall be subject to sections 661.11, 661.12, 661.13 and 661.14 as were the original plants. Until the project is sub-finaled, the Contractor is responsible for theft and vandalism of plants.

**662.23 Watering and Maintenance**. All plants planted shall be watered and maintained during the life of the contract.

**662.24 Weed control after sub-final acceptance.** When directed by the Engineer, weeds shall be eradicated in designated planting beds using physical, mechanical or chemical methods, or a combination thereof, as approved by the Engineer. Herbicides shall be applied in accordance with manufacturer's recommendations using care to protect desirable plants and other improvements. Restricted herbicides shall be applied by a licensed applicator.

Payment for weed control ordered by the Engineer after sub-final acceptance shall be made for the number of square yards of weeds successfully eradicated. When eradication is ordered by the Engineer more than one time, payment shall be made each time that eradication so ordered is successfully completed.

**662.25** Maintenance and Guarantee. All plantings shall be maintained for a minimum of 30 days following satisfactory completion of planting or until sub-final acceptance by the City, including watering, weeding and pruning of dead and broken branches, and disease and pest control. At 30 days, the contractor shall replace all dead and dying plants, remove all dead and broken branches by pruning, raise or lower any improperly planted plants and eliminate any and all weeds, paper and other foreign debris.

All plant materials shall be guaranteed for one year after subfinal acceptance of the plant material. Should replacement fall due during a non-planting season, the Contractor may request the City's permission to defer planting until the proper season.

**662.26** Method of Measurement. The number of shrubs of each species or variety shall be those planted and mulched, complete in place and accepted. Quantities to be paid for weed control shall be in accordance with 662.24.

**662.27 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
662	Each	Planting shrubs
662	Sq. Yd.	Weed control after subfinal acceptance

# **ITEM 663 PLANTING TREES**

663.01 Description 663.02 Certification

#### 663.01

- 663.03 General
- 663.04 Source of Supply
- 663.05 Schedule
- 663.06 Materials
- 663.07 Trees
- 663.08 Inspection, Labeling, Certificates, and Rejection
- 663.09 Digging Trees
- 663.10 Water Loss Preventative Spray, Temporary Storage
- 663.11 Coordination and Cleanup
- 663.12 Preparation for Planting
- 663.13 Planting Holes, Planting Trees, Backfill, Bricks, Grates
- 663.14 Watering, Herbicides, Fertilizing, Pruning, Mulching
- 663.15 Wrapping and Staking
- 663.16 Maintenance and Guarantee
- 663.17 Final Acceptance or Inspection
- 663.18 Method of Measurement
- 663.19 Basis of Payment

**663.01 Description**. This item shall consist of furnishing and planting deciduous shade and flowering trees and evergreen trees less than 6 inches in caliper, in accordance with and at locations as shown on the plans or as directed by the Engineer. In general, this work includes but is not limited to:

- 1. Excavating and preparing subgrade
- 2. Furnishing and placing tree
- 3. Furnishing and backfilling with topsoil
- 4. Furnishing and placing fertilizer
- 5. Watering and pruning tree
- 6. Cleaning up and removing excess materials and debris
- 7. Maintenance

For trees planted in lawn areas, the following item of work shall also be included.

1. Furnishing and spreading mulching materials.

For trees planted with grates, the following items of work shall also be included.

- 1. Furnishing and installing gravel base
- 2. Furnishing and installing concrete foundation to support tree grates
- 3. Furnishing and installing perforated pipe and gravel
- 4. Furnishing and installing tree grates
- 5. Furnishing and placement of gravel mulch

For trees planted with tree guards, the following item of work shall also be included.

1. Furnishing and installing tree guards and necessary hardware.

**663.02** Certification. Certification shall conform to the requirements of 650.01.

**663.03 General**. The work included under this item shall be performed by a single firm specializing in landscape work. The firm shall have a minimum of three (3) years experience with similar landscape work and shall be able to complete the work specified under this item within the approved planting period.

It shall be the Contractor's responsibility to be fully cognizant of all construction plans, utility drawings, existing and proposed utility locations, other specifications and the work of other contractors, including construction schedules and procedures pertaining to this project.

**663.04 Source of Supply**. The Contractor shall, within 15 days after receipt of notice of award of the contract, submit to the Engineer complete and detailed information concerning the source of supply of all trees including soil type in which trees were grown. Substitutions shall not be permitted unless written proof is submitted that a specified variety is not obtainable. A written proposal shall at this time be submitted by the Contractor to the Engineer for consideration of the use of a comparable equivalent size and variety, with an equitable adjustment of the contract price to be determined by the Engineer. Oversize trees may be accepted with specific approval of the Engineer, but shall not be considered for additional payment. The Contractor shall coordinate with the nursery, prior to digging, to remove the topsoil and expose the first order root flare. Failure to do so will result in the Contractor removing the topsoil to find the root flare at the time of planting.

**663.05** Schedule. The Contractor shall, a minimum of eight weeks prior to the beginning of the planting season, submit to the Engineer for approval a written tentative work schedule of planting, which shall include dates of shipping and planting and nursery locations. The Contractor shall not deviate from this schedule without written approval from the Engineer. Planting shall be performed during the following planting periods:

Spring - from the time the ground is workable until May 15 Fall - from September 15 until the ground is not workable

The Engineer shall determine when the ground is not workable.

#### 663.06 Materials.

Backfill material shall be in accordance with 661.24.

Topsoil shall be in accordance with 653.03.

Organic material shall be in accordance with 661.07.

Mulch shall be in accordance with 661.08.

Fertilizer shall be in accordance with 663.14.

Lime shall be in accordance with 661.05.

Water shall be potable water metered from hydrants in accordance with standard rules and regulations of the City of Akron Public Utilities Bureau, or an approved equal.

Gravel cover shall be 1/4 inch washed silica gravel unless otherwise directed.

Gravel bedding shall be No. 4 washed gravel.

Pre-emergent herbicide shall be as approved by the Engineer and applied according to the manufacturer's label.

Stakes shall be 2 inch (inside diameter) by 8 feet long steel pipe painted with an approved exterior matte black enamel. A single strand No. 12 gauge pliable zinc coated iron wire shall be used for anchoring. Hose used to cover the anchor wire shall be new, black, 1/2 inch rubber and fabric garden hose.

Concrete shall be Class "C" conforming to 499.

Reinforcing steel shall conform to 509.

Sand bedding and filler shall conform to 703.02.

Tree grates shall be 4' x 6', cast iron, as supplied by Neenah Foundry Co. Box 729, Neenah, Wisconsin, 54956, Telephone 414-725-3041, or an approved equal or as specified on the plans.

Tree guards shall have a 5 foot installed height from top of grate to top of guard, with a 12 inch inside diameter, as supplied by Neenah (catalog Style "A") or an approved equal, or as specified on the plans.

Hex head bolts and nuts and washers shall be stainless steel or cadmium plated. Tree grates, guards and mounting hardware must be from one manufacturer.

The Contractor may be required to submit the following samples for approval: packets of fertilizer and herbicide; one cubic foot of 1/4 inch washed pea gravel; 5-foot pieces of wire and hose; a paint chart for grate and guard finishes.

**663.07 Trees**. All trees shall be of the type and size called for in the plans or specifications, fully developed, having all buds intact and free of disease, insects,

scars, bruises and breaks and shall have been grown for the preceding one year under the same climatic conditions as exist at the planting location.

Tree names, unless otherwise specified, shall conform to the latest edition of "Standardized Plant Names, as adopted by the American Joint Committee of Horticulture Nomenclature". Trees shall be individually identified by name on legible weatherproof labels securely attached to the tree.

Trees shall be nursery grown and shall meet the standards as set forth in ANSI Z 60.1-2004 or most current, and in cases where grades are indicated, the Number 1, or top, grade shall be furnished. Shade-type trees (Maples, Lindens, Oaks, etc. maturing at over 25 feet) shall be straight trunked to 8 feet and headed between 6 and 7 feet. Ornamental-type trees (Crabapples, Hawthorns, Maples, etc. maturing at less than 25 feet) shall be straight trunked to 7 feet and headed between 5 and 6 feet. Trees specified B and B (ball and burlap) shall conform to 662.09.

**663.08** Inspection, Labeling, Certificates and Rejection. All trees furnished under this contract shall conform to 661.13 through 661.17.

**663.09 Digging Trees**. All trees shall be carefully dug immediately before shipping, avoiding all possible injury to the roots, with particular attention given to the fibrous roots. After trees are dug their roots shall not be permitted to dry out. All trees shall be dug in a dormant state and so held until planted.

**663.10 Water Loss Preventative Spray, Temporary Storage**. All trees shall be sprayed and stored as prescribed in 661.19.

**663.11** Coordination and Cleanup. It shall be the Contractor's responsibility to coordinate tree planting work with that work of other contractors on this project in order to insure that the tree planting proceeds expeditiously.

Throughout the planting operations, the Contractor shall keep the premises of the work clean and free of excess soils, plants, refuse, debris and other materials by removal and disposal from the project during the planting and as a final clean up.

**663.12 Preparation for Planting**. With the exception of street trees (which are located by the Engineer), the Contractor shall lay out the location of all planting (before digging the planting holes), for approval by the Engineer. The Contractor shall remove the twine and the wire basket from the root ball prior to it being placed in the planting hole. The Engineer may waive this requirement if deemed detrimental to the tree due to sandy or soft root balls. In order to establish a proper planting height, the burlap on top of the root ball shall be removed along with the topsoil on top of the root ball to expose the first order root flare.

**663.13 Planting Holes, Planting Trees, Backfill, Bricks, Grates.** Planting holes shall be dug no deeper than the height of the ball to be planted, and of sufficient width, with vertical sides, to permit at least 9 inches of backfill around the

#### 663.14

sides of the ball. The work shall be placed so the planting holes shall have the trees placed within 24 hours after being excavated. Unattended planting holes shall be properly barricaded.

- a. Trees in lawn areas shall be planted with the top of the ball one inch higher than the finished grade, unless otherwise directed by the Engineer. Backfill shall conform to 661.24. A two-inch high saucer, consisting of approved backfill material, shall be formed completely around the tree ball to the outer limits of the planting hole to facilitate watering.
- b. Trees with grates and guards.

Concrete foundations to support the tree grate shall be installed as shown on the plans, being set so that after the tree grate is placed and secured, the top of the grate shall not vary more than 1/16 inch above or below the adjacent curb, walk or brick.

Trees shall be planted with the top of the root ball four inches below the tree grate, using approved backfill material which shall be hand-tamped in six inch lifts. Two inches of washed silica gravel shall be added on top of the root ball. Tree grates shall have metal lugs cast or welded in place and drilled to receive the metal tree guard, as required and as shown on the plans. The tree guard adjustable spacer bars shall be fastened to the lugs on the tree grate in a manner that will allow the guard to be plumb.

After fabricating and welding, clean and wire brush all bare metal surfaces to remove any rust, oil, wax, grease and dirt prior to any painting. For castings that are delivered unpainted apply to all surfaces one prime coat and one finish coat (both 4 mils minimum) in the shop with only finish coat touch-up being permitted after installation. Castings that have a prime coat applied by the manufacturer shall have one coat (4 mils minimum) on all surfaces. Apply to all surfaces prime coat touch-up and one finish coat (4 mils minimum) in the shop, with only finish coat touch-up being permitted after installation. Prime coat shall be black rust inhibitive epoxy paint. Finish paint shall be Kem-Lustral Semi-Gloss Black, F65B4, as supplied by Sherwin Williams Company, or approved equal.

The tree grate, and guard when applicable, shall be installed and secured as required and as detailed on the plans, and the spaces in the grate filled with 1/4 inch silica gravel.

**663.14 Watering, Herbicide, Fertilizing, Pruning, Mulching**. Trees shall be watered within 12 hours of planting, or as directed by the Engineer. Trees in lawn areas and in tree grates shall be watered with the aid of a Treegator® Jr. Pro watering bag. The approximate 14 gallon capacity watering bag shall be used in accordance with 663.16 and shall become the property of the City of Akron upon final acceptance of the project. The cost of the Treegator® Jr. Pro watering bag

shall be included in the price bid for Item 663. Trees shall be restraightened and additional backfill used where settling occurs.

A pre-emergent herbicide, of the type approved by the Engineer, shall be applied in accordance with the manufacturer's recommendations, and as noted in 661.25.

Fertilizer shall, as determined by the soil analysis recommendations, be applied in type and rate as noted in the recommendations. In the absence of a soil analysis, a 20-6-12 or 18-6-12 (3-1-2 ratio) 100% slow release, sulfur coated urea or equal fertilizer approved by the Engineer shall be incorporated into the soil backfill at the rate of 5 cups of fertilizer per cubic yard of backfill. Rates of application and fertilizer ratios shall not vary unless approved by the Engineer.

Pruning shall be completed as noted in 666.03, or as determined by the Engineer.

Mulching material shall be an approved processed shredded hardwood bark, in accordance with 661.08. In lawn areas, the mulch shall be applied evenly 3 inches thick over the backfilled area.

**663.15 Wrapping and Staking**. Staking of trees will be performed when so specified in the contract documents or when directed by the Engineer. The Contractor, when not required to stake, shall periodically inspect and straighten trees where needed during the first four weeks after planting, at the beginning of the next planting season and at final acceptance, if necessary, or as required by the Engineer. Straightening, when deemed necessary by the Engineer, shall be completed by the Contractor within 3 days after Contractor notification.

**663.16** Maintenance and Guarantee. Insect and disease problems occurring during the maintenance and guarantee period shall be controlled by the Contractor. Type of control, whether chemical or biological, along with type of chemical, where required, shall be determined by the Engineer. Rates and frequency of application shall be as determined by the manufacturer. The Contractor shall, during the life of the contract, perform periodic straightening, where needed or as directed by the Engineer. Trees shall be watered on at least two separate occasions during periods of drought, normally in July and August. Occasions, methods and quantity of watering shall be as determined by the Engineer. Weed growth within the mulched areas shall also be controlled by the contractor a minimum of twice within the guarantee period. Once in each of the months of July and September, or when weed growth exceeds 6 inches. This may be done by physical, mechanical, or chemical means as approved by the Engineer. Trees which have either died, display greater than 15% general branch dieback or 10% leader dieback (by length), natural breakage or vandalism, to the extent that corrective pruning would alter the natural form of the species prior to final acceptance, shall be removed and replaced at the Contractor's expense, as instructed by the Engineer. Corrective pruning shall be allowable within the following guidelines:

- leaders and scaffold branches may only be cut back to a lateral branch which is not less than one third (1/3) of the diameter of the branch being removed, to assure proper and timely wound closure,
- flush cuts, or stubs greater than one eight (1/8) inch are unacceptable,
- sharp shears and saws, appropriate to the size of material being cut, shall be in good repair to cleanly cut, rather than tear the cambial area,
- when determined by the Engineer, a ten percent Clorox (bleach) solution shall be required as a sterilant for dipping trimming equipment between each pruning cut, to discourage the spread of disease.

Other reasons for rejection include irreversible, severe stress such as noticeably smaller leaves, abnormal foliage chlorosis, yellow or pale green color, premature fall color, excessive leaf drop (more than 25%) an irreparable girdling root(s), root damage or excessively loose ball as determined by the Engineer.

**663.17 Final Acceptance or Inspection**. Upon completion of the one year guarantee period, the Engineer shall make a Final Inspection. All trees not found in a healthy, viable condition or as noted in 663.16 shall be replaced by the Contractor, as well as receive a final pruning in accordance with 666 or as noted per Engineer. In addition, all trees shall be straight and all stakes, hose and wrapping is to be removed. The Contractor, upon being notified in writing, shall complete replacements and other noted work in a reasonable period of time as determined by the Engineer. Trees not <u>centered</u> in brick or grate openings shall be recentered. (up to one inch tolerance in any one direction will be allowable)

Straightening or recentering trees at final inspection shall be accomplished only by use of a proper sized tree spade or by hand. In either case the tree is to be completely dug around as in digging a tree with a ball of earth, severing all roots, quickly and cleanly with a sharp instrument to a diameter and depth noted in ANSI Z60.1-1986 - Item 1.3 Balling and Burlapping Specifications, prior to actual straightening.

**663.18 Method of Measurement**. Trees planted of each species or variety to be paid for shall be the number complete in place and accepted.

Where staking is required by the Engineer, it shall be included in the bid price for this work. Upon final acceptance, stakes shall be removed at no additional cost to the city.

**663.19 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
663	Each	Tree Planting in Lawn Area
663	Each	Tree Planting w/Grate

663 Each Tree Planting w/Grate and Guard

The above price shall constitute full compensation for furnishing all labor, materials, equipment, tools and incidentals required to complete this item as specified herein.

# **ITEM 664 PLANTING SALVAGED PLANTS**

- 664.01 Description
- 664.02 Certification
- 664.03 Materials and Construction Methods
- 664.04 Method of Measurement
- 664.05 Basis of Payment

**664.01 Description**. This item shall consist of digging and planting salvaged vines, shrubs, and trees up to six inches in diameter secured from within the limits of the project, including the digging and preparation of planting holes, furnishing and placing the necessary topsoil, compost, mulch, water and other incidentals necessary to complete this item.

**664.02** Certification. Certification shall conform to the requirements of 650.01.

**664.03** Materials and Construction Methods. The materials, except plants, to be furnished, and the performance of all operations shall be in accordance with the requirements of 661, 662 and 663 and shall include the backfilling of the hole from which the plant was dug. Plants shall be sprayed with a water loss preventative spray prior to digging and shall be planted within 36 hours after digging.

**664.04** Method of Measurement. Salvaged vines, shrubs and trees planted of each species or variety shall be the number complete in place and accepted.

**664.05 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
664	Each	Planting salvaged plants

## **ITEM 665 LARGE TREES MOVED AND RESET**

#### 665.01

- 665.01 Description
- 665.02 Certification
- 665.03 Material
- 665.04 Trees
- 665.05 Preliminary Wrapping
- 665.06 Digging Trees
- 665.07 Moving
- 665.08 Tree Holes
- 665.09 Drain Pits
- 665.10 Commercial Fertilizer or Peat Moss
- 665.11 Aggregate
- 665.12 Pipe Drains
- 665.13 Surplus Excavation
- 665.14 Backfill
- 665.15 Top and Root Pruning
- 665.16 Pre-Emergence Herbicide
- 665.17 Planting
- 665.18 Wrapping
- 665.19 Bracing
- 665.20 Mulching
- 665.21 Dead Trees
- 665.22 Watering and Maintenance
- 665.23 Method of Measurement
- 665.24 Basis of Payment

**665.01 Description**. This item shall consist of digging, moving and resetting trees 6 inches or more in diameter, including the digging of the necessary tree holes and drain pits, furnishing and placing the necessary topsoil, aggregate, peat, commercial fertilizer, mulch, water and all other incidentals necessary to complete this item.

**665.02 Certification**. Certification shall conform to the requirements of 650.01.

**665.03 Material**. Topsoil, compost, mulch and wound dressing shall conform to 662.

Commercial fertilizer shall conform to 659.

Aggregate shall be limestone, gravel or slag.

Stakes used for anchoring shall conform to 663.

Materials used in guying and anchoring shall conform to 663.

**665.04 Trees**. When the trees are required to be furnished under this item, they shall conform to 662.05, 663.07, 663.09, and 663.10, except that they shall be

measured in caliper. The caliper of the trees, six inches or more in caliper, shall be taken 12 inches above the ground line.

**665.05 Preliminary Wrapping**. The tree trunk shall be securely and properly wrapped with layers of burlap, and the branches tied in to prevent injury during digging, moving and planting.

**665.06 Digging Trees**. Each tree shall be dug in such a manner that it may be lifted with the necessary roots enclosed in an earth ball having a minimum diameter in feet equal to the caliper of the tree in inches, and in all cases the earth ball shall be of sufficient size in accordance with ANSI Z 60.1-2004 or most current. Only dormant trees shall be dug, moved and planted or reset excepting with written approval of the Engineer.

**665.07 Moving**. All trees shall be moved by the root ball with approved standard tree-moving equipment.

**665.08** Tree Holes. Tree holes for trees under this item shall be dug to a minimum depth of three feet with a minimum diameter of eight feet, and in no case shall the tree hole be less than 1-1/2 feet deeper than the depth of the root ball, nor shall the diameter of the hole be less than the diameter of the root ball plus four times the caliper of the tree. The bottom of the tree hole shall slope toward the drain pit or as indicated on the plans.

**665.09 Drain Pits**. When called for on the plans, drain pits shall be at least 2/3 the cubic contents of the tree hole, or of the size, shape, and the location specified.

**665.10** Commercial Fertilizer or Peat Moss. Either commercial fertilizer or peat moss, when called for on the plans, shall be spread uniformly on the bottom of the tree holes. Commercial fertilizer shall be of the analysis and applied at the rate specified. Peat moss shall be applied to a uniform depth of three inches compacted measurement. Both the commercial fertilizer and the peat moss shall be thoroughly spaded or otherwise worked into the subsoil to a depth of six inches.

**665.11** Aggregate. Aggregate shall be spread uniformly over the bottom of the tree hole as detailed on the plans.

When drain pits are required, they shall be filled with aggregate to a height of six inches above the flow line elevation of the pipe underdrain outlet and covered with a two inch layer of straw.

**665.12 Pipe Drains**. Specified tree holes shall be drained into a drain pit by pipe laid on the bottom of the tree hole, or as directed by the Engineer. Such drainage installation, including necessary pipe, shall be completed and paid for in accordance with 551.

**665.13 Surplus Excavation**. Any excavated material remaining after backfilling the underdrain trench and drain pit shall be disposed of by the Contractor in accordance with 203.

**665.14 Backfill**. After the drain pipe and aggregate have been placed, a four inch layer of sandy soil shall be spread and compacted over the bottom of the hole. Approved backfill shall then be compacted to the elevation of the bottom of the root ball. The balance of the backfill shall be made as each tree is set as specified under 662.18.

**665.15 Top and Root Pruning**. The ends of all broken and damaged roots of 1/4 inch diameter or larger shall be pruned with a clean cut, removing no more than the injured portion. The tops of all trees shall be pruned and thinned as prescribed in 666.02. All cuts and wounds, except ends of small terminal and side branches, shall be painted with paint or tree wound dressing immediately after pruning.

**665.16 Pre-Emergence Herbicide**. Herbicide applications shall conform to the requirements of 661.24.

**665.17 Planting**. The trees to be planted shall be the kind specified and such trees shall be delivered and planted immediately after digging as no temporary storage will be permitted. In addition, the planting shall meet the requirements specified in 662.18 and 663.14.

**665.18 Wrapping**. Immediately after planting, removal of the burlap, and approval of the trunk, the tree shall be wrapped with eight inch wide material in a spiral motion overlapping 2 inches, beginning at the base of the tree and ending at the second lowest branch. The wrapping shall be tied securely with twine, such tyings being spaced not more than one foot apart.

**665.19 Bracing**. Immediately after wrapping, the trees shall be securely braced by the tripod method. Trees 12 inches or more in caliper shall be braced with double wires twisted together.

**665.20** Mulching. The mulching material as described in 661.07 shall be placed according to 662.20, except that it shall cover the tree hole and an area 12 inches beyond the periphery.

**665.21 Dead Trees.** Before completion and final acceptance, all trees furnished under this item which are not alive or normally healthy, or that have died back beyond the normal pruning line shall be replaced at the Contractor's expense with trees of the specified species or variety, sizes and quality, and meeting these specifications.

**665.22** Watering and Maintenance. All trees moved and reset, including those furnished, shall be watered and maintained during the life of the Contract as described in 661.29 and 661.31, including necessary adjustments of braces, etc.

**665.23** Method of Measurement. Trees moved and reset, and also those furnished, shall be the number complete in place and accepted.

Aggregate for drain pits and tree holes shall be the number of cubic yards of aggregate furnished, hauled, placed, complete in place and accepted.

**665.24 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
665	Each	Large trees moved and reset
665	Cubic Yard	Aggregate for drain pits and tree holes

# **ITEM 666 PRUNING EXISTING TREES**

666.01	Description
666.02	Certification
666.03	Pruning
666.04	<b>Removal of Foreign Materials from Trees</b>
666.05	Removal of Rubbish
666.06	Method of Measurement
666.07	Basis of Payment

**666.01 Description**. This item shall consist of pruning trees specified, including the cleaning up and disposal of all branches, limbs and resulting rubbish.

**666.02** Certification. Certification shall conform to the requirements of 650.01.

**666.03 Pruning**. All trees noted for pruning shall be pruned to make them shapely, typical of the species. In general, where roots have been cut due to construction, approximately 1/3 of the canopy should be removed by first removing all dead and/or diseased wood. Using approved pruning principles, remove duplicating branching, i.e.: those within twelve inches of each other growing in the same direction, removing interfering and/or overlapping branches to improve structural appearance and removing structural poor branching. Any branch that may be partly dead, yet having a good healthy lateral branch between the dead part and the base shall be cut off with a clean slanting cut close to and beyond the healthy lateral branch. All branches or growth interfering with pedestrian or vehicular traffic shall be removed at the direction of the Engineer. All stubs or improper cuts resulting from former pruning or limbs that have been broken shall be cut off back to the trunk collar or limb of tree to promote proper closure. All pruning tools used and methods employed shall conform to 662.19. Workers shall not be permitted to climb trees with climbing spurs; however, they shall comply with the requirements of good

practice and safety in the use of safety ropes. Tree branches and trunks injured as a result of construction equipment will be pruned and/or treated professionally as per 662.19 - Pruning or as directed by the Engineer at no additional cost to the City.

**666.04 Removal of Foreign Materials from Trees.** All nails, spikes, bolts, wire or other foreign materials driven into or fastened to the trunk or branches of the tree shall be removed, or if directed by the Engineer, they shall be cut back to the branch collar at nearly a ninety degree angle to the branch in such a manner as to insure complete closure of the cambium and bark.

**666.05 Removal of Rubbish**. All rubbish and branches resulting from the pruning operations shall be removed and disposed of in accordance with 201.

**666.06 Method of Measurement**. Existing trees pruned and treated shall be the number, according to size, completed and accepted. Caliper measurements shall be as specified in 201.05(b).

**666.07 Basis of Payment**. Payment for accepted quantities, complete in place, will be made at the contract price for:

Item	<u>Unit</u>	Description
666	Each	Pruning existing trees, 3 to 8 inch caliper
666	Each	Pruning existing trees, 8 to 16 inch caliper
666	Each	Pruning existing trees, 16 to 24 inch caliper
666	Each	Pruning existing trees, 24 to 36 inch caliper
666	Each	Pruning existing trees, 36 inch and over

# **ITEM 667 SEEDING AND JUTE MATTING**

667.01 Description
667.02 Certification
667.03 Materials
667.04 Construction
667.05 Maintenance
667.06 Method of Measurement
667.07 Basis of Payment

**667.01 Description**. This work shall consist of furnishing, placing, and maintaining seeding and jute matting on areas as shown on the plans and as directed by the Engineer.

**667.02** Certification. Certification shall conform to the requirements of 650.01.

**667.03 Materials**. Matting shall be of a uniform open plain weave of undyed and unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Matting shall be furnished in rolled strips as follows:

Length - minimum, 50 yards Width - 48 inches plus or minus one inch Warp ends per width - 78 plus or minus two Weft ends per yard - 41 plus or minus three Average weight - 1.22 pounds per linear yard plus or minus ten percent

Staples used to fasten the matting shall be made from 12 inch lengths of 11 gage steel wire bent into a narrow "U" shape with the ends of the staples approximately 1 inch apart. For clay, shale and other heavy soils, a three inch steel staple, at least nine gage with points approximately one inch apart shall be used.

Seed and mulching materials shall be as specified in 659.

**667.04** Construction. After the areas have been fertilized, and limed if required, it shall be seeded with the mixture and at the rate specified in 659.07 or on the plans.

Within 48 hours after seeding, vegetative mulching material shall be carefully and evenly placed over the specified area at the rate of 25 pounds per 1,000 square feet, or approximately 1/2 ton per acre. No asphalt emulsion tack required. Immediately thereafter, the matting strips shall be laid flat and loose, parallel to the flow of water. Where more than one strip is required to cover the given area, the strips shall overlap at least four inches. Ends shall overlap at least six inches with the upgrade section on top. The up-slope end of each strip of matting shall be buried in six inch slots with the soil firmly tamped against it. The Engineer may require that any other edge exposed to more than normal flow be buried in a similar manner.

Check slots shall be placed between the ends of strips by placing a tight fold of the matting at least six inches vertically into the soil. These shall be tamped and stapled the same as up-slope ends. Check slots shall be spaced so that one check slot or one end occurs within each 50 feet of slope. Edges of matting shall be similarly buried when the matting abuts catch basins and other structures.

Matting shall be spread evenly and smoothly. It shall be in contact with the grade at all points and shall not be stretched or drawn taut during the stapling operation.

Matting shall be held in place by means of staples driven vertically into the soil. Three rows of staples shall be provided for each strip of matting, with one row along each edge and one row alternately spaced in the middle. The staples shall be spaced not more than three feet apart in each row. All ends of the matting and all check

#### 667.05

slots shall be stapled across their width, with staples spaced not more than six inches apart.

After the installation operations described have been completed, the areas disturbed through the preparation of check slots or other grade disturbances as determined by the Engineer shall be overseeded with the seed mixture specified at the rate of one pound per 1,000 square feet.

**667.05 Maintenance**. The matting areas shall be maintained until all work on the contract has been completed and accepted. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in such areas shall be restored to the condition and grade existing just prior to application of the matting, and restored areas shall be relimed, refertilized, and reseeded. Where necessary, the jute matting shall be completely replaced.

**667.06** Method of Measurement. The yardage of seeding and jute matting shall be the number of square yards of seeding and jute matting placed and maintained in accordance with these specifications, completed and accepted. The liming, and fertilizing required on the area covered by seeding and jute matting will be paid for under 659.

**667.07 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
667	Square Yard	Seeding and jute matting

# ITEM 668 SEEDING AND EXCELSIOR MATTING

668.01Description668.02Certification668.03Material668.04Construction668.05Maintenance668.06Method of Measurement668.07Basis of Payment

**668.01 Description**. This work shall consist of furnishing, placing and maintaining seeding and excelsior matting on areas as shown on the plans and as directed by the Engineer.

**668.02** Certification. Certification shall conform to the requirements of 650.01.

**668.03 Material**. Excelsior matting shall consist of a machine-produced mat of wood excelsior, 80 percent of which is at least eight inches in length. The wood from which the excelsior is cut shall be properly cured to achieve adequately curled and barbed fibers.

The matting shall be of consistent thickness, with the fiber evenly distributed over the entire area of the mat. The matting shall be covered on the top side with a netting having a maximum three inch by one inch weave of twisted kraft paper yarn having a high wet strength and entwined with the excelsior for maximum strength and ease of handling. Matting may be either 36 or 48 inches in width, plus or minus one inch, and in rolls of more than 100 feet in length. The weight of the material shall be not less than 0.72 pound per square yard, constant weight, air dry.

The staples used for stapling shall be as specified for jute matting in 667.03.

**668.04** Construction. Within 48 hours after the area has been fertilized, and limed if required, it shall be seeded with the mixture and at the rate specified in 659.07.

Within 48 hours after the specified area has been seeded, excelsior matting shall be installed, held in place and overseeded as specified in 667.04, except that edge and end overlap shall be 1-1/2 inches, and no check slots shall be required. The up-slope end or top edge of each strip need not be buried unless required by the Engineer due to special conditions in the field.

**668.05** Maintenance. The matting area shall be maintained as described for jute matting in 667.05.

**668.06 Method of Measurement**. The yardage of seeding and excelsior matting shall be the number of square yards of seeding and excelsior matting placed and maintained in accordance with these specifications, completed and accepted. The liming, fertilizing and maintenance required on the area covered by seeding and excelsior matting shall be expedited in accordance with item 659 and paid under item 668.

**668.07 Basis of Payment**. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<b>Description</b>
668	Square Yard	Seeding and excelsior matting

### **ITEM 669 PROTECTING TREES**

669.01 Description

669.01

669.02	Certification
669.03	General
669.04	Methods and Procedure
669.05	Root Cutting
669.06	<b>Inspection and Final Determination</b>
669.07	Damaged Trees
669.08	Pruning
669.09	<b>Trenching Near Trees Under 5" DBH</b>
669.10	Trenching Near Trees Over 5" DBH
669.11	Basis of Payment

**669.01 Description**. This item shall consist of furnishing all necessary labor, materials and equipment to protect all trees within limits of the project except those marked for removal on the plans.

**669.02** Certification. Certification shall conform to the requirements of 650.01.

**669.03 General.** The Contractor shall be required to submit to the Engineer his proposed method of protecting trees before any excavation is done on the project. No excavation work shall be started before the tree protection method has been reviewed and approved by the Engineer.

**669.04 Methods and Procedure**. The Contractor shall use due care while working around trees so as not to break any branches or damage any portion of the tree trunk or roots. Should it become necessary to trim any low hanging branches to facilitate construction, it shall be immediately brought to the Engineer's attention for prompt resolution. Branches shall not be broken off or severely skinned, but shall be cut in a manner approved by the Engineer. The trunk shall be protected by placing water-resistant cardboard or approved equal, around the entire trunk diameter.

**669.05 Root Cutting**. Roots of trees not designated to be removed, which extend into or through areas to be excavated, shall be cut prior to being dislodged by excavating equipment.

All roots, visible or buried, within the area of excavation for sidewalk, apron and curbing shall be properly severed and removed to a depth of 6" below the bottom of that respective improvement. In no instance shall the Contractor dislodge any roots without first cleanly severing those roots. Roots shall not be cut any closer to the tree trunk(s) than is actually required to place a form for the proposed improvement.

After roots are severed, they shall be removed from the area under the sidewalk, apron, curb or other proposed improvement. Chips and grindings from root cutting shall also be removed. Voids from root cutting and removal shall be backfilled and compacted in accordance with the requirements of Item 203.

When root cutting is bid as a separate pay item, specialized root cutting equipment shall be used to make a 12" deep vertical cut where directed by the Engineer, prior to excavation. The root cutting equipment shall be a Vermeer model V-430 root cutter or similar machine designed for root cutting. The extent of the pre-excavation root cutting will be generally as shown on the plan, but may be modified by the Engineer. If re-mobilization of the root cutting operation is required because of unexpected conditions or project scope changes, the additional work shall be paid for at the contract unit price with no allowance for re-mobilization.

The cutting of roots not severed by pre-excavation root cutting shall be done by hand excavating and using a chain saw or sharp hand axe. Payment for this root cutting shall be included in the lump sum payment for tree protection.

**669.06 Inspection and Final Determination**. If it is determined, by the Engineer after its roots are cut in accordance with this specification that a tree must be removed, the tree shall be removed by the Contractor in accordance with Item 201. Payment for tree removal shall be made at the unit price bid for respective tree size.

**669.07 Damaged Tree**. If the Contractor damages a tree not designated for removal because of improper procedures or negligence, replacement of damaged trees will be required of the Contractor. If deemed irreparable by the Engineer, the Contractor shall remove the tree and stump without compensation and be assessed the value of the damaged tree(s) using the International Society of Arboriculture's <u>Guide for Plant Appraisal</u>. If deemed reparable by the Engineer, repairs shall be made in accordance with ANSI A300 <u>Tree</u>, <u>Shrub and Other Woody Plant Maintenance - Standard Practices</u> without compensation and the assessed value of the tree(s) using the International Society of Arboriculture's <u>Guide to Plant Appraisal Cost of Repair Method</u>. A tree(s) shall be planted in a location designated by the Engineer, at no cost to the City. The Engineer shall determine tree quantity, size and variety.

**669.08 Pruning**. Pruning of trees, if directed by the Engineer, shall be done and paid for in accordance with Item 666 - Pruning Existing Trees.

**669.09 Trenching Near Trees Under 5'' DBH.** Open trenching in the root zone of a public tree is prohibited except in cases where the trenching falls outside the dripline of the tree involved. Exceptions will be allowed if, in the opinion of the Engineer, the impact of the trenching upon the tree will be negligible.

**669.10 Trenching Near Trees Over 5" DBH.** All public trees in excess of 5 inches DBH, where there is insufficient space to bypass the dripline by trenching, must be tunneled. The beginning/ending distance of the tunnel from the face of the tree truck in any direction is determined by the diameter of the tree as specified by the accompanying table:

When the tree diameter at	Trenching will be replaced by tunneling at this minimum
4.5 feet is:	distance from the face of the tree trunk in any direction
6-9 inches	5 feet
10-14 inches	10 feet
15-19 inches	12 feet
Over 19 inches	15 feet

Failure to strictly adhere to this table will result in damage and compensation, in accordance with 669.07.

**669.11 Basis of Payment**. The contract lump sum payment shall be full compensation for all services, materials, labor, equipment, tools and incidentals necessary to complete this item of work except for pre-excavation root cutting which shall be paid at the contract unit price for the accepted quantity.

Payment will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
669	Lump Sum	Protecting Trees
669	Linear foot	Root cutting (pre-excavation)

### **ITEM 671 PLAY EQUIPMENT AND MATERIALS**

- 671.01 Description
- 671.02 Wood Fiber Surfacing
- 671.03 Geotextile Fabric
- 671.04 Resilient Wear Mats
- 671.05 Pea Gravel
- 671.06 Age Use Sign
- 671.07 Play Structures
- 671.08 Certifications
- 671.09 Submittals
- 671.10 Warranty
- 671.11 Installation
- 671.12 Method of Measurement
- 671.13 Basis of Payment

**671.01 Description.** This item shall consist of furnishing and installing play equipment and materials in accordance with details shown on the plans, Standard Construction Drawings, manufacturer's requirements and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

**671.02 Wood Fiber Surfacing.** Surfacing used shall be a mix of randomsized wood fibers, free draining with minimum moisture retention, comprised of wood such as white oak, red oak, maple, ash, douglas fir, lodge pole pine, poplar, etc.. Standard wood chips or bark mulch will not be acceptable.

Wood fiber shall be free of bark, twigs, leaves, debris, insects, chemical preservatives, artificial ingredients or other noxious matter.

The wood fiber shall meet ASTM F1292 and ASTM F355 Procedure C, and the Head Injury Criteria (HIC) of less than 1000. The wood fiber shall also meet or exceed the ASTM F-1951-99 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment. Wood fiber surface shall be installed per manufacturer's installation instructions.

The wood fiber shall be manufactured by The Fibar Group, 80 Business Park Dr., Suite 300, Armonk, N.Y. 10504-1705, telephone: 800-342-2721, or approved equal.

Install wood fiber surface, then spread to a uniform initial depth of 15 or 12 inches (for a minimum compacted depth of 12" or 9", respectively) above the level of gravel. Rake to a level top surface. Machinery shall not disturb or travel on the drainage medium system. Any overspill of wood fiber surfacing material beyond the edges of the defined play area shall be cleaned up.

**671.03 Geotextile Fabric.** Fabric shall be needle punched non-woven polyester, 70 mils thickness, in conformance with ASTM D 4632, 75" minimum, 150" maximum width geotextile fabric.

The geotextile fabric shall be "Fibarfelt", manufactured by The Fibar Group, 80 Business Park Dr., Suite 300, Armonk, N.Y. 10504-1705, telephone: 800-342-2721, or approved equal.

Install the geotextile fabric in accordance with manufacturer's instructions. All fabric seams shall be lapped 36" minimum, and shingled in the direction of water flow. Seal seams, tears, and punctures in fabric. Cut fabric/drainage medium system to fit around equipment; tape cuts after fitting. Lap fabric 4" vertically at interior perimeter of wood ties, fasten with galvanized roofing nails 32" O.C. (Maximum).

**671.04 Resilient Wear Mats.** The resilient wear mats shall comply with ASTM F1292, requiring a peak deceleration below 200 G's and ASTM F355 Procedure C, and the Head Impact Criteria (HIC) of less than 1000 from a fall height of 9'-6" minimum. The areas of mats indicated on the drawings are the minimum areas required to provide the specified impact attenuation exclusive of tapered edges of mats (if any). Mats with square edges are acceptable unless the system provided requires beveled perimeter pieces for anchorage.

The resilient wear mats shall be "Fibarmat", manufactured by The Fibar Group, 80 Business Park Dr., Suite 300, Armonk, N.Y. 10504-1705, telephone: 800-342-2721, or approved equal.

Install resilient wear mats below swings and slides, mechanically anchored in strict accordance with manufacturer's recommendation.

**671.05 Pea Gravel.** Granular filter materials (pea gravel) shall be made from durable aggregates, No. 8 or No. 9, per Table 703-1.

Install pea gravel drainage base over existing asphalt to a uniform thickness of 3". Over prepared earth subbase, place geotextile fabric (as noted below and detailed in the plans) followed by pea gravel drainage base to the indicated depths and/or elevations.

**671.06** Age Use Sign. 'Age Group Use' sign shall be the Play Safe 'Simple Sign' with steel reinforced posts,  $3 \frac{1}{2}$ " dia. rounds. Mounting height shall be 5'-0" from top of finished grade to top of posts. Color of sign and posts shall be as designated on the plans.

Intermediate sign shall read: "Play safe! This play area is designed for children 5-12 years of age. Adult supervision is recommended."

Tot sign shall read: "Play safe! This play area is designed for children 2-5 years of age. Adult supervision is required."

Sign shall be manufactured by:

The Plastic Lumber Company, Inc., 540 S. Main St., Akron, Ohio 44311 Phone: (330) 762-8989, or approved equal.

Sign posts for Age Use Signs shall be embedded in Class 'C' Concrete footers, and in accordance with the details shown on the plans. Furnishing and placing Concrete shall be in accordance with 511 - Concrete for Structures. The location shall be as shown on the plans.

**671.07 Play Structures.** The Contractor shall furnish play structures which are manufactured by one of the approved manufacturers listed on the plans.

Maintenance kits shall be provided for each structure and shall include the following: additional washers, nuts, bolts and fasteners of the type used to assemble the structure, any special tools or keys used to assemble the structure, touch-up paint for each color used, graffiti remover, maintenance manuals, and labeled tool box to contain all the items.

Installed play structures shall comply with the most recent standards established by the ADA and the ASTM, as well as CPSC's Handbook for Public Playground Safety.

The Contractor shall verify all play structure dimensions established by the Engineer and satisfy himself as to the correctness thereof and the mutual agreement of the parts.

Upon completion of the play structure installation, the contractor shall have the manufacturer's representative inspect the structures and note any deficiencies needing correction. After completion of the items listed on the inspection report, a signed certificate of compliance form must be completed and signed by the manufacturer's representative. This certification will verify the structure was indeed installed to manufacturer's specifications and current safety standards. Sub-final payments will not be approved before this signed certificate is received by the City.

Before final acceptance of the play structure, all special tools, extra hardware, maintenance kits, parts lists, and maintenance manuals shall be delivered to the Engineer. The Engineer shall deliver all such materials to the City Facilities Maintenance Division.

All new play structures shall be installed in accordance with the manufacturer's recommendations, the manufacturer's Play Equipment Installation Manual, and as designated on the plans and approved shop drawings unless otherwise directed by the Engineer. New play structure footings shall be anchored by setting in Class 'C' Concrete. Furnishing and placing Concrete shall be in accordance with 511 - Concrete for Structures. The contractor and manufacturer shall design and install footers of sufficient size to support the structure based on the existing soil conditions and that are a minimum of 42" deep. New play structures shall be installed in the locations shown on the plans and verified in the field by the Engineer prior to pouring footers.

Support posts shall be of sufficient length to provide depth of footer as shown on the drawings, shop drawings and height of play structure as recommended by the manufacturer. The top of the post shall be a minimum of 6" above the top of the clamp (not including cap).

All mounting hardware for stairs, slides, and climbers shall be extended by the manufacturer to accommodate the 16-inch soft surface.

#### 671.08 Certifications.

<u>Resilient Surface and Geotextile Fabric:</u> The Contractor shall submit certification that the compacted surface depth of the resilient surface and the installation of resilient wear mats shall be in accordance with ASTM F1292, ASTM F355 Procedure C with HIC values of less than 1000 and ASTM PS83 for surfacing as follows:

The peak deceleration of the head shall not exceed 200 G's, and a Head Injury Criteria shall not exceed a value of 1000 for the following critical heights:
10' Fall Height (9" of compacted wood fibers) 10' Fall Height (resilient wear mat)

The Contractor shall certify that no chemicals or additives are present in the wood surface material and that surface material is non-toxic.

The Contractor shall provide certification from the manufacturer or installer that the final installed play system meets or exceeds all current safety requirements.

**671.09 Submittals.** The Contractor shall submit copies of testing procedures and results performed by independent testing source, which demonstrate compliance with and in accordance with ASTM F1292, ASTM F355 Procedure C with HIC values of less than 1000 and ASTM PS83.

The Contractor shall submit manufacturer's technical product data substantiating that products comply with all requirements. Submit a listing of the species of wood used in the wood fiber.

Samples: Three (3) cubic feet of fiber surfacing material. 1'-0" square of geotextile fabric. 1'-0" square of resilient wear mat and one anchor (if applicable).

The Contractor shall also submit a copy of detailed manufacturer's installation instructions of the above mentioned items to the Engineer.

For Play Structures, the Contractor shall submit to the Engineer, for review and approval, six (6) copies of shop drawings and installation manuals, unless additional copies are requested. Fabrication and/or assembly shall not begin until the submitted drawings and colors have been approved by the Engineer.

**671.10 Warranty.** The Contractor shall provide a written guarantee for three (3) years from the date of installation against decay and biochemical degradation calling for replacement of defective materials during the guarantee period.

**671.11 Installation.** The Contractor shall strictly follow the detailed manufacturer's installation instructions for the wood fiber, geotextile fabric, and the resilient wear mat.

Inspect timber enclosure curbs at play surface perimeter. Clean existing drainage holes in existing wood timbers of all obstacles and debris for free passage of water. Verify that proper drainage will be maintained through drainage holes of timber curbs.

Subsurface to receive resilient playground surface shall be clean, dry, free of accumulated dirt, rubbish and other construction debris and free of any oils, gasoline, or other chemical deposits.

**671.12 Method of Measurement.** Quantities to be paid for under these items shall be the number of cubic yards of wood fiber installed, the number of square feet of geotextile fabric, the number of cubic yards of pea gravel, the number of each resilient wear mats, and the number of Age Use Signs complete, measured in place, and accepted. For play structures, the quantity to be paid shall be for each completed, certified, and accepted play structure inclusive of all individual component parts and maintenance kits.

**671.13 Basis of Payment.** Payment for accepted quantities will be made at the contract price for:

Item	<u>Unit</u>	<b>Description</b>
671	Cubic Yard	Resilient Surface
671	Square Feet	Geotextile Fabric
671	Each	Resilient Wear Mat
671	Cubic Yard	Pea Gravel
671	Each	Age Use Sign, Intermediate
671	Each	Age Use Sign, Tot
671	Each	Play Structure, Intermediate
671	Each	Play Structure, Tot

The above price shall constitute full compensation for furnishing all labor, material, tools, equipment and incidentals necessary to complete the work as specified herein.

The price bid for the play structure item of work shall constitute full compensation for furnishing all labor, materials, tools, extra hardware, maintenance kits, and maintenance manuals required to assemble and construct the associated play structure including any item not expressly shown on the plan or listed herein, but necessary to provide a complete play structure.

#### ITEM 672 PARK EQUIPMENT AND MATERIALS

- 672.01 Description
- 672.02 Park Bench
- 672.03 Picnic Table
- 672.04 Trash Receptacle
- 672.05 Wood Bollards
- 672.06 Verification of Dimensions
- 672.07 Shop Drawings
- 672.08 Guarantee
- 672.09 Method of Measurement
- 672.10 Basis of Payment

**672.01 Description.** This work shall consist of the furnishing and installing new park equipment and materials as indicated on the plans, Standard Construction

Drawings, and in accordance with the specifications for the various items which constitute the completed structure, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

**672.02 Park Bench.** Park benches shall be "Survivor" Series, Model FP2055, as manufactured by The Plastic Lumber Company, Inc., 540 South Main Street, Building #7, Akron, Ohio 44311-1010 (telephone: 330-762-8989).

All park benches shall be installed in accordance with the manufacturer's recommendations, and as designated on the plans and approved shop drawings unless otherwise directed by the Engineer. New park benches shall be anchored by setting in Class 'C' Concrete. Furnishing and placing concrete shall be in accordance with 511 - Concrete for Structures. The cost of the concrete shall be included in the price bid for park benches. New park benches shall be installed in the locations shown on the plans and verified in the field by the Engineer prior to pouring concrete for bench footers.

Support posts for benches shall be of sufficient length to provide depth of footer as shown on the drawings, shop drawings and height of equipment as recommended by the manufacturer.

**672.03 Picnic Table.** Picnic tables shall be Model FP1030, as manufactured by The Plastic Lumber Company, Inc., 540 South Main Street, Building #7, Akron, Ohio 44311-1010 (telephone: 330-762-8989).

All picnic tables shall be installed in accordance with the manufacturer's recommendations, and as designated on the plans and approved shop drawings unless otherwise directed by the Engineer. New picnic tables shall be anchored by setting in Class 'C' Concrete. Furnishing and placing concrete shall be in accordance with 511 - Concrete for Structures. The cost of the concrete shall be included in the price bid for picnic tables. New park equipment shall be installed in the locations shown on the plans and verified in the field by the Engineer prior to pouring concrete for bench footers and table anchors.

Table anchors shall be of sufficient length to provide depth of anchor as shown on the drawings, shop drawings and height of equipment as recommended by the manufacturer.

**672.03 Trash Receptacle.** Trash receptacles shall be precast concrete, as manufactured by Lindsay Concrete Products (telephone 1-800-837-7788). Trash receptacle shall have a sandblast finish, plastic lid, and be capable of holding a 30 gallon galvanized trash container. A heavy duty 30 gallon galvanized steel trash container shall be supplied with each unit.

A 3'x3'x4" thick concrete pad shall be provided for each unit if it is to be located in a lawn area. Concrete for the pad shall be Class 'C' Concrete, finished per 456. **672.04 Park Sign.** Signs identified on the plan or in the proposal as Type A indicates that the lettering shall be on one side only of the panel boards. Signs identified as Type B indicates that the lettering shall be on both sides of the panel boards. Wood shall be pressure treated timbers, rails and panels of the sizes and type indicated on the standard drawing or as shown on the plan.

Concrete used for the foundation shall be Class "C". Reinforcing steel shall be according to 509. The wooden park signage shall be assembled, lettered, stained, painted and installed as indicated on the standard drawing or as shown on the plan.

Signs furnished must be of quality workmanship. The Engineer reserves the right to reject any sign, or part thereof, that is poor in appearance or otherwise defective.

A list of qualified sign makers is included in the proposal.

Posts shall be set plumb in holes and encased in concrete as indicated on the standard drawing.

Grass areas disturbed by this work shall be seeded and mulched in accordance with 659.13, unless the plan calls for a mulched planting area near the base of the sign.

**672.05 Wood Bollards.** Timbers for wood bollards shall be as specified in ODOT Section 711.26. Dimensional lumber and timbers shall be treated #1 Southern Pine, dressed S4S according to SFPA or WWPA standards.

Timbers shall be pressure preservative treated with ACQ or approved equal in accordance with AWPA C2 and AWP LP-22, rev. 1980 and AASHTO M133. Minimum retention shall be 0.037 pounds/cubic foot.

Kiln dry all material after treatment to less than 19% moisture content. All fabrication including beveling, notching, easing, hole boring and cutting shall be accomplished prior to treatment. This does not refer to field cutting and boring. Field fabrication shall be treated according to AWPA Standard M4. Bollards shall be stained with two coats of solid color stain of the color indicated on the plans.

Hardware required for the collapsible bollard shall be manufactured from medium carbon steel meeting the appropriate ASTM standard for its type and be sized to suit the application. Spikes and nails shall be galvanized common wire type and shall meet AISI specification 1010 or 1020 for steel. All hardware shall be hot-dip galvanized in accordance with ASTM A153 and ODOT Section 711.02. The zinc coating shall be Class A in accordance with ASTM B695 Class 55.

The Contractor shall supply eight (8) sets of keys for collapsible bollards to the City of Akron. All locks to be keyed the same.

**672.06 Verification of Dimensions.** The Contractor shall verify all dimensions and satisfy himself as to the correctness thereof and the mutual agreement of the parts.

**672.07 Shop Drawings.** The Contractor shall submit to the Engineer for review and approval, six (6) copies of shop drawings and installation manuals for each piece of park equipment, unless additional copies are requested. Fabrication and/or assembly shall not begin until the submitted drawings have been approved by the Engineer.

**672.08 Guarantee.** All park benches, picnic tables and trash receptacles furnished and installed must be warranted by the Contractor for a period of at least one (1) year. The Contractor is responsible for the maintenance, repairs, and any adjustments necessary during the guarantee period.

**672.09** Method of Measurement. The quantity to be paid shall be for each completed and accepted park bench, picnic table, trash receptacle, or park sign inclusive of all individual component parts, including excavation and concrete.

**672.10 Basis of Payment.** Park equipment will be paid for at the contract unit price bid for:

<u>Item</u>	<u>Unit</u>	Description
672	Each	Park Bench, "Survivor"
672	Each	Picnic Table
672	Each	Trash Receptacle
672	Each	Trash Receptacle w/Pad
672	Each	Park Sign, Type (Name: "")
672	Each	Park Sign, Directional, Type ()
672	Each	Wood Bollard
672	Each	Wood Bollard, Collapsible

The price bid for these items shall constitute full compensation for furnishing all labor, materials, tools, and hardware required to assemble and construct each piece of park equipment, including any item not expressly shown on the plans or listed in the specifications but necessary to provide a complete installation.

#### ITEM 673 SPORTS EQUIPMENT AND MATERIALS

- 673.01 Description
- 673.02 Basketball Goal Assembly
- 673.03 Tennis Court Items
- 673.04 Baseball Field Items
- 673.05 Verification of Dimensions
- 673.06 Permits

673.07 Shop Drawings673.08 Guarantee673.09 Method of Measurement673.10 Basis of Payment

**673.01 Description.** The Contractor shall provide all labor, equipment, tools and materials required to furnish and install new sports equipment as indicated on the plans, and in accordance with the specifications for the various items which constitute the completed installation, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

**673.02 Basketball Goal Assembly.** Equipment and installation for each Basketball Goal Assembly, including but not limited to one basketball goal post, one basketball backboard, and one basketball rim and net shall be per Standard Construction Drawing No. LA-9.

**673.03 Tennis Court Items.** Equipment and installation for each Tennis Net Post and Cap shall be per Standard Construction Drawing No. LA-7.

**673.04 Baseball Field Items.** The Contractor shall furnish and install the following items:

<u>Home Plate:</u> Home Plate shall be item HPS #12908160, as manufactured by Hollywood Bases, Inc., or approved equal. Installation shall be per manufacturer's recommendations, and as designated on the plans. Concrete used for installation of the home plate shall be Class "C" Concrete.

<u>Pitching Rubber:</u> Pitching rubber shall be 6" x 24" four-way with polyvinyl surface and aluminum inner support tube, as manufactured by Hollywood Bases, Inc., catalog number BBPB #12909180, or approved equal. Installation shall be per manufacturer's recommendations, and as designated on the plans.

<u>Bases:</u> Bases shall be strapless 15" x 15" x 3" high vinyl covered, as manufactured by McGregor "Collegiate Series Strapless Bases' catalog number #BBBASEBO or approved equal. Installation shall be per manufacturer's recommendations, and as designated on the plans. Bases shall be installed complete with anchors.

<u>Bleachers:</u> Each Bleacher shall be Model #NB-0530A/GDLX, as manufactured by National Research Systems, Inc., 5120 Investment Drive, Fort Wayne, Indiana, 46808 (Phone (219)482-6023, Web address: www.bleachers.com), or approved equal. Each Bleacher shall be heavy duty aluminum, 5 row, 30 feet long, with semiclosed deck, fully enclosed deck aisle rails, meeting or exceeding current Ohio Building Code OBBC 1013 and NFA 102-4. Installation shall be per manufacturer's recommendations, and as designated on the plans.

#### 673.05

<u>Foul Poles:</u> Equipment and installation for each Foul Pole shall be per Standard Construction Drawing No. LA-10.3. Concrete used for installation of the foul pole shall be Class "C" Concrete.

<u>Dirt Storage Box:</u> Material for each dirt storage box shall be plastic lumber, as detailed on the plans and manufactured by the Plastic Lumber Co., Inc., or approved equal. The plastic lumber color shall be Brown. Foundations for dirt storage boxes shall be Class "C" Concrete per 511. Installation shall be per manufacturer's recommendations, and as designated on the plans.

<u>Fence Protection</u>: Equipment for the fence protection shall be Poly-Cap Protective Fence Guard, Model BSN-BBPC250-F, and Poly-Cap Protective Guard Ties, Model BSN-BBPCTIES, as manufactured by BSN Sports, P.O. Box 7726, Dallas, Texas 75209 (Telephone: 1-800-527-7510, fax: 1-800-899-0149), or approved equal. All fence protection shall be installed per manufacturer's recommendations and as designated on the plans.

Sand/Clay Mix: Furnishing and placing infield mix, 6" thick, shall consist of 60% to 75% clay and 40% to 25% sharp sand screened through a 3/8" mesh. Material shall be free of organic debris and less than 2% organic matter by weight. Provide test results for preliminary approval to the Engineer. After preliminary approval, the delivered infield mix shall be stockpiled prior to placement. The Engineer shall then have a sample of the mix tested by an independent soils testing laboratory for final approval. Mix shall be manufactured by: Kurtz Bros. Inc., 4700 East 49th Street, Cuyahoga Heights, Ohio 44125, phone: (216) 641-7000, FAX (216) 341-9331 or approved equal.

After completion of excavation and embankment as required, the existing subgrade soil shall be compacted with a power tamper to reflect a grade lower than the existing finish grade as shown on the plans. The various materials shall be installed to the appropriate depths as shown on the plans.

Density of compaction for subgrade soil shall not be less than 90 percent of the maximum density at optimum moisture. The moisture content shall be as determined by the Engineer to obtain the desired compaction.

Compact each layer of infield mix to a density of not less than 95 percent of the maximum density, as determined by AASHTO T180-74, Method D. The Engineer will test density in-place, in accordance with AASHTO T 191-61, T205-64, or other recognized method. Random tests for compacted depth will be made during the progress of the work.

**673.05 Verification of Dimensions.** The Contractor shall verify all dimensions and satisfy himself as to the correctness thereof and the mutual agreement of the parts.

**673.06 Permits.** Prior to installation of bleachers, Contractor shall submit to the Plans and Permits Center, for review and approval, all required information under a separate 'Miscellaneous Structures' permit for the bleachers. All costs associated with the permitting process shall be considered incidental to this item.

**673.07 Shop Drawings.** The Contractor shall submit to the Engineer for review and approval, six (6) copies of shop drawings and installation manuals, unless additional copies are requested. Fabrication and/or assembly shall not begin until the submitted drawings have been approved by the Engineer.

**673.08 Guarantee.** All sports equipment furnished and installed must be warranted by the Contractor for a period of at least one (1) year. The Contractor is responsible for the maintenance, repairs, and any adjustments necessary during the guarantee period.

**673.09** Method of Measurement. The accepted quantities of specific items will be paid for at the contract prices designated for each pay item listed.

**673.10 Basis of Payment.** Sports equipment and materials will be paid for at the contract unit price bid for:

<u>Item</u>	<u>Unit</u>	Description
673	Each	Basketball Goal Assembly
673	Each	Tennis Post and Cap
673	Each	Tennis Strap and Anchor
673	Each	Tennis Net
673	Each	Tennis Practice Boards
673	Each	Home Plate
673	Each	Pitching Rubber
673	Each	Bases
673	Each	Foul Pole
673	Each	Bleachers
673	Each	Dirt Storage Box
673	Linear Feet	Fence Protection
673	Square Yard	Infield Baseball Diamond Sand / Clay Mix, 6" Thick

The price bid for this item shall constitute full compensation for furnishing all labor, materials, tools, and hardware required to assemble and install sports equipment or install sports materials including any item not expressly shown on the print or listed in the specifications but necessary to provide a complete installation.

# 700 MATERIAL DETAILS

Materials shall conform to the stated requirements and/or the requirements of the referenced specifications, including modifications as noted.

# 701 HYDRAULIC CEMENT

Acceptance. Cements meeting the requirements of 701.01, 701.04, 701.05 and 701.08 may be accepted for shipment to and immediate use in construction projects by cement manufacturer's certification, at the option of the City in lieu of sampling by inspectors at manufacturing plants, when requested by a cement manufacturer and agreed to by both the requesting cement manufacturer and the City.

**701.01** Air-entraining Portland Cement. ASTM C 150, Type 1A. The Gillmore time of set and the air-permeability (fineness) test shall govern.

**701.04 Portland Cement**. ASTM C 150, Type 1. The Gillmore time of set and the air-permeability (fineness) tests shall govern. This cement may be used provided 705.10 admixture is added at the mixer.

**701.05** High-early-strength Portland Cement. ASTM C 150, Type III. The Gillmore time of set shall govern. This cement may be used provided 705.10 admixture is added at the mixer.

701.07 Masonry Cement. ASTM C 91.

701.08 Expansive Hydraulic Cement. ASTM C 845, Type K.

701.11 Non-shrink Grout. ASTM C 827.

## 702 ASPHALT MATERIAL

**Acceptance.** Asphalt binders, 702.01 and liquid asphalts 702.02, 702.03, and 702.04 may be acceptable for shipment to and immediate use in construction projects. The Contractor has the option of using the manufacturer's certification, when requested by an asphalt manufacturer and agreed to by both the requesting asphalt manufacturer and the City. Acceptance procedure is according to ODOT Supplement 1032.

**702.00 Application Temperatures.** Apply asphalt materials, according to the temperature ranges specified in Table 702.00-1.

Type and Grade of Material	Application Temperature Range °F (C)			
	Spray	Mix		
RC-70	75 to 150 (24 to 66)			
RC-250	100 to 175 (38 to 79)	80 to 150 (27 to 66)		
RC-800	66 to 107 (150 to 225)	66 to 93 (150 to 200)		
RC-3000	200 to 275 (93 to 135)	175 to 225 (79 to 107)		
MC-30	50 to 120 (10 to 49)			
MC-70	75 to 150 (24 to 66)			
MC-250	100 to 225 (38 to 107)	100 to 225 (38 to 107)		
MC-800	150 to 250 (66 to 121)	150 to 225 (66 to 107)		
MC-3000	225 to 275 (107 to 135)	200 to 250 (93 to 121)		
All Emulsions	50 to 160 (10 to 71)	50 to 140 (10 to 60)		
Asphalt Primer for	50 to 80 (10 to 27)			
Waterproofing	50 to 80 (10 to 27)			
Asphalt for Waterproofing	300 to 350 (149 to 177)			
CBAE 350, CBAE 350 Special	100 to 150 (38 to 66)	100 to 150 (38 to 66)		
CBAE 800, CBAE 800 Special	125 to 175 (52 to 79)	125 to 175 (52 to 79)		
Primer 20	60 to 120 (16 to 49)			
Primer 100	75 to 125 (24 to 52)			
Asphalt Binders	350 (177) Max.	325 (163) Max.		
Asphalt Binders-Polymer modified with SB, SBR, or SBS		350 (170) Max.		

Table 702.00-1

### 702.01 Asphalt Binders.

General. According to AASHTO M 320-03 except as follows.

PG Binders with the suffix "M" (e.g., PG 70-22M, PG 76-22M) will meet the requirements of Table 702.01-1. When a PG 64-28 is made thru modification ensure it meets the requirements of Table 702.01-1.

An independent laboratory will not be owned or operated, in whole or part, by the binder supplier, Contractor, or affiliates of either.

Materials and Manufacture. Replace the requirements of AASHTO M 320-03 Section 5 "Materials and Manufacture" Section with the following:

5.1 Supply PG Binder from the refining of crude petroleum, or combination of asphalt binders from the refining of crude petroleum, or asphalt binders and suitable liquid from the refining of crude petroleum, and possible organic modifiers for performance enhancement. Material from the crude refining stream is considered neat. Liquid from crude refining may be used for adjustments, but do not used liquid from crude refining for the purpose of substitution of crude refined asphalt binders exhibit unusual properties a supplier may be requested by the Laboratory to supply information about the makeup of a PG Binder. Failure to cooperate will mean removal from Supplement 1032 certification.

5.2 A modifier may be any organic material of suitable manufacture that is proven compatible with asphalt binder (does not separate appreciably in routine storage), and that is dissolved, dispersed or reacted in asphalt binder to improve its performance. Performance enhancement is defined as a decrease in the temperature susceptibility of the asphalt binder while maintaining or improving desirable properties in a neat asphalt binder such as coatability, adhesiveness and cohesiveness. Limit modifiers to no more than 6.0 percent by PG Binder weight.

5.3 The use of previously used materials in a PG Binder must be approved by the Department. Since no standard test procedures exist for reprocessed materials (and original tests were not developed with the use of such materials in mind), appropriate test methods may be chosen by the Department for review. Department approval does not relieve the binder supplier from full responsibility for content and use of any previously used material in a PG Binder nor guarantee suitable performance enhancement as defined above. The detected presence in a PG Binder sample of any unapproved previously used material will mean immediate removal from Supplement 1032 certification. Limit approved reprocessed materials to 6.0 percent by PG Binder weight.

5.4 Ensure the PG Binder is homogeneous, free from water and deleterious materials, and does not foam when heated to  $350^{\circ}$  F ( $175^{\circ}$  C). Prove the asphalt binder (before modification or after modification if liquid modifier used) is fully compatible with a negative result by means of the Spot Test per AASHTO T 102 using standard naphtha solvent. If standard naphtha shows a positive result, a retest using reagent grade 35 percent Xylene/ 65 percent Heptane (volume) may be used.

5.5 Ensure the PG Binder is at least 99.0 percent soluble as determined by ASTM D 5546 or D 2042. Ensure any insoluble component is substantially free of fibers and have discrete particles less than 75  $\mu$ m.

5.6 Ensure flash point is 500° F (260° C) minimum. Ensure mass loss on RTFO of the final PG Binder grade is 0.5 percent maximum.

5.7 Ensure that PG 58-28 has a minimum Viscosity (ASTM D2171 @ 60° C) of 800 poise and that PG 64-22 has a Penetration (ASTM D5) between 55 and 75.

5.8 Direct Tension testing is not required, unless otherwise required in this specification.

**Requirements for PG Modified Binder.** Furnish PG Modified Binder according to the requirements of Table 702.01-1 by modifying a non-oxidized, non-air blown, neat asphalt binder by using a styrene butadiene latex rubber compound (SBR polymer) or a styrene butadiene styrene polymer block copolymer (SBS polymer). The polymer supplier will certify to the refiner and Contractor that the polymer used meets a minimum 68 percent by weight butadiene content. Perform SBS polymer

modification prior to shipment to the asphalt concrete mixing plant (preblend). Perform SBR polymer modification at the asphalt concrete mixing plant (postblend) or prior to shipment to the asphalt concrete mixing plant (preblend).

For each project, the PG Modified Binder supplier will give the Contractor a handling guide specifying temperature, circulation, shelf life, and other requirements for assuring the PG Modified Binder will perform as desired. Give this handling guide to the Testing Lab and place a copy in the plant control room and plant laboratory.

If PG Modified Binder is retained at the asphalt concrete mixing plant for more than two weeks before use or beyond the supplier recommended shelf life, whichever is less, a top and bottom sample test (material property difference between samples taken from the top and bottom of the storage tank) will be performed by the Laboratory on samples retrieved by the Contractor at the City's direction. Do not use material on hand until approved.

Table 702.01-1 Material Requirements for PG Modified Binder					
Test / Requirement	SBR Polymer		SBS Po	Notes	
Final PG Binder Grade	70-22M (a, b)	64-28 (a,b)	70-22M (a)	76-22M (a)	с
Final PG Binder Grade			64-28 (a)		
Actual Pass Temperatures	Rep	ort	Report		i
RTFO Mass Loss, percent	0.	5	0.5	0.5	d
max					
Phase Angle, max	70	6	80	76	d
Elastic Recovery, min			65	75	e
Toughness, in lb	118	105			f, d
Tenacity, in lb	70	80			f, d
Elongation, in, min	20	20			f, d
Ductility, in, min	28 28				j, d
Separation, F max	10		10		g
Homogeneity		None Visible		h, d	

a. Preblended Binder with a base binder of at least -22 grade or stiffer for 70-22M.

b. Post blended Binder made from ODOT Supplement 1032 certified or preapproved standard PG Binder grade and rubber solids amount equal to or above 3.5 percent by weight of total binder to achieve the PG Binder grade.

- c. Without Direct Tension, graded with actual pass temperatures
- d. PG Modified Binder
- e. ASTM D 6084, 10cm @ 25° C, hold 5 min. before cutting, on RTFO material
- f. ASTM D 5801, 50cm/min @ 25° C

g. Softening point difference of top and bottom of tube sample conditioned at 340° F for 48 hours. Compatibility of polymer and neat binder is sole responsibility of supplier. Formulate PG Modified Binder to retain dispersion for 3 days minimum.

h. Heat a minimum 400 gram sample at  $177^{\circ}$  C for 2.5-3 hours. Pour entire sample over a hot No 50 (300  $\mu$ m) sieve at 340° F. Look for retained polymer lumps.

i. Actual high and low temperature achieved by PG Modified Binder beyond required grade, but will not grade out to the next standard PG Binder grade for low temperature.

j. ASTM D 113, @ 4º C, 1 cm/min

**702.02** Cut-Back Asphalt. Provide rapid curing cut-back asphalt according to AASHTO M 81 and medium curing cut-back asphalt according to AASHTO M 82. Instead of viscosity on the residue, the penetration in note 3 (AASHTO M 81) or note 4 (AASHTO M 82) shall govern.

**702.03 Cut-Back Asphalt Emulsions.** Prepare emulsions by compounding a suitable volatile solvent and water with 702.01 asphalt to produce emulsions according to Table 702.03-1.

	CBAE- 350	CBAE- 350	CBAE- 800	CBAE- 800	Primer 20	Primer 100
		Special		Special	-	
Kinematic Viscosity at 60 C,	350-700	350-700	800-1600	800-1600	20-40	100-200
Centistokes						
Water Content <sup>[1]</sup> , %	4-12	4-12	4-12	4-12	3-8	3-8
Volatile Solvent <sup>[1]</sup> , %	12-25	12-25	10-20	10-20		
Asphalt Content <sup>[1]</sup> , %	67+	67+	72+	72-	45+	60-
Adhesion Test <sup>[1]</sup>	[2]	[2]	[2]	[2]		
Wet Stone Coating Test <sup>[1]</sup>		[2]		[2]	[2]	[2]
Stripping Test <sup>[1]</sup>		[2]		[2]		
		Tests	on Residue	From Distil	lation	
Penetration at 25 C	80-150	80-150	80-150	80-150	100-200	100-200
Ductility at 25 C, in cm	100+	100+	100+	100+	100+	100+
Total Binder (Sol. in CSx), %	99+	99+	99+	99+	99+	99+
[1]Perform tests according to 3	Supplement 1	014.				
[2]Meets.						

Table 702.03-1

**702.04 Emulsified Asphalts.** Provide emulsified asphalts according to AASHTO M 140 or AASHTO M 208.

**702.05** Asphalt Primer for Waterproofing. Provide asphalt primer for waterproofing according to ASTM D 41.

**702.06** Asphalt for Waterproofing. Provide asphalt for waterproofing according to ASTM D 312, Type III.

**702.07** Asphalt Emulsion MWS. Prepare asphalt emulsion MWS from a base material according to 702.01, except vary the penetration to meet the float test and penetration specified below. Ensure that the emulsion coats the aggregate readily, thoroughly, and uniformly. Ensure that the specified characteristics do not change during transportation or normal storage and that the emulsion is according to the following when tested according to AASHTO T 59:

Saybolt furol viscosity at 77° F (25° C), seconds	50+ [1]
Asphalt residue, percent	68+
Settlement, 7 days, percent	5-
Sieve test	0.1-
Coating test	[2]
Oil distillate, percent	7-
Withstand freezing to	-10° F (-23° C) <sup>[3]</sup>
Particle charge	Negative
Penetration, 77 °F (25 °C) [6]	[4]
Float test at 140 °F (60 °C), seconds [6]	1200+ [5]
Total bitumen soluble CS <sub>2</sub> <sup>[6]</sup>	97.5+
Ash content, percent [6]	2.0-

#### [1]Pumpable.

[2]Use aggregates to test the emulsion that are from sources standardized by the Laboratory. Use aggregates consisting of 100 percent passing a 3/8 inch (9.5 mm) sieve and 0 percent passing a 1/4 inch (6.3 mm) sieve. Wash the standard reference aggregates with distilled water until free of dust, and dry them.

Weigh 3.280 ounces (93 grams) of the dry graded reference aggregate into a suitable container. Weigh 0.247 ounces (7 grams) of the emulsion onto the aggregate in the container, and vigorously mix the contents for 5 minutes. After mixing, thoroughly coat the stone. Completely immerse the mixture in tap water, and immediately pour off the tap water. Ensure that the aggregate surface area is at least 90 percent coated. [3]When shipped after October 1 and before April 15, except if the emulsion is stored and mixed at temperatures of emulsion, aggregate, and atmosphere above  $40^{\circ}$  F (5° C).

[4]Select the penetration within the following ranges of the designation specified:

Designation	Penetration at 77° F (25° C)	
MWS 300	300+	
MWS 150	150 to 300	
MWS 90	90 to 150	
MWS 60	60 to 90	

[5]AASHTO T 50, except immediately pour residue from distillation into the float collar at 500° F ( $260^{\circ}$  C); or if the residue has been allowed to cool, heat it again to 500° F ( $260^{\circ}$  C) and pour it into the float collar.

[6]Test on residue from distillation.

#### 702.13

**702.13 Rubberized Asphalt Emulsion.** Provide material consisting of asphalt emulsion SS-1 or SS-1h, according to 702.04, blended with rubber compound, according to 702.14, to produce a residual mixture of asphalt and rubber solids having a composition of 95 0.3 percent asphalt and 5 0.3 percent rubber solids by weight.

Furnish a certification to the Laboratory showing the following:

A. The weight of rubber compound blended with the emulsion.

B. The weight of SS-1 or SS-1h emulsion blended with the rubber compound.

C. The Laboratory Report Number and/or the approved Notice of Shipment Number of the SS-1 or SS-1h emulsion.

D. The certified lot or batch number of the rubber compound.

E. The percent of asphalt in the emulsion residue by distillation.

F.The percent of rubber solids in rubber compound.

G. The percent of rubber solids in the mixture of asphalt residue by distillation and rubber solids.

Determine the weight of the rubber compound to be added to a designated weight of SS-1 or SS-1h emulsion to provide the percent of rubber solids in the mixture of asphalt residue by distillation and rubber solids specified herein using the following formula:

$$X = \frac{0.0526 B x W}{A}$$

where:

*X* =pounds (kilograms) of rubber compound

A = percent of rubber solids in the rubber compound

B =percent of asphalt residue by distillation of SS-1 or SS-1h emulsion

*W*=pounds (kilograms) of SS-1 or SS-1h emulsion

**702.14 Rubber Compound.** Provide a dispersible rubber compound.. consisting of unvulcanized virgin synthetic rubber in the liquid latex form. The manufacturer of the rubber compound will furnish a written certification of the total rubber solids content of the rubber compound and provide written certification containing actual test results showing compliance with the requirements of these Specifications.

Provide a rubber compound according to the following:

A. Rubber compound:

Total rubber solids, % by weight (Certification)	49+
Ash, % of total rubber solids (ASTM D 297)	3.5-

B. Combination of rubber compound with reference asphalt, mixed according to Supplement 1012.02:

Flow, cm	5-
Softening point, °C raise from	
reference asphalt, ASTM D 36	12+
Penetration @ 25 °C., 100 g, 5 sec.,	
mm/10 drop from reference asphalt, ASTM D 5	10 +
Viscosity, Brookfield units, Model RVF,	
spindle No. 7 @ 10 RPM @ 94 °C *	175,000+
Toughness inch-pounds (Nm)	150+(17+)
Tenacity, inch-pounds (Nm)	90+ (10+)
Peak load, pounds (N)	65+ (289+)
Elongation, inches (mm)	20+(500+)
Ductility @ 4 °C, 1 cm/min, ASTM D 113	150 +

\*Take the reading 60 seconds after spindle is actuated.

C.Mixture of the rubber compound with the reference asphalt and reference aggregate:

Dispersion of rubber, number	
of remaining black rubbery	
particles visible to the naked eye	. None
Resistance to flexure fatigue,	
number of flexural units	1500 +

Perform the testing according to Supplement 1012

## 702.16 Polymer Emulsified Binder

Emulsion (ASTM D 244)	Туре А	Type B (j)
Saybolt Furol Viscosity	75-400 (50° C)	20-100 (25° C)
Storage stability, 24 hrs., % difference, max	1	1
(a)		
Demulsibility, 35 ml of 0.8% Dioctyl Sodium	40 (b)	60
Sulf., min		
Demulsibility, 35 ml of 0.02N, CaCl <sub>2</sub> , %,	40	60
min	(c)	
Sieve test, (distilled water), %, max	0.1	0.05
Distillation to 190 °C or (h), residue % solids	68	63
(d) symbol		
Oil distillate, %, max	2	2
Distillation Residue		
Penetration, 100g, 5 sec @25°CASTM D 5	75-115	90-150

### 702.17

Float Test, sec, min ASTM D 139	1200 (g)	
Softening point, °C, min ASTM D 36	60	
Solubility in TCE, %, min ASTM D 2042 or	97.5	97.5
D 5546		
Elastic Recovery, 10° C, %, minASTM D	70	58
113, (e),(j)		
Force Ductility, 4° C, 40 cm, lb/ sq in ASTM	report	report
D 113, (j)		
Toughness/Tenacity,		
25° C, 50 cm/min, Nm ASTM D 5801 (f), (j)	report	
	16.0/ 9.0	
25°C, 50 cm/min, Nm ASTM D 5801 (i)		
Ductility, 4 ° C,1cm/min, min ASTM D 113,	70	
(i)		

## Notes:

(a) After standing undisturbed for 24 hours, the surface will show no white, milky colored substance, but will be a smooth homogeneous color throughout. (b)CRS-2P, test within 20 days of shipment.

(c)HFRS-2P, test within 20 days of shipment.

(d)Maximum of 190 °C held for 15 minutes. (e)Straight molds. Hold at test temperature for 90 minutes. Place in ductilometer and elongate 10 cm at 5 cm/min. Hold for 5 minutes and cut. After 1 hour retract the broken ends to touch and note elongation in cm (X). Percent Recovery =  $((10-X)/10) \times 100$ .

(f)Report on JMF. Not part of normal QC testing. Run when requested for investigation.

(g)HFRS-2P

(h)California Test 331, Residue by Evaporation

(i)SBR

(j)SBS, SB

# 702.17 Crack Sealant

A.Type I Crack Sealant. Conform to 705.04

**B.Type II Crack Sealant.Provide** a mixture of PG 64-22 certified binder (Supplement 1032) and polyester fibers (recycled fibers not permitted) according to the following requirements:

Denier; ASTM D 1577*	
Length	.0.25 0.02 inch (6.35" 0.51mm)
Crimps; ASTM D 3937	None
Tensile str, min. ASTM D2256*	70,000 psi (483 Mpa)
Specific gravity	
Minimum melting temperature	
Ignition temperature	1000° F (538° C) min.

\*This data must be obtained prior to cutting the fibers.

Combine materials so the fibers are a minimum of 5.0 percent by total weight of the asphalt binder. Ensure combined materials are according to the following properties:

Strength (at break)	
at 72° F (22° C)	
at 0° F (-18° C)	500 psi (3.5 MPa) min.
Elongation (at break)	
at 72° F (22° C)	
at 0° F (-18° C)	

The option for using premixed and prepackaged Type II crack sealant is permitted provided (1) the fibers and the fiber binder are according to the requirements as shown and, (2) the fiber binder is according to the manufacturer's specifications. Furnish certified test data from the fiber binder manufacturer annually to the Laboratory, and when requested <del>of</del> by the Laboratory. Furnish a <del>A</del> letter of certification with each shipment stating that the material complies with specification requirements.

**C.Type III Crack Sealant.** Provide a mixture of PG 64-22 certified binder (Supplement 1032) and polypropylene fibers (recycled fibers not permitted) according to the following requirements:

Denier; ASTM D 1577*	
Length,	.0.390.08 inch (9.91" 2.0 mm)
Crimps; ASTM D 3937	None
Tensile strength, min, ASTM D 2256*	
Specific gravity	
Minimum melting point	

\*This data must be obtained prior to cutting the fibers.

Combine materials so the fibers are a minimum of 7.0 percent by total weight of the asphalt binder. Ensure combined materials are according to the following properties:

Strength (at break)	
at 72° F (22° C)	
at 0° F (-18° C)	500 psi (3.5 MPa) min.
Elongation (at break)	
at 72° F (22° C)	
at 0° F (-18° C)	

**D.Type IV Crack Sealant.**Provide a prepackaged, preapproved mixture of modified binder according to the following properties and minimum 2.0 percent

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polyester fibers (recycled fibers not permitted) according to the following properties. Place sealant with a manufacturer's representative for the fiber binder on site to ensure proper application and conditions.

Modified binder:

Cone penetration, 77° F(25° C)	50-90
Flow, 140° F (60° C)	1.0 cm max
Resilience, 77° F (25° C)	25-60 percent
Ductility, 77° F (25° C)	40 cm min
Bond, 0° F (-18° C), 100 percent ext.Pass	5 cycles
Impact, 0° F (-18° C)	Pass
Compression recovery	0.40 min
Recommended pour temperature	. 380° F (193° C)
Safe heating temperature	410° F (210° C)

Polyester fiber properties and fiber approval: Same as for Type II crack sealant.

Fiber binder properties:

Safe heating temperature	400° F (204° C)
Softening point	190° F (88° C)
Viscosity, 400° F(225° C)	
Cone penetration, 77° F(25° C)	
WorkabilityCapable of being melted and ap	oplied through a pressure feed, indirect
heated and agitated melter	
Flexibility*	Pass
-	

\* 1 inch (25mm) sample at -20° F(-30° C), 90 degree bend, 10 sec

Crack sealant approval: Submit 10 pounds (4.5 kg) of base modified binder and 10 pounds (4.5 kg) of fiber binder from the same batch to the Laboratory. Submit samples for approval annually. Before shipment to the project the fiber binder must be approved by the Laboratory. Additional testing or submission of samples may be required by the Laboratory.

# 703 AGGREGATE

**703.01 General.** Soundness. When the major portion of the unsound material in a coarse aggregate acquires a mud-like condition when tested for soundness, the maximum loss shall be five percent for all uses.

Stock Piles. Stockpiling and loading methods shall be such as to permit ready identification of the aggregates and to minimize segregation. Sites for stock piles shall be clean prior to storing materials. No material which has become mixed with foreign matter or other sizes or grades of aggregates shall be used.

Aggregates shall be handled in such a manner that the moisture content will be reasonably uniform for each day's run. If necessary, in order to secure uniformity of moisture content of the aggregate, stockpiling will be required.

Open-hearth and Basic-oxygen Furnace Slags. All open-hearth and basic-oxygen furnace slags shall be furnished to a size meeting the specified grading requirements of the use item to which it will be incorporated, and stockpiled for a period of not less than 6 months prior to use. New material shall not be added to the stockpile during the 6 month aging period, or prior to or during delivery from the stockpile to the project. Any addition of new material to a stockpile will require initiation of a new aging period before any material from that stockpile may be used. Prior or during the stockpiling operation, these materials shall have water added to provide a uniform moisture content not less than their absorbed moisture and the stockpile shall be maintained in a moist condition during the required stockpiling period.

The Contractor shall furnish the Engineer with a certificate stating that the slag material stockpiling requirements have been complied with for all such material furnished to the work. This certification shall include the estimated yardage, the detailed location, and the beginning and ending dates of the aging periods, of each stockpile. The certification shall be submitted with sufficient lead time, prior to intended use, to allow for inspection, sampling, and testing.

Air Cooled Blast Furnace Slag. In addition to meeting the same requirements stated above for open-hearth and basic oxygen furnace slags, all air cooled blast furnace slag shall be subject to the acceptance requirements set forth in ODOT Supplemental 1027 (Sulphur Leachate Test).

Size. Aggregate shall conform to the size specified in the material specifications, the construction item or as shown in AASHTO M 43.

#### APPLICABLE DOCUMENTS

- ASTM C142 Amount finer than No. 200 Sieve AASHTO T11 or ASTM C117 Clay Lumps and Friable Particles.
- ASTM D75 Sampling Aggregate.
- ASTM C29 Test for unit weight and voids in aggregate.
- ASTM C39 Test for compressive strength of cylindrical concrete specimens.
- ASTM C40 Test for organic impurities in sands for concrete.
- ASTM C78 Test for Flexural strength of concrete (using simple beam with third-point loading).

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- ASTM C87 Test of effect or organic impurities in fine aggregate on strength of mortar.
- ASTM C88 Test for soundness of aggregates by use of Sodium Sulfate or Magnesium Sulfate.
- ASTM C117 Test for materials finer than No. 200 (75-mm) sieve in mineral aggregates by washing.
- ASTM C123 Test for lightweight pieces in aggregate.
- ASTM C125 Definitions of terms relating to concrete and concrete aggregates.
- ASTM C131 Test for resistance to abrasion of small size coarse aggregate by use of Los Angeles machine.
- ASTM C136 Test for sieve or screen analysis of fine and coarse aggregates.
- ASTM C142 Test for clay lumps and friable particles in aggregates.
- ASTM C227 Test for potential alkali reactivity of cement-aggregate combinations (mortar-bar method).
- ASTM C289 Test for potential reactivity of aggregates (chemical method).
- ASTM C295 Recommended practice for petrographic examination of aggregates for concrete.
- ASTM C342 Test for potential volume change of cement- aggregate combinations.
- ASTM C535 Test for resistance to abrasion of large size coarse aggregate by use of the Los Angeles machine.
- ASTM C586 Test for potential alkali reactivity of carbonate rocks for concrete aggregates (rock cylinder method).
- ASTM C666 Test for resistance of concrete to rapid freezing and thawing.
- ASTM D75 Sampling Aggregates.
- ASTM E11 Specifications for wire-cloth sieves for testing purposes.

Method of Test. Aggregate shall be tested by the following methods:

Amount finer than No. 200 sieve	S1004*
Clay lumps	S1017*
Coal and lignite AASHT	TO T113

Crushed pieces	S1021*
Deleterious materials	S1029*
Effect of organic impurities	
on strength of mortar	AASHTO T71
Liquid limit	AASHTO T89
Percentage of wear,	
Los Angeles abrasion test. AASHTO T9	6 or ASTM C535
Plasticity index	AASHTO T90
Sieve analysis	.S1004*, S1005*
Sieve analysis of mineral filler	AASHTO T37
Sodium sulfate soundness test, 5 cycles	AASHTO T104
Specific gravity and percent absorption	
for fine and coarse aggregate	S1031*
Unit weight	AASHTO T19

\* Supplement on file in the Office of the Engineer.

SIEVE SIZE	1	2	24	3	357	4	467	5	56	57
4"	100									
3-1/2"	90-100									
3"		100	100							
2-1/2"	25-60	90-100	90-100	100	100					
2"		35-70		90-100	95-100	100	100			
1-1/2"	0-15	0-15	25-60	35-70		90-100	95-100	100	100	100
1"				0-15	35-70	20-55		90-100		95-100
3/4"	0-5	0-5	0-10			0-15	35-70	20-55	40-75	
1/2"			0-5	0-5	10-30			0-10	15-35	25-60
3/8"						0-5	10-30	0-5	0-15	
No. 4					0-5		0-5		0-5	0-10
No. 8										0-5
No. 16										
No. 50										
No. 100										

# TABLE 703-1 SIZES OF COARSE AGGREGATE (AASHTO M 43)

SIEVE SIZE	6	67	68	7	78	8	89	9	10
4"									
3-1/2"									
3"									
2-1/2"									
2"									
1-1/2"									
1"	100	100	100						
3/4"	90-100	90-100	90-100	100	100				
1/2"	20-55			90-100	90-100	100	100		
3/8"	0-15	20-55	30-65	40-70	40-75	85-100	90-100	100	100
No. 4	0-5	0-10	5-25	0-15	5-25	10-30	20-55	85-100	85-100
No. 8		0-5	0-10	0-5	0-10	0-10	0-10	5-30	10-40
No. 16			0-5		0-5	0-5	0-10	0-10	
No. 50							0-5	0-5	
No. 100									10-30

(1) Numbered sieves are those of the United States Standard Sieve Sizes.

(2) Amounts given are the percentages by weight passing each sieve size (square openings).

(3) Screenings. Where sizes of coarse aggregate designated by two or three digit numbers are specified, the specified gradation may be obtained by combining the appropriate single digit standard size aggregates by a suitable proportioning device which has a separate compartment for each coarse aggregate combined. The blending shall be done as directed by the laboratory.

# 703.02 Aggregate for Portland Cement Concrete.

# Fine Aggregate.

1. The fine aggregate shall be natural sand.

<u> </u>	<b>a</b> .		
· ,	VIAVA	Ang	170101
<i>L</i> .	SIEVE	лпа	1 8 515.
			J

<b>Total Percent Passing</b>	
Sieve Size	Natural Sand
3/8 Inch	100
No. 4	95-100

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No. 8	70-95
No. 16	45-80
No. 30	5-60
No. 50	10-30
No. 100	1-10
No. 200	0-4

Fine aggregate failing to meet the minimum requirement for amount passing either the No. 50 or No. 100 Sieve, or both, may be used provided an approved fine material is added to correct the deficiency. The amount added shall be determined by the laboratory.

Should the fineness modulus of a job control sample of sand from any source vary by more than 0.20 from that of a representative sample from that source, the sand may be rejected.

3. Soundness, Sulfur, etc.:	
Maximum	Percent
Loss, Sodium Sulfate Soundness test Section 305	12
Sec. 451, 452, 511, 515, 519, 603, 604,	
453, 454, 455, 456 457, 458, 704 and 706	10

When the sand has more than 0.3 percent by weight of sulfur compounds, the service record of the sand when exposed to weathering in concrete will be examined before classifying the material as satisfactory or unsatisfactory for use.

When tested for the effect of organic impurities on strength of mortar, the compressive strength at three and seven days of mortar made with untreated sand shall be not less than 95 percent of the compressive strength of mortar made with treated sand.

Aggregations of soil, silt, etc., maximum percent, by weight, 0.5.

### **Coarse Aggregate.**

1. The coarse aggregate shall be washed gravel, crushed carbonate stone, or crushed air-cooled blast furnace slag. Gravel for coarse aggregate in concrete may be used only where specifically noted on the plans or with written permission of the Engineer.

2. Physical Properties:

Percent of wear, Los Angeles test, maximum (stone or gravel)......40 Unit weight, compacted, minimum pounds (slag)......70 Loss, Sodium Sulfate Soundness Test, percent, maximum:

305	15
451, 452, 511, 519, 551, 562,	
563, 613, 622, 704 and 706	12
515	10

Deleterious substances shall not exceed the following:

	Percent by Weight	
	Super-Structure	All Other
		Concrete
Soft Pieces	2.0	3.0
Coal and Lignite	0.25	1.0
Clay Lumps	0.25	0.25
Pieces having a length greater than 5		
times the average thickness	15	15
Shale and Shaly Material	0.5	1.0
Other Deleterious substances, such as		
limonitic concretions, alkali, metallic		
particles and chert which disintegrates	0.5	1.0
in 5 cycles of soundness test		

3. Amount finer than No. 200 sieve. The percentage of material finer than the No. 200 sieve in the aggregate portion of the concrete mix shall not exceed the following:

	Percent by Weight	
	Super-Structure	All Other
Where the finer than No. 200 sieve		Concrete
consists of the dust of fracture	3.4	3.8
Where the finer than No. 200 sieve		
consist of or include material other than	2.0	2.2
dust of fracture		

# 703.03 Fine Aggregate for Mortar or Grout.

- 1. The fine aggregate shall be natural sand.
- 2. Sieve Analysis:

	Total
Sieve Size	Percent Passing
No. 4	100
No. 8	95-100
No. 50	10-40
No. 100	0-10
No. 200	0-5

3. Soundness Sulfur, Etc.:

Loss, Sodium Sulfate Soundness test, percent, max.....10

When the sand has more than 0.3 percent by weight of sulfur compounds, the service record of the sand when exposed to weathering in mortar or grout will be examined before classifying the material as satisfactory or unsatisfactory for use.

When tested for the effect of organic impurities on strength of mortar, the compressive strength of mortar made with untreated sand shall be not less than 95 percent of the compressive strength of mortar made with treated sand.

Aggregations of soil, silt, etc., max. percent, by weight, 0.5.

# 703.04 Aggregate for:

Bituminous Aggregate Base, 301 Aggregate Base, 304 Slope and Channel Protection, 601

1. The coarse aggregate for bituminous aggregate base used in flexible pavements shall be crushed carbonate stone or crushed gravel. The fine aggregate for bituminous aggregate base shall be natural sand.

2. Physical Properties	<u>301</u>	<u>304</u>	<u>601</u>
Percentage of wear, Los Angeles Test, maximum	50	50	50
Unit weight, compacted, pounds minimum (slag)	65		65
Loss, Sodium Sulfate Soundness test, percent maximum	15	15	15
Percentage of fractured pieces, minimum	40	90	90

Deleterious substances shall not exceed the following:

# Percent by Weight <u>Item 301</u>

Soft Pieces	3.0
Coal and Lignite	1.0
Clay Lumps	0.25
Pieces having a length greater than	
5 times the average thickness	
Shale, shaly material, and chert which	
disintegrates in 5 cycles of the soundness test	2.5

# 703.05 Aggregate for:

- (1) Asphalt Concrete, 302, Asphalt Concrete (Intermediate and Surface Courses), 412, and 413
- (2) Prime Coat (408).
- (3) Seal Coat, 409
- (4) Bituminous Road Mix, 406

# A.Fine Aggregate.

1. Provide fine aggregate consisting of natural sand or sand manufactured from stone, gravel or air-cooled slag.

2. Sieve analysis.

Sieve Size	Total Percent Passing
3/8 inch (9.5 mm)	100
No. 4 (4.75 mm)	90 to 100
No. 8 (2.36 mm)	65 to 100
No. 16 (1.18 mm)	40 to 85
No. 30 (600 mm)	20 to 60
No. 50 (300 mm)	7 to 40
No. 100 (150 mm)	0 to 20
No. 200 (75 mm)	0 to 10

3. Soundness, etc.

	Maximum
	Percent
Loss, sodium sulfate soundness test, %	15
Aggregations of soil, silt, etc., by weight	0.5

## **B.**Coarse Aggregate.

1. Provide coarse aggregate consisting of CCS, crushed air-cooled slag, or washed gravel.

2. Physical properties.

## 703.06

Percent of wear, Los Angeles test, maximum (stone or gravel)40
Unit weight, compacted, lb/ft <sup>3</sup> (kg/m <sup>3</sup> ), minimum (slag): Asphalt Concrete, 406,408,409 and 412
Loss, sodium sulfate soundness test, %, maximum: Asphalt Concrete, and 41212
Loss, sodium sulfate soundness test, %, maximum: 405 and 40915
Percent by weight of fractured pieces, minimum40

Deleterious substances shall not exceed the following:

	Percent by
Material Type	Weight
Soft pieces	3.0
Coal and lignite	1.0
Lightweight pieces	1.0
Clay lumps	0.25
Amount finer than No. 200 (75 m) sieve	3.0
Pieces having a length greater than 5 times the average thickness	15
Shale and shaly material	2.5
Limonitic concretions	2.5
Alkali	2.5
Chert, that disintegrates in 5 cycles of the soundness test	2.5

## C.General Requirements for Coarse and Fine Aggregate.

- 1. Calculate each individual sieve fraction soundness loss and ensure that the fractional size does not exceed the following:
  - a. 13.0 percent for all surface courses and any asphalt concrete course directly below an open graded friction course.
  - b. 13.0 percent for No. 8 aggregate fractions used in intermediate courses that will be exposed to traffic over the winter months.
  - c. 15.0 percent for all other coarse aggregate used in intermediate courses that will be exposed to traffic over the winter months.

Statistical evaluation of data will be per Group List procedures.

**703.06 Sand Cover (407 and 408)**. 1. For 407 and 408 the sand shall be natural sand.

2. Sieve Analysis:

Sieve Size	Total Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-10

## 703.07 Mineral Filler.

1. The mineral filler shall be limestone dust, portland cement, or other inert mineral matter. It shall be thoroughly dry and free from lumps.

2. Sieve Analysis:

Sieve Size	Total Percent Passing
No. 30	100
No. 50	95-100
No. 200	5-100

## 703.08 Granulated Slag.

1. The granulated slag shall be the glassy, granular materials formed when molten blast-furnace slag or electric-furnace slag is rapidly chilled, as by immersion in water. Material containing mill waste, cinders, large pieces of ungranulated slag, or other matter foreign to the production of slag in the normal operation of the blast-furnace or electric furnace may be rejected.

The material shall be of such nature that it will compact to the satisfaction of the engineer.

2. Sieve Analysis:

Sieve Size	Total Percent Passing
2 Inch	100
1 Inch	5-100
No. 100	0-15

### 703.09 Slacker Aggregate.

1. The slacker aggregate shall be the by-product of lime slackers and shall consist of unburned and underburned limestone, or silica, or both. Material containing calcium oxide, coke, or other foreign matter may be rejected.

The material shall be of such nature that it will compact to the satisfaction of the Engineer.

2. Sieve Analysis:

<u>Sieve Size</u>	Total Percent Passing
2 Inch	100
3/4 Inch	75-100
No. 4	35-75
No. 200	0-15

# 703.10 Screenings.

- 1. The screenings shall be No. 10 size gravel, stone, or air-cooled slag. Where crushed material is specified, it shall be crushed from material larger than the 1/2 inch sieve.

# 704 MASONRY UNITS

**704.01 Clay or Shale Brick**. ASTM C 32, Grade SM, with the following exception:

- 4.1 Size. The units shall be 8-1/4" x 3-5/8" x 2-3/4".
- 7.1 Sampling and Testing. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**704.02** Concrete Brick. ASTM C 55, Type II, Grades N 11 or S 11 with the following exceptions and additions:

- 3. Materials. 3.1.1 and 3.1.2, Cement shall conform to 701 Portland Cement. 3.2 Aggregate shall conform to the quality requirements of 703.02.
- 7. Methods of Sampling and Testing. 7.1. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer. 7.2. Brick shall be sampled and tested in accordance with ASTM C 140 except that each sample shall consist of 12 full sized brick.

Size and Shape. The units shall be of such size and shape as to permit their incorporation in the structure in conformance with the specified dimensions of the structure. They shall be of a rectangular cross section with square corners. The ends, edges and one face shall have plain surfaces.

**704.03 Concrete Masonry Blocks**. ASTM C 139, with the following exceptions and additions:

4. Dimensions and Permissible Variations. In addition, the units shall be of such size and shape as to permit their incorporation in the structure in conformance with the specified dimensions of the structure.

5. Sampling and Testing. 5.1 Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

# 705 CONCRETE PAVEMENT INCIDENTALS

705.01 Hot Applied Joint and Crack Sealer. ASTM D 3405.

705.02 Cold Applied Joint Sealer. ASTM D 1850.

**705.03 Preformed Fillers**. AASHTO M 153 or AASHTO M 213, with the following exceptions and additions:

3.7 Asphalt Content. The producer shall certify to the Engineer that the asphalt cement content is at least 35 percent by weight of the filler.

Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**705.04 Hot Applied Joint Sealer.** Furnish hot applied joint sealer conforming to ASTM D 6690, Type II Use this material as the primer for Type 3 membrane.

705.05 Burlap Cloth. AASHTO M 182, Class 2.

**705.06** Sheet Materials for Concrete Curing. AASHTO M 171, moisture loss and reflectance only.

**705.07 Liquid Membrane-forming Compounds for Curing Concrete**. ASTM C 309 Type 1, Type 1-D or Type 2, Class B, with the following additions:

8.1 Packing and Marking. The containers for Type 2 white pigmented liquid membrane forming compounds shall be equipped with mechanical agitators. Drums containing resin base compound shall be marked "Resin Base." Each drum in any batch or lot shall have a number assigned as the drum is being filled.

705.08 Waterproofing Polyethylene Film.

705.10 Air-Entraining Admixtures. AASHTO M 154.

**705.11 Preformed Elastomeric Compression Joint Seal for Concrete**. AASHTO M 220 with the following exceptions and additions:

- 5.1 Size and design shall be as shown on the plans.
- 7.2 Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site, or at other locations designated by the Engineer.
- 7.3 A minimum of 6 linear feet shall constitute one sample.
- 8.3 Specimens for the low temperature recovery tests shall be lightly dusted with talc on the outside surfaces only.
- 11.1 In addition, one-foot length markings shall be not less than 11-15/16 nor more than 12-1/8 inches from center to center.

The lubricants for installation of preformed compression seals shall be as recommended by the seal manufacturer.

Qualification. Each design, shape, width, depth, web and shell thickness shall be approved by the Engineer prior to use. Drawings of the seals showing all dimensions and dimension tolerances and weight per foot shall be submitted with the request for design approval. A copy of Certified Test Data covering the specified properties of preformed elastomeric joint seals shall accompany the request for approval. A 6-foot length of elastomeric joint sealer shall be submitted concurrently with the request for qualification.

**705.12** Chemical Admixture for Concrete. ASTM C 494. The minimum relative durability factor shall be 90.

**705.13** Fly Ash for Use in Portland Cement Concrete. ASTM C 618, Class C or F, except the maximum loss on ignition shall be 3 percent.

conforming to the	e following:
Viscosity	Less than 25 cps (Brookfield viscometer, Model RVT with UL adaptor or
	Model LVF, # spindle and UL adaptor C @ 77 °F (25 °C) (ASTM D 2849)
Density	Greater than 8.4 lb/gal Ca 77 °F (25 °C) (ASTM D 2849)
Flash Point	Greater than 200 °F (93 °C) (PenskyMartens CC)
	(ASTM D 93)
Vapor Pressure	Less than 1.0 mm Hg C @ 77 °F (25 °C) (ASTM D 323)
TG (DSC)	Greater than 135 °F (58 °C) (ASTM D3418)
Shelf Life	Must be 1 year minimum at manufacturers recommended environmental considerations
Gel Time	Greater than 40 min, 100 g mass (ASTM D 2471) (thin film)
Percent Solids	Greater than 90% by weight

**705.15 High Molecular Weight Methacrylate (HMWM) Resin.** Provide low viscosity, non-fuming high molecular weight methacrylate (HMWM) resin conforming to the following:

Bond Strength

Use a No. 6 (20M) deformed reinforcing bar 30 inches (760 mm) long, cleaned and degreased. After thoroughly cleaning the hole, grout the bar into the test block or cylinder as recommended by the resin manufacturer. Hold and center the bar perpendicular to the concrete surface in the grout-filled hole during the curing period.

Cure the resulting specimen at  $77\pm5^{\circ}$  F ( $25\pm3^{\circ}$  C) for 24 hours. Apply an axial pull out load to the bar at a rate of 1/2 inch (13 mm) per minute until the bar pulls out of the specimen, or the concrete block or cylinder cracks or spalls. Record the failure mode and applied load.

Supply the polyester, vinylester, and epoxy resins in non-reactive containers and with their MSDS. Label containers with the name of the mixture, the manufacturer, the shelf life expiration date, the batch number, quantity, and instructions.

Maintain storage areas between 40° and 100° F (5° and 38° C).

**705.23A Epoxy-Urethane Sealers.** Provide an Epoxy-Urethane sealer conforming to the following requirements: Absorption - ASTM C642 (non-air entrained concrete). Proportion and mix concrete according to ASTM C672. Sealed concrete, under total immersion, will not exceed 1.0% after 48 hours or 2.0% after 50 days

Scaling Resistance - ASTM C672 A rating of "No scaling" after 100 cycles on the sealed concrete (non-air entrained concrete) as compared to "Severe Scaling' on untreated concrete.

NCHRP 244, Series 11 - Cube Test

3.1 Weight gain - not to exceed 25% of untreated cube

3.2 Absorbed chloride - not to exceed 25% of untreated cube

NCHRP 244, Series IV - Southern Exposure 4.1 Absorbed chloride - not to exceed 10% of untreated concrete Record and report the application rate (square footage/gallon) of sealer during the tests.

Provide test data from an approved independent testing facility. The sealer manufacturer funds the testing costs.

Furnish the test data, a one quart sample, and the MSDS to the City of Akron Materials Testing Lab for approval.

**705.23B** Non-Epoxy Sealer. Provide an Non-Epoxy sealer conforming to the following requirements:

Absorption - ASTM C642 (non-air entrained concrete). Proportion and mix concrete according to ASTM C672. Sealed concrete, under total immersion, will not exceed 1.0% after 48 hours or 2.0% after 50 days

Scaling Resistance - ASTM C672 A rating of "No scaling" after 100 cycles on the sealed concrete (non-air entrained concrete) as compared to "Severe Scaling" on untreated concrete.

NCHRP 244, Series 11 - Cube Test

3.1 Weight gain - not to exceed 25% of untreated cube

3.2 Absorbed chloride - not to exceed 25% of untreated cube

NCHRP 244, Series IV - Southern Exposure

4.1 Absorbed chloride - not to exceed 10% of untreated concrete

Record and report the application rate (square footage/gallon) of sealer during the tests.

Provide test data from an approved independent testing facility. The sealer manufacturer funds the testing costs.

Furnish the test data, a one quart sample, and the MSDS to the City of Akron Materials Testing Lab, who will determine material acceptance.

**705.24** Soluble Reactive Silicate. Provide a soluble reactive silicate (SRS) that is a blend of Na/K/FlxSiOx (sodium, potassium, fluoro or other silicate), surfactants, polymers, and stabilizers capable of thoroughly saturating and sealing concrete. The treatment system will meet the following performance requirements:

A. Scaling Resistance - Treated concrete will pass ASTM C 672, Scaling Resistance test with a rating of 'No Scaling' after 100 cycles (non-air entrained concrete) as compared to "Severe Scaling' on untreated concrete

B. Absorption - The absorption of treated concrete under total immersion will not exceed 1.0 percent after 48 hours or 2.0 percent after 50 days (ASTM C 642, non-air entrained concrete). Concrete should be proportioned and mixed in accordance with ASTM C 672.

C. Skid resistance - The skid resistance of treated concrete pavement will not be reduced by more than 10 percent as compared to the same untreated pavement. ASTM E 274 using ASTM E 501 ribbed tire at 40 mph (64 kph), five test average.

D. AASHTO T 259 as modified. The standard T 259 Resistance of Concrete to Chloride Ion Penetration will be modified as follows:

In addition to section 3.1, intentionally break the specimens so they have a full depth crack through the middle of the slab. Install section 3.2 dams around the perimeter of the re-assembled, cracked, concrete specimens. Caulk around the perimeter of the dam to assure that only the crack and the concrete will allow water to pass through or be absorbed. After assembly, measure the crack width at three locations and report the crack width.

Perform the ponding of 3.4 until the 3% solution comes through the specimen's crack. Record and report he time required for the solution to appear through the specimen's crack. Remove the solution from the specimens and re-dry according to 3.3 (T 259).

After drying apply the SRS to the specimen 's top surface at the manufacturer's recommended rate of application. Record and report the rate of application. Air dry the SRS coated dammed sample specimens for 7 days. After 7 days, re perform the ponding with 3% chloride solution until solution comes through the specimen's crack or 14 days. Record the time the till the ponded solution comes through the crack.

Acceptable SRS materials will have a value of 2 or more when the ponding time before SRS application is divided into the ponding time after SRS application. Sections 3.5, 3,6, 4.1,4.2 and 5.1 (of T 259) will not apply.

Have tests performed by an approved independent testing facility acceptable to the Engineer.

Submit test data and a one quart (one liter) a technical data sheet and the MSDS to the City of Akron Materials Testing Lab for approval

**705.25 Gravity-Fed Resin.** Provide non shrink, non metallic resin conforming to ASTM C 881, Type 1, Grade 1, Class B or C and the following:

The maximum viscosity at the lowest allowable temperature will be 250 cps. The manufacturer will provide test data to verify the viscosity at the lowest temperature for the class for which it is to be approved.

A minimum average sand retention of 95.0% for three samples tested according to the Sand Penetration Test Method described below.

Show no signs of cracking, debonding or insufficient curing during the sand penetration test
**SAND PENETRATION TEST METHOD.** This test will be conducted with the following equipment and materials:

1. 4 oz [118 ml] wax coated paper cup. Maximum top diameter 2 5/16"[59 mm]; bottom diameter 1 11/16" [43 mm]; height 2 3/8" [60 mm].

- 2. 20 30 grade sand (ASTM C 778)
- 3. Pint non-absorbent container
- 4. 8 oz [240 ml] plastic cup
- 5. Stirring stick or spatula
- 6. Scale accurate to 0.1 g
- 7. Disposable gloves
- 8. Stop watch
- 9. Thermometer
- 10. Paint brush

# Perform the test as follows

- 1. Assure the material and the room is at 73° F [23°C]
- 2. Determine and record the tare weight of the paper cup (1).
- 3. Introduce 100.0 grams of 20 30 graded sand (2) into the paper cup.
- 4. Record the weight of the cup and the sand

5. Consolidate the sand in the cup by lifting the cup approximately  $\frac{1}{2}$  "[13 mm] and dropping 25 to 30 times. Then lightly tap the sides of the cup 25 to 30 times with the fingers. The sample may also be placed on a vibrating table for 10 to 15 seconds.

6. Measure enough material into the 8 oz plastic cups (4) to make at least a 200 g sample.

7. Combine the components into the non-absorbent container (3) and mix according to the manufacturer's recommendations using a spatula or stirring stick (5).

8. Pour 40.0g of material over the sand and record the weight of the resin, cup and sand

9. Allow the resin, sand and cup to set undisturbed for 24 hours at 73°F [23°C]. Reweigh the resin, cup and sand

10. Remove as much of the paper cup from around the hardened resin and sand matrix as possible. Lightly brush any loose sand from the matrix. Weigh the hardened matrix.

11. Calculate the percent of sand retained [F] as follows:

F = [E / (D-A)] x 100

[A] Tare weight of paper cup (g)
[B]Weight of cup and sand (g)
[C]Weight of fresh mixture of resin, cup and sand (g)
[D]Weight of cured mixture of resin, cup and sand (g)
[E]Weight of resin sand matrix as measured in step 10 (g)

12. Report the average of three specimens mixed separately

13. Also calculate and report the percent loss due to curing [G] as follows:

 $G = [(D - C) / (C - B)] \times 100$ 

14. Examine the sand / resin matrix for signs of insufficient curing and bond, or excessive shrinkage.

**MATERIAL APPROVAL**. The manufacturer will provide certified test data verifying compliance with the above requirements; technical data sheet; current MSDS for the material; 1 gallon sample; and a letter certifying that the product formulation will not be altered without notification to the Engineer.

The City of Akron Materials Testing Lab will determine acceptance of the material.

**705.26 Epoxy injection Resin.** Provide epoxy injection resin capable of application, positive adherence and strength development when applied to moist or wet surfaces at temperatures of  $33^{\circ}$  F (1° C) and above.

Use products that contain 100% solids material and no non-reactive diluents, solvents or other fillers. Provide materials that meet the following requirements:

A. The injection will meet the requirements of ASTM C 881 Type IV, Grade 1 and Class B or C and viscosity 600cps at the lowest ambient material and substrate temperature to be used.

B. The <u>paste materials</u> will meet the requirements of ASTM C 881 Type I, Grade 3 and Class B or C.

#### Material Approval.

The manufacturer of the materials is responsible for prequalifying the material and submitting the following to the City of Akron Materials Testing Lab:

A. An Independent certified test data indicating that the materials, when mixed according to the manufacturer's recommendations, meet the requirements listed above.

B. Manufacturer's technical data sheet for the paste and injection materials.

- C. MSDS for paste and injection materials.
- D. 1 Gallon Sample or 2 kits of the injection materials

#### 706 CONCRETE AND CLAY PIPE

#### 706.01 Non-Reinforced Concrete Pipe. ASTM C 14.

#### **706.02 Reinforced Concrete Circular Pipe**. ASTM C 76.

Acceptance. Concrete pipe may also be judged for acceptance on the basis of cores cut from the pipe wall.

Visual Inspection. The core will be examined for reinforcing steel area and spacing, steel position as to cover depth, lack of bond between cement paste and reinforcing steel, and void around the reinforcing steel.

Void Inspection. If voids are found larger than one quarter of the diameter of the reinforcing steel and extending along the steel throughout the core diameter, the pipe will be subject to retest. If the same condition is found in the retest pipe, the pipe will be rejected.

Test Specimens. The pipe to be cored will be the same as tested for three edge bearing test and the retest pipe will be two for one the same as ASTM C 76.

Marking. In addition, after the capital letter "D" designating the D-load, the design wall thickness in inches expressed as a decimal. Pipe with "S" stirrups shall have the symbol S. Pipe requiring axis orientation without lift holes (i.e., stirrup pipe, quadrant reinforced pipe, elliptically reinforced pipe) shall have the center line of the crown of the pipe marked inside and outside with the symbol TB. Pipe with quadrant steel shall be marked with the symbol Q. Pipe with elliptical reinforcement shall be marked with the symbol E. Pipe with deformed wire reinforcement required in the design shall have the symbol DF.

All reinforced concrete pipe shall be manufactured using Type II Cement.

**706.03 Reinforced Concrete Pipe, Epoxy Coated.** ASTM C 76. In the plant, the interior barrel and joint surface areas of the concrete pipe for sanitary or combined sewers shall be prepared as per manufacturer's recommendations so as to remove all forms of oil, laitance and other deleterious materials. Concrete must be etched with a 15 to 20% muriatic acid solution or brush blasted to achieve a medium grade profile. The surface so prepared shall then be lined with a high build, polyamide-cured, 2-component coal tar epoxy coating "Bitumastic No. 300-M" as manufactured by Koppers Company, Inc., Pittsburgh, Pennsylvania 15219, or an approved equal, each meeting Military Specification DOD-P-23236A (SH), Type 1,

Class 2. The lining compound shall be sprayed two or more coats with a maximum of ten to twelve dry mils (twelve to fourteen wet mils) per coat to obtain a continuous and relatively uniform and smooth lining. The total dry film thickness should not be less than 20 mils (0.02 inches). Additional coatings may be necessary for pipes to be laid on steel grades or within industrial areas, as shown on plans. All coated pipe shall be free of surface irregularities such as air bubbles, delaminations, lumping, sagging, blistering, pinholes or porosity in the coating film.

All reinforced concrete pipe shall be manufactured using Type II cement.

**706.04 Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe**. ASTM C 507. All reinforced concrete pipe shall be manufactured using Type II cement.

**706.06 Perforated Concrete Pipe**. ASTM C 444. All reinforced concrete pipe shall be manufactured using Type II cement.

706.07 Concrete Drain Tile. Extra-quality concrete drain tile ASTM C 412.

706.08 Vitrified Clay Pipe. ASTM C 700, extra strength.

706.11 Resilient and Flexible Gasket Joints. For concrete pipe, ASTM C 443.

706.12 Resilient and Flexible Joints. For vitrified clay pipe, ASTM C 425.

**706.13** Precast Reinforced Concrete Manhole Riser Sections and Precast Catch Basin and Inlet Tops. ASTM C 478 with the following additions:

Joints. ASTM C 443.

Compression Tests. Compression tests for satisfying the minimum specified concrete strength requirements shall be made from cores not less than 3-1/2 inches in diameter drilled from the wall of the risers, cones or tops. Cores shall be obtained, prepared for testing, and tested by the appropriate methods of AASHTO T 33.

Precast Reinforced Concrete Manhole, Epoxy Coated. In the plant, the interior barrel, joint and slab top surface areas of the precast manhole for sanitary or combined sewers shall be prepared as per manufacturer's recommendations so as to remove all forms of oil, laitance and other deleterious materials. Concrete must be etched with 15 to 20% muriatic acid solution or sandblasted. The surface so prepared shall then be lined with a high-build, polyamide-cured, 2-component coal tar epoxy coating "Bitumastic No. 300-M" as manufactured by Koppers Company, Inc., Pittsburgh, Pennsylvania 15219, or an approved equal, each meeting Military Specifications DOD-P-23236A (SH), Type I, Class 2. The lining compound shall be sprayed two or more coats with a maximum of ten to twelve dry mils (twelve to fourteen wet mils) per coat to obtain a continuous and relatively uniform and smooth lining. The total dry film thickness should not be less than 20 mils (0.02 inches).

## 706.14

Additional coatings may be necessary within industrial areas, as shown on the plans. All coated surface of manhole shall be free of surface irregularities such as air bubbles, delaminations, lumping, sagging, blistering, pinholes or porosity in the coating film.

**706.14 Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.** ASTM C 923.

**706.15** Flexible Plastic Gasket. For concrete pipe, AASHTO M 198, Type B, with the following exception:

4.3 Flash point and fire point are waived.

# 707 STEEL AND PLASTIC PIPE

**707.01 Galvanized Corrugated**  $(2-2/3 \times \frac{1}{2})$  **Steel Pipe**. This pipe shall conform to AASHTO M 36 with the following additions:

Type I Pipe and Type II Pipe. Helical corrugated pipe, 12 inch diameter and larger, shall have at least two circumferential corrugations at each end of each pipe length.

Dimensions. The minimum wall thickness (before galvanization) of steel pipe and pipe-arches shall be as follows:

	Pipe		Pipe-Arch	
		Wall		Wall
	Diameter	Thickness	Size	thickness
	Inches	Inches	Inches	Inches
	6	0.052		
	8	0.064		
	10	0.064		
Item 554	12	0.064		
Roadway	15	0.064	17 x 13	0.064
Culverts	18	0.064	21 x 15	0.064
	21	0.064	24 x 18	0.064
	24	0.064	28 x 20	0.064
	27	0.064		
	30	0.064	35 x 24	0.064
	33	0.064		
	36	0.064	42 x 29	0.064
	42	0.064	49 x 33	0.079
Item 555	48	0.064	57 x 38	0.109
Drainage	54	0.079	64 x 43	0.109
Culverts	60	0.109	71 x 47	0.138
	66	0.138	77 x 52	0.168
	72	0.138	83 x 57	0.168
	78	0.168		
	84	0.168		

Minus tolerances shall be in accordance with AASHTO M 218

# TABLE 1 - PIPE REQUIREMENTS

Nominal inside	Corrugation Depth	Minimum Width
Diameter (inches)	Nominal (inches)	of Lap (inches)
27	1/2	2
33	1/2	2

Coupling Bands. The bands for pipe diameters 60 inches and greater may be less than 16-1/4 inches, provided they have a circumferential corrugation that indexes into the inboard corrugation of the pipe, have a minimum width of 10-1/2 inches and are equipped with harness fasteners consisting of two bolts through each strap-bar assembly.

Samples. Six inch by six inch manufacturer's coupons which are representative of furnished pipe will be accepted as samples if they are properly identified as to manufacturer, size, type of pipe, thickness and heat number of base material. Samples cut from the pipe will be required if coupons are not available or if there is any question as to the identity of the coupons.

**707.02** Galvanized Corrugated (3 x 1) Steel Pipe. This pipe shall conform to AASHTO M 36 with the following additions:

Type I pipe and type II pipe. Helical corrugated pipe shall have at least two circumferential corrugations at each end of each pipe length.

Dimensions. The minimum wall thickness (before galvanization) of steel pipe and pipe-arches shall be as follows:

Ріре		Pipe-Arch	
	Wall		Wall
Diameter	Thickness	Size	thickness
Inches	Inches	Inches	Inches
36	0.064	40 x 31	0.079
42	0.064	46 x 36	0.079
48	0.064	53 x 41	0.079
54	0.064	60 x 46	0.079
60	0.064	66 x 51	0.079
66	0.064	73 x 55	0.079
72	0.064	81 x 59	0.079
78	0.064	87 x 63	0.079
84	0.064	95 x 67	0.079
90	0.064	103 x 71	0.109
96	0.079	112 x 75	0.109
102	0.079	117 x 79	0.109
108	0.109	128 x 83	0.138
114	0.109	137 x 87	0.138
120	0.109	142 x 91	0.168

Minus tolerances shall be in accordance with AASHTO M 218.

Coupling Bands. The bands for pipe diameters 60 inches and greater may be less than 16-1/4 inches provided they have a circumferential corrugation that indexes into the inboard corrugation of the pipe, have a minimum width of 10-1/2 inches and are equipped with harness fasteners consisting of two bolts through each strap-bar assembly.

**707.03** Structural Plate Corrugated Steel Structures. Structural plate pipe, pipe-arch and arch structures shall conform to AASHTO M 167, with the following exceptions:

Random Sampling. Six inch by six inch coupons which are representative of furnished plates will be accepted as samples if they are properly identified as to manufacturer, thickness, weight of coating and heat number of base metal. Samples cut from the plates will be required if coupons are not available or if there is any question as to the identity of the coupons.

Accessories. Assembly bolts may be galvanized by mechanical or electrolytic processes in lieu of hot-dipping.

**707.04** Bituminous Coated Corrugated  $(2-2/3 \times \frac{1}{2})$  Steel Pipe and Pipe Arches. These pipes and coupling bands shall conform to 707.01 and to AASHTO M 190, Type A, with the following exception:

Methods of Sampling and Testing (Par. 5.3.2). Flow Test. The bituminous cement shall not lose its stability when subjected to the following test:

Parallel lines shall be drawn along the crest of the corrugations of a representative sample of coated pipe and a specimen placed on end in a constant temperature oven, with the parallel lines horizontal. The temperature of the specimen shall be maintained within  $2^{\circ}$ F of  $150^{\circ}$ F ( $65^{\circ}$ C) for a period of four hours. At the end of this time, no part of any line shall have dropped more than 1/4 inch.

**707.05** Paved Bituminous Coated Corrugated  $(2-2/3 \times \frac{1}{2})$  Steel Pipe and Pipe Arches. These pipes and coupling bands shall conform to 707.01 and to AASHTO M 190, Type B half bituminous coated and paved invert or Type C fully bituminous coated and paved invert, except that the flow test shall be as specified in 707.04.

**707.06** Bituminous Coated Corrugated  $(3 \times 1)$  Steel Pipe and Pipe Arches. These pipes and coupling bands shall conform to 707.02 and to AASHTO M 190, Type A, except that the flow test shall be as specified in 707.04.

**707.07** Paved Bituminous Coated Corrugated (3 x 1) Steel Pipe and Pipe Arches. These pipes and coupling bands shall conform to 707.02 and to AASHTO M 190, Type B half bituminous coated and paved invert, or Type C fully bituminous coated and paved invert, except that the flow test shall be as specified in 707.04.

707.08 Welded and Seamless Steel Pipe. ASTM A 53.

707.10 Square and Rectangular Steel Tubing. ASTM A 500 or A 501.

**707.11 Welded and Seamless Alloy Steel Pipe**. Scope 1. These specifications cover welded and seamless alloy steel pipe. The pipe shall comply with the requirements of ASTM A 53 with the following exceptions:

Chemical Requirements 5. The steel shall conform to the following requirements:

	Minimum	Maximum
	Percent	Percent
Carbon		0.20
Manganese		1.00
Phosphorus		0.08
Sulfur		0.05
Copper	0.75	1.25

Nickel 1.60 2.20	
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Tensile Requirements 7. The steel shall conform to the following minimum requirements:

Tensile strength, pounds per square inch, min	50,000
Yield strength, pounds per square inch, min	
Elongation in two inches, min., percent	

Rejection 24. Each length of pipe failing to meet the requirements of these specifications or which develops injurious defects in shop working or application will be rejected.

**707.12 Corrugated Aluminum Alloy Pipe.** This pipe shall conform to AASHTO M 196.

**707.13** Bituminous Lined Corrugated (2-2/3 x  $\frac{1}{2}$ ) Steel Pipe and Pipe Arches. This pipe shall comply with the requirements of 707.04 and AASHTO M 190, Type D, and shall have an essentially concentric, cylindrical, smooth inner surface formed by a bituminous lining. The bituminous lining shall have a minimum thickness of 1/8 inch above the crests of the corrugations.

**707.14** Bituminous Lined Corrugated (3  $\times$  1) Steel Pipe and Pipe Arches. This pipe shall comply with the requirements of 707.06 and AASHTO M 190, Type D, and shall have an essentially concentric, cylindrical, smooth inner surface formed by a bituminous lining. The bituminous lining shall have a minimum thickness of 1/8 inch above the crests of the corrugations.

**707.15 Plastic and Polyethylene Corrugated Drainage Pipe or Tubing**. AASHTO M 252, with the following exceptions:

Nominal Diameter. Tolerances shall be plus or minus 3 percent.

Heavy Duty Tubing shall be marked "heavy duty."

Table I Heavy Duty Tubing Stretch Resistance shall be 7.5 percent maximum.

**707.16 Fiber Bonded Corrugated Steel Pipe**. The pipe shall conform to 707.01 and 707.02 with the following exceptions:

The pipe shall be fabricated from corrugated sheets coated on both sides with a layer of heavy inert fibers which are saturated with bitumen after they have been embedded in the pipe coating.

Prior to furnishing the pipe, the contractor or supplier shall submit for the Engineer's approval a complete set of the manufacturer's detailed specifications for the coating materials and coating process.

**707.17 Fiber Bonded Corrugated Steel Pipe Arches**. The pipe arches shall conform to 707.03 with the following exceptions:

Corrugated steel sections used in the pipe arches shall be coated as specified in 707.16.

**707.18 PVC Composite Sewer Pipe.** Pipe and fittings shall conform to ASTM D 2680, with the following additions and exceptions:

Solid wall PVC pipe for house connection sewers (6" diameter) shall conform to 707.20.

All pipe shall be certified by the manufacturer to meet the applicable ASTM specification requirements. Certification forms, together with a report of the test results, shall be provided to the inspector with pipe deliveries, and copies shall be forwarded to the Engineer and Testing Lab.

The City may choose to make tests for which the manufacturer shall submit samples at no cost to the City. Certification forms shall include project name, location, contractor, and test lot number. Lot sizes shall be acceptable to the Engineer.

Joints shall be gasketed conforming to ASTM D-3212, using elastomeric gaskets conforming to ASTM F477. Use only lubricant supplied or recommended for use by the pipe manufacturer. Verify that the ends of the pipe are marked to indicate insertion stop (home) position, and ensure that pipe is inserted into pipe or fitting bells to this mark. Protect the end of the pipe during homing and do not use excessive force that may result in over-assembled joints or dislodged gaskets. If full insertion is not achieved, disassemble and clean the joint and reassemble. All pipe ends shall be properly sealed prior to joining the pipe using a material recommended by the pipe manufacturer.

Factory made fittings must be used on all house connections or other connections. Bedding material for house connections (sanitary sewer house laterals) shall be equal to that of the main sewer. Risers in deep or unstable trenches should be embedded in Class I materials only. Brackets or anchors shall be used to hold end caps or plugs in place on sanitary sewers for the purpose of withstanding air test pressures. Caps or plugs shall not be chemically welded in place.

All pipe and fittings shall be suitably marked to provide manufacturer's name, lot or production number, ASTM designation, ABS, nominal diameter and SDR number. Fittings, however, need not contain the lot or production number. Pipe shall have a "home" mark. Composite pipe with an absence of filler material at the ends greater than 1/4" deep shall be subject to rejection or must be repaired, if required, to an acceptable condition.

**707.19 P.V.C. Pressure Pipe**. Pipe and fittings shall conform to ASTM D 2241 and ASTM D 2672 with the following additions or exceptions:

All pipe and fittings shall conform to the design stress required by the plans or specifications. Where no design stress is shown all pipe and fittings shall be designed for 100 psi or greater.

All pipe and fittings shall be suitably marked to provide manufacturer's name or trademark, lot or production number, ASTM designation, PVC cell classification, SDR number and nominal diameter. Fittings, however, need not contain a lot number, cell classification or SDR number. Pipe shall have a "Home" mark.

**707.20 PVC Gravity Sewer Pipe**. Pipe and fittings shall conform to ASTM D 3034 for 4"-15" pipe, with the following additions and exceptions:

All pipe and fittings for sanitary, storm and combined sewers shall conform to SDR 26 for mainline and SDR 23.5 for laterals.

All pipe shall be certified by the manufacturer to meet the applicable ASTM Specifications requirements. Certification forms, together with a report of the test results, shall be provided to the inspector with pipe deliveries, and copies shall be forwarded to the Engineer and Testing Lab. The City may choose to make spot tests for which the manufacturer shall submit samples at no cost to the City. Certification forms shall include project name, location, Contractor and test lot number. Lot sizes shall be acceptable to the Engineer.

All joints shall be of the elastomeric gasket type, and shall be assembled per manufacturer's recommendations and ASTM D3212. Care shall be taken to insure all joints are being pushed to the full "Home" position and held tightly in the "Home" position during any grade or line adjustments.

Factory made fittings must be used on all house connections or other connections. Bedding material for house connections (sanitary sewer house laterals) shall be equal to that of the main sewer. Risers in deep or unstable trenches shall be embedded in Class I materials only. Brackets or anchors shall be used to hold end caps or plugs in place on sanitary sewers and house laterals for the purpose of withstanding air testing pressures. Caps or plugs shall not be chemically welded in place.

All pipe and fittings shall be suitably marked to provide manufacturer's name or trademark, lot or production number, ASTM designation, PVC cell classification, SDR number and nominal diameter. Fittings, however, need not contain a lot number, cell classification or SDR number. Pipe shall have a "Home" mark.

**707.21** Polyethylene Corrugated Drainage Pipe and Tubing. Diameters 12" to 24" conforming to AASHTO M 294

707.22 Aluminized Steel. Type II pipe shall conform to AASHTO M 274.

**707.23 Corrugated Polyethylene Watertight Smooth Lined Pipe.** Smooth lined corrugated polyethylene pipe, closed profile polyethylene pipe, couplings and fittings conforming to AASHTO M 294, Type S, SP or D, with the following modifications:

- 1.1.1 Nominal sizes of 4 to 60 inches are included.
- 4.1.2 Annular corrugated pipe (Type S or SP) or closed profile pipe (Type D) shall be provided.
- 6.1 Carbon black may be blended with the virgin resin by means of a carrier resin. The proportioning of the carrier resin to carbon black shall not be greater than 3:1.
- 7.2.1 Nominal diameters shall be 4, 6, 8, 10, 12, 15, 18, 24, 30, 36, 42, 48, 54, and 60 inches.
- 7.2.2 The inner liner of Type S and SP pipe, and both inner and outer walls of Type D pipe shall have the following minimum thicknesses, when measured in accordance to 7.2.2.

Diameter (Inches)	Inner Wall Thickness (Inches)	Diameter (Inches)	Inner Wall Thickness (Inches)
4	0.020	24	0.060
6	0.020	30	0.060
8	0.025	36	0.060
10	0.025	42	0.065
12	0.035	48	0.070
15	0.040	54	0.070
18	0.050	60	0.070

7.4 When tested in accordance with Section 9.1, the pipe shall have a minimum pipe stiffness at 5 percent deflection as follows:

Diameter	Pipe Stiffness	Diameter	Pipe Stiffness
(Inches)	(lbs./in./in.)	(Inches)	(lbs./in./in.)
4	50	24	34
6	50	30	28
8	50	36	22
10	50	42	20

12	50	48	18
15	42	54	16
18	40	60	14

- 7.8.5 For Corrugated Polyethylene Smooth Lined Pipe, joints shall conform to the most current edition of AASHTO M 294. All joints shall be gasketed and watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. If deemed necessary by the Engineer, water-tightness of joints shall be field-tested per ASTM F1417 or C969. Any testing shall be performed by the Contractor, with the cost to be included in the unit price bid for the pipe.
- 9.1 Test specimens shall have a minimum length of 12 inches or one pipe diameter, whichever is greater.
- 11.1.3 In addition, pipe with diameters 4 through 10 inches inclusive may be marked "AASHTO M 252". Pipe with diameters 54 or 60 inches may be marked "AASHTO M P7".
- 12.1 All pipe shall be certified by the manufacturer to meet all applicable ASTM or AASHTO specification requirements, including all amendments herein. Certification forms, along with test results shall be provided to Resident Project Representative with pipe deliveries, and copies shall be forwarded to the Engineer and Testing Lab.

**707.24 PVC Smooth Interior Pipe.** Provide PVC profile wall pipe with a smooth interior that consists of an outer wall fused to a smooth inner wall. Nominal size of 4, 6, 8, 10, 12, 15, 18, 21, 24, 27, 30, and 36 inch diameter pipe are included for pipe, joints, and fittings. Minimum pipe stiffness shall be 46 pounds/inch/inch. Pipe shall be made of PVC compounds having a cell classification of 12454B as defined in ASTM D 1784. Provide storm sewer and drain pipe conforming to ASTM F 949 or AASHTO M 304, with the following modifications:

#### ASTM F 949

- 5.2.4 Perforated pipe may be specified.
  - 10.1 The manufacturer shall furnish test data annually to the City or at any time when the method of manufacture has changed. Provide letter of certification to cover each shipment of material verifying that it meets specification requirements.

## ASTM M 304

10.5 The manufacturer shall furnish test data annually to the City or at any time when the method of manufacture has changed. Provide letter of

certification to cover each shipment of material verifying that it meets specification requirements.

**707.25** Glass Fiber Reinforced Pipe. Provide Glass Fiber Reinforced Thermosetting Resin Pipe (RTRP), or Glass Fiber Reinforced Polymer Mortar Pipe (RPMP), conforming to ASTM D 3262. Minimum pipe stiffness shall be 36 pounds/inch/inch.

All pipe shall be certified by the manufacturer to meet all applicable ASTM or AASHTO specification requirements, including all amendments herein. Certification forms, along with test results shall be provided to Resident Project Representative with pipe deliveries, and copies shall be forwarded to the Engineer and Testing Lab.

**707.26 High Density Polyethylene Pipe (HDPE).** Provide High Density Solid Wall Polyethylene Pipe and fittings conforming to ASTM F 714.

Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 355464C for black or 345464E for color or stripes per ASTM D 3350; and shall be listed in the name of the pipe and fitting manufacturer in the PPI (Plastic Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at  $73^{\circ}$  F.

Joints between plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle branch fusion used shall be procedures that are recommended by the pipe and fitting manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months prior to commencing construction. External and internal beads shall not be removed.

All pipe shall be certified by the manufacturer to meet all applicable ASTM or AASHTO specification requirements, including all amendments herein. Certification forms, along with test results shall be provided to Resident Project Representative with pipe deliveries, and copies shall be forwarded to the Engineer and Testing Lab.

**707.27 PVC Drain waste and Vent Pipe.** Provide PVC drain, waste, and vent pipe and fittings with nominal size of 1 1/4 through 12 inch diameter conforming to ASTM D 2665, with the following modifications:

8.1The retest provisions do not apply.

10 Furnish certified test data as defined in 101.08 to the Engineer. Perform inspection at the project site.

#### 708 PAINT

708.01 Raw Linseed Oil. ASTM D 234.

708.02 Boiled Linseed Oil. ASTM D 260, Type 1.

708.03 Turpentine. Destructively distilled wood turpentine, ASTM D 13.

708.04 Mineral Spirits. ASTM D 235, Type 1.

**708.05 White Structural Paint**. AASHTO M 70, Type I, with the following exception:

Vehicle 5. The vehicle shall contain not less than 85 percent raw or boiled linseed oil 708.01 or 708.02, the balance to be combined drier and thinner. The thinner shall be turpentine 708.03, mineral spirits 708.04, or a mixture thereof.

When this paint is used as a prime coat for wood, linseed oil and thinner shall be added as follows and thoroughly mixed.

	Minimum	Maximum
Paint	1 gal.	1 gal.
Linseed Oil, 708.01 or 708.02	1 qt.	2 qts.
Drier where raw linseed oil is used	_	1/4 pt.
Turpentine, 708.03	1 pt.	1 qt.
	_	_

**708.12** Aluminum Paint. AASHTO M 69 with the following exceptions:

Scope 1. This specification covers two types of aluminum paint for exterior use, both of which are two-component systems. The primer paint containing a non-leafing pigment is suitable for prime coats on wood and intermediate on metal after undercoating with a suitable primer. The finish paint containing a leafing pigment is suitable for finish coat on wood and metal.

Aluminum paste and varnish shall be furnished in separate compartments or containers and in the proportion of two pounds of paste per gallon of varnish. In addition, the packages shall contain the correct amount of paste to combine with the containers of varnish furnished. The aluminum paste and varnish shall be combined immediately prior to the use of the aluminum paint.

Detailed Requirements 3. The pigment shall be aluminum paste meeting the requirements of ASTM D 962. The primer shall meet Type 4, Class B, medium. The finish shall meet Type 2, Class B, medium. The primer pigment shall have no leafing.

General Requirements 4. The varnish used for both primer and finish shall be a high grade long oil, water-resisting type FSS TT-V-81 Type II and shall show the specified leafing when used with finish pigment. It shall be clear and free from suspended matter and shall not thicken in the container. The use of free or limed rosin will not be permitted. The oils, resins, driers and thinners shall be of such type and so proportioned and treated that proper drying and brushing characteristics will be obtained on both cold and hot days. Manufacturers desiring to use solvent naphtha must first have the approval of the Engineer. When flowed on a smooth vertical tin panel the varnish shall dry hard without wrinkling. The varnish shall also meet the following requirements:

	Minimum	Maximum
Non-volatile oils and resins	50%	
Acid number (based on non-volatile)		15
Viscosity, Gardner Holdt	С	E
Set to touch	1/2 hr.	4 hrs.
Dry hard		18 hrs.

Air Dry Bend Test. The varnish shall be flowed on a smooth vertical tin panel (thickness 0.011 inches) and allowed to air dry at room temperature for 72 hours. The panel shall then be bent through 180 degrees over a 1/8 inch rod. No cracking, checking or flaking shall be noticeable.

The same panel shall be cooled at  $0^{\circ}$  C (32° F) for 1 hour and immediately bent through 180 degrees over a 1/8 inch rod. No cracking, checking or flaking shall be noticeable.

The bent portion at either temperature shall show satisfactory adhesion under a knife test.

Cold Bend Test. The varnish shall be flowed on a smooth vertical tin panel (thickness 0.011 inches) and allowed to air dry for one hour at room temperature. The panel shall then be baked for five hours at  $105^{\circ}$  C to  $110^{\circ}$  C ( $221^{\circ}$  F to  $230^{\circ}$  F), cooled at  $0^{\circ}$  C ( $32^{\circ}$  F) for one hour and immediately bent through 180 degrees over a 1/8 inch rod. No cracking, checking, or flaking shall be noticeable.

Water Resistance. The varnish shall be flowed on a smooth vertical tin panel and allowed to air dry for 48 hours at room temperature. The panel shall then be placed for 18 hours in a beaker containing 2-1/2 inches of distilled water at room temperature (immerse the end of the panel which was uppermost during the drying period). Only slight whitening shall occur and shall entirely disappear within one hour after removal from the water.

Color of Varnish. The color shall not be darker than a freshly prepared solution of three grams of potassium dichromate in 100 cubic centimeters of pure sulfuric acid (sp. gr. 1.84).

#### 708.14

Tinting. 6a. Note 2 does not apply.

**708.14 Traffic Zone Paint**. White and yellow ready-mixed traffic paint suitable for centerlining and edgelining the various types of pavement.

Composition. The manufacturer shall formulate the paint in such a manner as to meet the requirements of this specification.

Finished Paint. The paint shall be a suitable binder for glass beads on pavement exposed to traffic. It shall not deteriorate in storage, within one year after date of receipt, to the extent that it cannot be readily broken up with a paddle to a smooth uniform paint capable of easy application by spray. Paint, purchased by Purchase Orders, which deteriorates in storage within one year shall be replaced at no cost to the City.

The paint shall not bleed or discolor when sprayed on bituminous surfaces.

Type 1 paint shall be the fast dry, water-based 100% acrylic type.

Type 2 paint shall be the fast dry, alkyd type.

Type 3 paint shall be the conventional, water-based 100% acrylic type.

Type 4 paint shall be the conventional, alkyd type.

All paint shall comply to the following requirements:

	Minimum	Maximum
Consistency, Krebs Units		
Type 1	75	85
Type 2	90	110
Type 3	65	75
Type 4	65	75
Dry Time (No Track), minutes:		
Type 1		2
Type 2		2
Type 3		30
Type 4		30
Prime Pigment Content.		
percent by weight of paint:		
Type 1 white	11.0	
vellow	10.0	
Type 2 white	17.0	
vellow	17.0	
Type 3 white	80	
vellow	9.0	
Type 4 white	17.0	
vellow	17.0	
Pigment Content, percent by weight of paint:	17.0	
Type 1 white		
vellow		50
Tupe 2 white		50
vellow		50 61
Type 3 white		61
vellow		53
Type 4 white		53
vellow		61
yenow		61
Nonvolatile Vehicle Solids Content, percent by		01
weight of paint:		
Type 1 white		
vellow	24	
Tupe 2 white	24	
vellow	12	
Tupe 3 white	12	
vellow	12	
Type 4 white	17	
vellow	13	
yenow	13	
Finances of Grind micromaters:	15	
All types	50	
All types Pleading Datio D060:	50	
Type 1 white	0.07	
rype i wille	0.97	
Type 2 white	0.97	
rype 2 wille	0.93	
yenow	0.93	

	0.0 <b>-</b>	1
Type 3 white	0.97	
yellow	0.97	
Type 4 white	0.94	
yellow	0.94	
Color		
a. White, Daylight Directional Reflectance,		
ASTM E 1347:		
Type 1		
Type 2	90	
Type 3	91	
Type 4	88	
	90	
h Yellow		
1 Refer to Highway Vellow Color		
Tolerance Chart PR Color No. 1		
June 1065 U.S. Dent Of Transportation		
FHWA: Vallow, Color Difference		
505 22529 ASTM D2244 L Maagura E. L. a		
595-55556, ASTM D2244 I. Measure E, L, a,		
b as Clelab, Source C		
Type 1 and 5		
L		
a		<b>5</b> 0
b	+1.5	+5.0
Type 2 and 4	+1.0	+5.0
L	+3.0	+13.5
a		
b	+1.5	+5.5
	+0.5	+9.0
	+0.5	+15.0
Dry Opacity, D 2805 at 0.005 wet:		
Type 1 and 3	097	
Flexibility, all types and colors:		
a. TT-P-1952 B, Section 4.5.4		
Type 1		Passes
Type 3		Passes
b. TT-P-85E		
Type 2		Passes
Type 4		Passes

Freeze-Thaw Stability, TT-P-1952 B, Section	
4.5.7:	
Type 1 and 3	 5 KU
Change 10% difference in Scrub Resist	

**708.15 Prime Paint**. A semi-quick drying paint suitable for use as a prime coat on clean iron and steel surfaces. This paint shall have a basic lead silicochromate pigment and a linseed oil-alkyd (1 to 1) vehicle. The paint shall comply with FSS TT-P-615, Type II.

# 708.16 White Guardrail Paint. SSPC-PS 1.04:

a.Primer: TT-P-641, Type I.

b. Intermediate Coat: SSPC - Paint 104, Type II, tinted. The color shall closely approach FSS 595A-16492.

c.Finish Coat: SSPC - Paint 104, type I.

**708.17** Inorganic Zinc Silicate Primer Paint. AASHTO M 300, Type I or Type III, with the following additions.

Color. A green colorant approximating No. 34159 of FS 595A.

Prequalification. Prior to use, the Contractor shall submit to the Engineer copies of the manufacturer's certified test data showing that the material complies with the qualitative, quantitative and performance requirements of this specification. The test data shall be developed by an approved testing laboratory, and shall include the brand name of the paint, name of manufacturer, number of the lot tested and date of manufacture. When the paint has been approved by the Engineer, further performance testing by the manufacturer will not be required unless the formulation or manufacturing process has been changed, in which case new certified test results will be required.

**708.18 Blue-Green Vinyl Finish Coat**. This specification covers a vinyl paint suitable for use over cured inorganic zinc silicate prime paint when applied in accordance with the manufacturer's printed instructions.

Pigment. The pigments shall be finely ground and not be livered, skinned or settled to the degree that they cannot easily be redispersed.

Vehicle. The vehicle shall consist essentially of vinyl chloride-vinyl acetate copolymer resins containing sufficient plasticizers to insure an adequate tensile strength for the binder.

Finished Paint. The finished paint shall meet the following requirement and possess a color closely approaching Federal Standard No. 595-34241:

	Minimum	Maximum
Pigment, percent	27.0	
Vehicle solids, percent	21.0	
Total solids, percent	48.0	
Weight per gallon, pounds	9.0	11.0

Material Quality Assurance. The viscosity of the paint shall be within  $\pm$  5.0 Krebs Units of the viscosity of the previously submitted sample. The weight per gallon of the paint shall be within  $\pm$  0.3 pounds of the previously submitted sample.

#### 708.19 Structural Steel Prime Paint. FSS TT-P-615, Type V.

# **709 REINFORCING STEEL**

**709.01** Deformed and Plain Billet Steel Bars for Concrete Reinforcement. ASTM A 615, with the following exceptions and additions:

Test Specimens 12.1. Tension test specimens shall be the full section of the bar as rolled.

Number of Tests 13.1. Where positive identification of a heat can be made, one tension test and one bend test shall be made from each bar designation number of each heat in the lot. Where identification of the heat is not practicable, one tension test and one bend test shall be made for each bar designation number in each lot of 10 tons or fraction thereof.

Inspection 15.1. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Laboratory.

# **709.03** Rail Steel Deformed and Plain Bars for Concrete Reinforcement. ASTM A 616, with the following exceptions and additions:

Note 2. A lot is defined as all of the bars of one bar number and pattern of deformation or bar size for plain bars contained in an individual shipment, or all bars of one bar number and pattern of deformation or bar size for plain bars in a stock identified as rolled from rails varying not more than ten pounds per yard.

Test Specimens 11.1. Tension test specimens shall be the full section of the bar as rolled.

Inspection 14.1. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Laboratory.

**709.05** Axle Steel Deformed and Plain Bars for Concrete Reinforcement. ASTM A 617, with the following exceptions and additions:

Note 2. A lot is defined as all the bars of one bar number and pattern of deformation or bar size for plain bars contained in an individual shipment, or all bars of one bar number and pattern of deformation or bar size for plain bars in a stock identified as rolled from axles with a single carbon range.

Test Specimens 12.1. Tension test specimens shall be the full section of the bar as rolled.

Inspection 15.1. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.08 Cold-Drawn Steel Wire for Concrete Reinforcement**. ASTM A 82, with the following exceptions:

Finish 8.2. Galvanized wire shall be completely covered in a workmanlike manner with a coating of pure zinc of uniform thickness, so applied that it will adhere firmly to the surface of the wire. The minimum weight of zinc coating shall be 0.8 ounces of zinc per square foot of surface as determined by ASTM A 90.

Inspection 11. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.09 Fabricated Steel Bar or Rod Mats for Concrete Reinforcement**. ASTM A 184 with the following exceptions:

4. Materials. Bars shall be deformed.

(a) Welded bar mats. Bar mats shall have a maximum carbon content of 0.35 percent. Longitudinal bars shall conform to 709.01 Grade 60. Transverse bars shall conform to 709.01.

(b) Clipped bar mats. Longitudinal bars shall conform to Grade 60 of 709.01, 709.03 or 709.05.

Inspection 9.1. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.10 Welded Steel Wire Fabric For Concrete Reinforcement**. ASTM A 185 with the following exceptions:

Inspection 13. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.11 Deformed Steel Wire for Concrete Reinforcement**. ASTM A 496, with the following exception:

Inspection 13. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.12** Welded Deformed Steel Wire Fabric for Concrete Reinforcement. ASTM A 497, with the following exception:

Inspection 13. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**709.13 Epoxy Coated Reinforcing Steel**. ASTM A 775, with the following exceptions and additions:

4.1 Steel reinforcing bars to be coated shall meet the requirements of 709.01, 709.03 or 709.05, and shall be free of oil, grease, or paint.

4.2 The coating material shall meet the requirements listed in Annex A7 and shall be a color that facilitates inspection of the installed bar. The color shall be subject to approval of the Engineer.

4.2.1 and 4.3 In addition, written certification and samples mentioned in these sections shall be required.

7.3.1 The adhesion of the coating shall be evaluated by bending production coated bars around a mandrel of specified size as prescribed in bending tables in ASTM A 615, ASTM A 616 or ASTM A 617 as applicable. The bend test for adhesion of the coating shall be made at a uniform rate and shall take up to 90 seconds to complete. The two longitudinal deformations shall be placed in a plane perpendicular to the mandrel radius, and the test specimens shall be at thermal equilibrium between 68°F and 86°F (20°C and 30°C).

11. Delete last sentence. Replace with: Tests, inspection and sampling shall be made at a site as specified by the Engineer. Sampling for testing shall require three 30-inch samples for each bar size, for each coating lot or for each heat of steel reinforcing bars.

12.1 All damaged coating areas greater than 1/4-inch square or 1/4-inch diameter; approximately 1/8-inch square or 1/8-inch diameter if the opening is within 1/4 inch of an equal or larger opening; or, a length of 6 inches regardless of area, shall be repaired with a patching material.

12.2 Coating damage due to fabrication or handling need not be repaired in cases where the damaged area is less than 12.1.

12.4 The patching material shall be of the same composition and quality as the original coating. The surface preparation shall be as per section 5.1

(SSPC-SP10 near white metal blast) or a surface preparation approved by the Engineer.

14. Certification shall be required.

Where reinforcing bar cages for prestressed concrete beams are fabricated by tack welding, the areas damaged by the tack welding shall be patched as outlined above.

# 710 FENCE AND GUARDRAIL

**710.01 Barbed Wire**. ASTM A 121, Class 3 Galvanizing, or ASTM A 585, Type 1, Class 2 coating, with the following exceptions:

(a) Exceptions to ASTM A 121, Class 3:

Ordering Information 3.2. Sentence one relative to billing shall not apply.

Size and Construction 5. Barbed wire strand wires shall be No.  $12^{1}/2$ ,  $13^{1}/2$  or  $15^{1}/2$  steel wire gage. Barbs shall be 4 point round steel wire spaced 5 inches center to center.

Weight of Coating 8. The weight of coating for various gages of wire composing the strands and barbs shall be not less than 0.80 ounces per square foot of surface.

Sampling 10.2. Test Specimens. Sufficient completed barbed wire shall be cut from the end of a spool to provide a sample length of 5 feet.

10.3. Does not apply.

Inspection 12. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

(b) Exceptions to ASTM A 585, Type I, Class 2:

Size and Construction 6. Barbed wire strand wires shall be No.  $12^{1}/2$  steel wire gage. Barbs shall be 4 point round steel wire spaced 5 inches center to center.

Weight of Coating 9. The weight of coating of various gages of wire composing the strands and barbs shall be not less than 0.30 ounces per square foot of surface.

Sampling 11. Test specimens. Sufficient completed barbed wire shall be cut from the end of a spool to provide length of 5 feet.

11.3. Does not apply.

In addition the minimum breaking strength shall be in accordance with ASTM A 121.

Inspection 13. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

**710.02** Woven Steel Wire Fence Type **47** ASTM A 116 Class 3 galvanizing, with the following exceptions:

Basis of Purchase 3.2. Sentence one relative to billing does not apply.

Size and Style 7. The fence fabric shall be Simplified Practice Recommendations R 9-47 design number 1047-6.9.

Inspection 11. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

Galvanizing. In addition, all hardware and attachments shall be galvanized in accordance with 711.02.

**710.03 Chain-Link Fence**. AASHTO M 181 with the following exceptions and additions:

(1) General. Gate frames shall be constructed of tubular members and, for gate leaves more than 8 feet wide, shall have intermediate members and/or diagonal truss rods to provide gates of ample strength free from sag or twist.

Gates shall be swing type, complete with latches, stops, keepers, hinges, locks and fabric. Hinges shall be of adequate strength to support the gate and shall not twist or turn under action of the gate. Latches shall be of the plunger bar type and shall be full gate height located in a manner that will engage the gate stop. Forked latches may be used for single gates less than 10 feet wide. Latches shall provide for locking. Stops shall consist of a flush plate with anchor to be placed in concrete to engage the plunger bar of the latch. Other approved types of stops may be used for single gates less than 10 feet wide. Keepers shall be substantial devices for securing and supporting the free end of the gate in open position.

Gates shall be covered with fabric matching the fence.

Top rails shall be furnished in lengths not less than 18 feet. Top rail couplings shall be self-centering, outside sleeve type at least 6 inches long. A minimum of 20

percent of the couplings shall have an internal heavy spring to take up expansion and contraction.

Post tops shall be provided with a hole suitable for through passage of the top rail. They shall fit snugly to the post, have a means of attaching securely to the post and exclude moisture from tubular posts.

Truss and brace rods shall be steel 3/8 inch outside diameter or equivalent cross section and shall have suitable adjustment.

Brace bands shall be beveled edge bars  $1 \ge 1/8$  inch section.

Chain-link fence fabric 60 inches high and under shall be furnished knuckled on both selvages.

Chain-link fence fabric over 60 inches high shall be furnished with knuckling at one selvage and barbing at the other.

Sampling. Certified copies of the chemical and physical properties of each of the aluminum components shall be furnished the Engineer.

Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Engineer.

(2) Steel posts, gate frames, post braces, brace rails and top rails shall conform to the requirements of Table 710.03-1.

Stretcher bars shall have a  $3/16 \times 3/4$  inch cross section or equivalent cross section with length equal to full height of fabric.

Gate frames shall be assembled by welding or by means of heavy fittings making rigid and watertight connections.

Post tops shall be ornamental caps of steel, malleable iron or cast iron.

Fabric ties shall be not less than 0.148 inch diameter aluminum alloy or galvanized steel wire or bands having not less than 0.8 ounces of zinc per square foot.

Type I zinc-coated steel chain link fabric shall be (9 gage) 0.148 inch diameter wire, Class B weight coating, 2 inch mesh. Vinyl coated fabric shall be 0.148 inch wire before coating.

The vinyl covering shall be uniformly colored as specified.

(3) Aluminum posts, gate frames, post braces, brace rails and top rails shall conform to the requirements of Table 710.03-2.

# 710.03

Stretcher bars shall be flat bars 3/4 to 1/4 inch section.

Gate frames shall be assembled by welding using properly designed, formed sheet or sandcast fittings.

Hinges shall be the offset type. Latches, stops and keepers shall be galvanized malleable iron except plunger bars which may be galvanized tubular or bar steel conforming to 6.2.

Turnbuckles shall be wrought or cast.

Bolts shall have anodic coating at least 0.0002-inch in thickness, chromate sealed.

Tie wire shall be 0.148-inch diameter wire ASTM B 211 Alloy 100 H 18 temper.

Usagenominal fence height	Gention	Outside Diameter or	Weight		Min. Yield
6 feet of less	Section	Dimension incres	Nominal lb./ft.	Tolerance %	Psi
Line Posts	Grade 1 Pipe	2.375	3.65	-5	25,800
	Grade 2 Pipe	2.375	3.12	-5	50,000
	C-Section	2.25 x 1.70	2.73	-6	45,000
	H-Section	2.25 x 1.70	3.26	-5	45,000
End, corner	Grade 1 Pipe	2.875	5.79	-5	25,800
pull posts	Grade 2 Pipe	2.875	4.64	-5	50,000
	Square	2.5	5.70	-3	40,000
	Roll-form	3.5 x 3.5	5.14	-6	35,000
Gate posts, for nominal width of gate (Single or one leaf of Double):					
Up to 6					
feet incl.	Grade 1 Pipe	2.875	5.79	-5	25.800
	Grade 2 Pipe	2.875	4.64	-5	50,000
	Square	2.5	5.70	-3	40,000
	Roll-form	3.5 x 3.5	5.14	-6	35,000
Over 6 to 13	Grade 1 Pine	4.0	9.11	-5	25 800
feet incl.	Grade 2 Pipe	3.5	5.21	-5	48.000
	Square	3.0	9.35	-3	40,000
Over 13 to 18 feet incl.	Grade 1 Pipe	6.625	18.97	-5	25,800
Over 18 feet	Round	8 625	24 70	-5	25 800
Gate Frames	Grade 1 Pine	1 900	2.72	-5	25,800
	Grade 2 Pipe	1.900	2.28	-5	50,000
	Square	2.00	2.66	-3	40,000
Top Rails,	Grade 1 Pipe	1.660	2.27	-5	25,800
*post braces	Grade 2 Pipe	1.660	1.84	-5	50,000
-	H-Section	1.50 x 1.31	2.25	-5	45,000
	Roll-form	1.625 x 1.25	1.35	-6	35,000
	Round tubing	1.660	1.38	-5	50,000

# TABLE 710.03-1 STEEL POSTS, GATE FRAMES, POST BRACES, AND TOP RAILS

\*When tension wire is specified, it shall be of 0.177 inch diameter.

# TABLE 710.03-2DIAMETERS OF PLAIN END, SCHEDULE 40 ALUMINUM ALLOY PIPE

The weights and dimensions shall be as specified in ANSI H 35.2.

Material	Nominal Pipe Size in.
Brace rails and top rails	
Gate frames and rail couplings	

#### 710.06

Line posts	2
End and corner posts	2-1/2

Gate posts--single or one leaf of double:

Gate openingfeet	
to 6, inclusive	
over 6 to 12, inclusive	
over 12 to 18, inclusive	6
over 18 to 32, inclusive	8

**710.06 Deep Beam Rail**. AASHTO M 180, Type II Class A, with the following exceptions:

The minimum check limits for both triple and single-spot tests apply.

Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the laboratory.

Acceptance by sampling shall apply.

In addition: (a) in lieu of samples, Certified Test Data covering the mechanical properties may be furnished with each identified heat of guardrail in conjunction with a field check of coating thickness indicating satisfactory coating weights. However, when a field check of coating thickness shows insufficient coating weight the guardrail shall be sampled and tested.

(b) One piece of rail element, back up plate and end or buffer section may represent the entire lot.

710.09 Wire Rope Rail. AASHTO M 30 Class A, Type I Rope.

Inspection. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Laboratory.

**710.10** Guardrail Hardware. Unless otherwise specified, all fittings, bolts, washers and other accessories shall be galvanized in accordance with 711.12.

**710.11** Fence Posts and Braces. Wood posts shall be round and conform to the requirements of 710.12 and 710.14. Dimension timber, posts and lumber for braces and stream crossings shall be sound, straight, free from knots, splits and shakes, and shall be treated in accordance with 712.06.

Steel line posts shall be either U, Y, T or channel sections. They shall have corrugations, knobs, notches or studs so placed and constructed as to engage a

substantial number of fence line wires in the proper position. Punched tabs for fastening wires are not permitted. Posts shall have tapered anchors weighing 0.67 pounds or more, each firmly attached by means of welding, riveting or clamping. Posts shall have a nominal weight of 1.33 pounds per linear foot exclusive of the anchor plus or minus 3-1/2 percent for any lot of posts. Permissible variation in length shall be a maximum of one inch under and two inches over the designated length. Excessive bow, camber, twist or other injurious defects in posts shall be cause for rejection. Each post and anchor shall be hot dip galvanized in accordance with 711.02. Each line post shall be furnished with a sufficient number of galvanized wire fasteners or clamps, of not less than 0.120 inch in diameter, for attaching fence wire to the post. Fasteners or clamps shall be galvanized in accordance with ASTM A 116 Class 3.

**710.12 Square Sawed, and Round Guardrail Posts**. Butt treated posts shall be made of seasoned white oak, pine or fir. Pressure treated posts shall comply with 710.14 and 712.06. Posts shall be cut from growing timbers and shall be free from unsound or loose knots and rot and from injurious or excessive shake, and season checks that exceed 1/4 inch in width.

Round posts shall have a uniform taper and sweep shall not exceed three inches. Round posts shall be peeled their entire length, removing all outer and inner bark and leather fiber by shaving the surface. Knots shall be trimmed even with the post, and both ends of the post shall be sawed square.

Square sawed posts shall be free from injurious cross grain and sapwood. They may contain a limited number of sound knots that do not exceed two inches in diameter. They shall be free from wane above the ground line. Wane below the ground line shall be limited to two adjacent corners and shall not exceed 1-1/2 inches measured along the wane.

**710.13** Butt Treated Guardrail Posts. Posts shall conform to the requirements of 710.12. The lower four feet of all posts to be butt treated shall be continuously immersed or soaked in a bath of hot creosote oil, 712.06, for a period of at least two hours. The oil shall be maintained at a temperature of 175°F to 225°F and for at least three-fourths of that time the temperature shall be 210°F or higher. The time of immersion shall be increased, if necessary, to obtain a minimum penetration of 1/8 inch.

**710.14 Pressure Treated Guardrail and Fence Posts, Braces and Blocks**. Posts, braces and blocks shall conform to the requirements of AASHTO M 168 and 710.11, 710.12 and 712.06.

All posts, braces and blocks originating within the State of Ohio shall be subject to inspection by an authorized Agent of the City. Material originating outside the State of Ohio shall be inspected before treatment for conformance to the requirements of this specification, other than treatment, by an agency qualified and approved by the Engineer for such inspection. The material shall bear the identification mark of the

#### 710.15

inspection agency and a certificate of inspection shall be forwarded to the Engineer. The cost of this inspection and furnishing reports shall be included in the price bid for material.

**710.15** Steel Guardrail Posts. These posts shall be of the section and length as specified. They shall be of copper bearing steel when so specified. Steel shall conform to ASTM A 36. Posts shall be galvanized in accordance with 711.02.

# 711 STRUCTURAL STEEL AND STRUCTURE INCIDENTALS

**711.01 Structural Steel**. Steel shall be structural steel ASTM A 36 or, when specifically called for, high-strength low alloy steel ASTM A 572 Grades 42 through 50, or A 588.

Material designated to meet notch toughness requirements shall have a minimum longitudinal Charpy V-notch (CVN) energy absorption value as listed below. Sampling and testing procedures shall be in accordance with ASTM A 673. The (H) frequency of heat testing shall be used, and the test data shall be provided as required by 501.07.

ASTM	Thickness and	Min CVN
Designation	<b>Connection Method</b>	Value
A 36	Up to 4" mechanically fastened or welded	15 ft lb @ 40° F
A 572, A 588	Up to 4" mechanically fastened	15 ft lb @ 40° F*
A 572, A 588	Over 2" to 4" welded	20 ft lb @ 40° F*
A 572, A 588	Up to 2" welded	15 ft lb @ 40° F*

\*If the yield point of the material exceeds 65 ksi, the temperature of the CVN value for acceptability should be reduced by 15°F for each increment, or part of increment, of 10 ksi above 65 ksi.

**711.02** Galvanized Steel. Steel shall be galvanized to conform to ASTM A 123 after cutting, bending and welding. At the discretion of the Engineer, damaged galvanized material shall be replaced, regalvanized or repaired. If a repair is authorized, the method shall be acceptable to the Engineer.

Weight of coating. Bolts and similar threaded fasteners may be mechanically zinc coated in accordance with ASTM B 454, Class 50. Except for ASTM A 325, electrogalvanized items meeting the above coating requirements may also be used.

All galvanized parts that are to be embedded in fresh concrete, except chairs for reinforcing bar support, shall be given a chromate treatment in accordance with the American Hot Dip Galvanizers Association, Inc. recommendations. The galvanizer shall furnish a certification for each lot of chromate treated steel.

711.03 Steel for Sheet Piling. ASTM A 328.

**711.04 Cold Rolled Steel**. ASTM A 108, Grade 1016 through 1030 for pins, rollers, trunnions and other similar parts.

**711.07** Steel Castings. ASTM A 486, Class 70 or ASTM A 27, Grade 70-36 with the following additions.

Steel castings shall be free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. No sharp, unfilleted angles or corners will be allowed.

**711.08** Arc-Welding Electrodes and Fluxes. The following applies except for exposed bare ASTM A 242 and A 588 steels. See Table 711.08-1 for exposed bare ASTM A 242 and A 588 applications.

- (A) Manual shielded metal-arc welding.
- (1) AWS A 5.1
- (2) AWS A 5.5
- (B) Submerged arc welding.
- (1) AWS A 5.17
- (2) AWS A 5.23
- (C) Gas metal-arc welding, AWS A 5.18
- (D) Flux cored arc welding, AWS A 5.20

#### Table 711.08-1

Filler Metal requirements for exposed bare applications of ASTM A 242 and A 588 steel

Welding Process			
		Gas metal arc	
Shielded	Submerged	or	
metal arc	arc	Flux cored arc <sup>2</sup> , <sup>4</sup>	
AWS A5.5	AWS A5.23	AWS A5.18	
E8016 or 18-G <sup>1</sup> , <sup>2</sup>	F7X-EXXX-W <sup>2</sup> , <sup>3</sup>	AWS A5.20	
E8016 or 18-B1 <sup>2</sup>	F7X-EXXX-B1 <sup>2</sup> , <sup>3</sup>	AWS A5.28	
E8016 or 18-B2 <sup>2</sup>	F7X-EXXX-B2 <sup>2</sup> , <sup>3</sup>	AWS A5.29	
$E8015 \text{ or } 18\text{-}B2L^2$		62 ksi min YP	
E8016 or 18-Cg	F7X-EXXX-Nil <sup>3</sup>	(403 M Pa)	
E8016 or 18-C2	F7X-EXXX-Ni2 <sup>3</sup>	72 ksi min TS	
E8016 or 18-C3	F7X-EXXX-Ni3 <sup>3</sup>	(495 M Pa)	
		Elon. 18% min.	

1.Deposited weld metal shall have the following chemical composition: C, max %, 0.12; Mn, %, 0.50/1.30; P, max %, 0.03; S, max %, 0.04; Si, %, 0.35/0.80; Cu, %, 0.30/0.75; Ni, %, 0.40/0.80; Cr, %, 0.45/0.70.

2.Deposited weld metal shall have a minimum impact strength of Charpy V-notch 20 ft/lb (27.1 J) at  $0^{\circ}$ F (-18°C) (only applied to bridges).

3. The use of the same type of filler metal having next higher mechanical properties as listed in AWS specification is permitted.

4.Deposited weld metal shall have a chemical composition the same as that for any one of the weld metals in this table for the shielded metal arc welding process.

Certified test data showing compliance with the specified requirements shall be submitted for each lot of electrodes proposed for use.

**711.09 High-Strength Steel Bolts, Nuts and Washers**. ASTM A 325, with the following exception:

Inspection 11. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Laboratory.

Bolts for steel used in bare unpainted applications shall be ASTM A 325 Type 3.

When galvanized bolts, nuts and washers are specified, they may be mechanically galvanized.

Bolts used to fasten steel painted according to 514 System A shall be galvanized and need not be painted

**711.10 Machine Bolts**. ASTM A 307 with the following exception:

Inspection 11. Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site or at other locations designated by the Laboratory.

Mechanical galvanizing is permitted.

**711.12 Gray Iron Castings**. ASTM A 48, minimum Class 30, and AASHTO M 306-05 with the following exceptions:

Number of tests and retests. (a) Two or more test bars shall accompany each lot of castings, or one pair of test bars may represent castings shipped to two or more projects provided the lot number or date cast are cast in both the bars and castings, or such identification shall be anchored in the castings and test bars. The identifying data on castings shall not interfere with the use of the casting.

Workmanship and Finish. In addition, the castings shall be free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. They shall be generously filleted at angles and the arrises shall be sharp and perfect.

Inspection. Inspection shall be made at the project site. Test bars representing the lot shall be made available to the Laboratory at the place of manufacture or warehouse from the lot to be shipped, or shall accompany the lot shipped.

**711.13 Ductile Iron Castings**. ASTM A 536 and AASHTO M 306-05 with the following additions and exceptions:

Workmanship and Finish. In addition, the castings shall be free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength. They shall be generously filleted at angles and arrises shall be sharp and perfect. All castings shall be cleaned of all rust, scale, grease and foreign matter and shall receive two coats of an approved bituminous paint, if required by plans or standard drawings.

Number of tests. A keel block or Y-block specimen made in accordance with A 536 shall accompany the shipment for each heat number, ladle number and date of casting.

Inspection. Inspection shall be made at the project site.

Certification. Test bars shipped with castings shall be accompanied by a certification stating the bars were prepared in accordance with specified requirements.

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**711.14 Stainless Steel Fasteners**. Stainless steel fasteners shall be passivated and have a smooth lustrous finish. The manufacturer shall certify that the material furnished was passivated.

711.15 Sheet Copper. ASTM B 370.

711.16 Phosphor Bronze Plate. ASTM B 100.

**711.17 Cast Bronze**. ASTM B 22, Copper Alloy No. 91100 with the following addition:

The cast plate shall be finished to plane surfaces and one plate of a pair shall be finished at right angles to the other plate of the pair.

**711.18 Leaded Bronze**. ASTM B 584, Copper Alloy No. 93700 with the following addition:

The cast plate shall be finished to plane surfaces and one plate of a pair shall be finished at right angles to the other plate of the pair.

711.19 Sheet Lead. ASTM B 29.

**711.20** Aluminum for Railings. Aluminum other than permanent mold castings shall conform to the following requirements:

	American Society		
	for Testing Materials		
			Condition or
	Designation	Alloy	Temper
			(B 296)
Sand castings	B 26	356.0	T6
Shims	B 209	1100	0
Washers	B 209	Clad 2024	T4
		6061	T6
Sheet and plate	B 209	6061	T6
Drawn seamless tubes			
Bars, rods, wire	B 210	6061 or 6063	T6
Bolts, set screws	B 211	6061	T6
	B 211	2024*	T4
Nuts		6061	T6
	B 211	6061	T6
Extruded bars, rods,		6262	T9
shapes	B221	6061 or 6063	T6
		6351	T5
Extruded tubes			
	B 221	6061 or 6063	T6
Pipe		6351	T5
Rivets	B241	6061 or 6063	T6
	B316	6061	T6

\* Shall have an anodic coating.

Permanent mold cast aluminum for bridge railing posts shall comply with the requirements of AASHTO M 193.

**711.21 Preformed Bearing Pads**. Composition. Preformed bearing pads shall consist of a fabric and rubber body. The pad shall be made with new, unvulcanized, natural and/or synthetic rubber and unused cotton and/or synthetic fabric fibers in proper proportion to maintain strength and stability.

Physical Properties. The surface hardness expressed in standard rubber hardness figures shall be  $80 \pm 10$  Shore Durometer. The ultimate breakdown limit of pads under compressive loading shall not be less than 10,000 pounds per square inch. The pads shall be furnished to specified dimensions with all bolt holes accurately located and cleanly cut.

**711.23 Elastomeric Bearings**. Bearing pads and laminated bearings shall be of the compound known as neoprene and shall be cast in molds under pressure and heat. A plain elastomeric bearing pad and steel load distribution plate combination shall be classified as a laminated elastomeric bearing. Test specimens shall be in accordance with ASTM D 3182 or D 3183. Where test specimens are cut from the finished product, a 20 percent variation from the original physical properties is allowed. Compound of nominal hardness between the values shown in the following table may be used and the test requirements interpolated.
PHYSICAL		GRADE	
PROPERTIES			
	50	60	70
Original Physical Properties:			
Hardness, Durometer A, ASTM D 2240	50 <u>+</u> 5	60 <u>+</u> 5	70 <u>+</u> 5
Tensile Strength, min psi, ASTM D 412	2,500	2,500	2,500
Elongation at break, min %	400	350	300
Accelerated Tests to Determine Long-Term Aging			
Characteristics,			
Oven-Aged 70 hrs/212° F, ASTM D 573:			
Hardness, points change, max	+15	+15	+15
Tensile strength, % change, max	-15	-15	-15
Elongation at break, % change, max	-40	-40	-40
Ozone-1 ppm in air by volume - 20% strain - 104° F -			
ASTM D 1149, 100 hrs	No	No	No
	Cracks	Cracks	Cracks
Samples to be solvent wiped before test to remove any traces of surface impurities)			
Compression set 22 hrs/212 °E ASTM D 205			
Method B % max	35	35	35
Adhesion bond made during vulcanization	55	55	55
ASTM D 428 Method B lbs/in	40	40	40
A5 I W D +20, Wellou D, 105/III	.0	.0	10

Bearing pads may be molded individually, cut from previously molded strips or slabs, or extruded and cut to length. Laminated bearings shall be molded together into an integral unit with all edges of internal steel laminates covered by a 1/8 inch minimum thickness of elastomer. Indentations or groves on the exterior surface of the bearings caused by external laminate restraining devices shall be filled to a 1/8 inch minimum cover by a re-vulcanized patch; or by a silicone caulk conforming to Federal Specification TTS - 001543A; or by an approved equal. The patching shall be done by the bearing manufacturer.

The external connection or distribution plates of laminated bearings shall be the same material as the attached structural steel and be similarly cleaned and coated; internal plates shall be ASTM A 36 or A 570, Grade 36 or Grade 40. All plates shall be deburred. The internal plates shall not be less than 0.074 inch thick.

The manufacturer shall proof load each laminated elastomeric bearing with a compressive load equal to 1.5 times the maximum design load as per Article 25.7, Bearing Tests and Acceptance Criteria, Division II, Construction, of the AASHTO Standard Specifications for Highway Bridges. The testing shall be included in the price bid for the bearings. Acceptance of the bearing shall be according to Level I acceptance criteria of Article 25.7.

The manufacturer shall furnish certified test data for the elastomer, base plate, steel laminates and proof load.

**711.24 Waterproofing Fabric**. Furnish waterproofing fabric according to ASTM D 173.

Physical Properties	
Thickness ASTM D 1777	60 mils (1500 m) min.
Width	36 inches (914 mm) min.
Pliability [180 bend over 1/4 inch (6 mm) mandrel @ -25 F (-32 C)] ASTM D 146	No Effect
Elongation ASTM D 412 (Die C)	300% min
Puncture Resistance-Membrane	
ASTM E 154	40 lb (18 kg) min.
Permeance (Grains/ft <sup>2</sup> /hr/in Hg)	
ASTM E 96, Method B	0.1 max.
Water Absorption (% by Weight) ASTM D 570	0.2 max.
Adhesion to concrete ASTM D 903	5.0 min.
Submit certified test data and letter of certification to the Engineer.	

# 711.25 Type 2 Membrane Waterproofing.

**711.26 Structural Timber, Lumber and Piling**. AASHTO M 168 with the following additions:

Timber and lumber shall be air dried or kiln dried to a moisture content not to exceed 19 percent by weight. Size and grade shall conform to American Lumber Standards.

All untreated lumber shall bear the Association Grade Mark of a Regional Association of Lumber Manufacturers and shall be graded under the rules of one of the following associations:

- (1) West Coast Lumber Inspection Bureau
- (2) Western Wood Products Association
- (3) Southern Pine Inspection Bureau
- (4) Northern Hardwood and Pine Manufacturers Association

The untreated lumber shall be graded by, and bear the mark of an agency certified for grading under the rules of one of the above associations.

All treated timber and lumber except piling, guardrail posts, fence posts, braces, and spacer blocks originating outside the State of Ohio shall be certified before treatment as to grade, specie, and grading agency by the following means:

(a) A certificate of inspection from an approved grading agency.

(b) A mark of identification on one end of each piece indicating grading agency, grade and producer. Such identification is to be applied by the manufacturer producing the material.

711.27 Prestressing Steel. ASTM A 416 with the following exception:

Inspection. Sampling and inspection as directed by the Laboratory.

**711.28 Cellular Polyvinyl Chloride Sponge**. Cellular polyvinyl chloride sponge shall meet the requirements of AASHTO M 153, Type I, except the density of the PVC sponge shall be not less than 20 pounds per cubic foot.

**711.29 Plastic Pipe and Fittings**. ASTM D 2661, D 2665, D 2680, D 2751, D 3033, D 3034 or F679 with the following additions:

Certification and Inspection. Certified test data as defined in Section 101.08 shall be furnished the Engineer. Inspection shall be done at the project site. Random samples shall be obtained at the project site or at other locations designated by the Laboratory.

The retest provisions of the above ASTM specifications do not apply.

**711.30 Type 3 Membrane Waterproofing.** Furnish Type 3 membrane waterproofing conforming to the following requirements.

Physical Properties	
Thickness	0.135 inches (3.43 mm) min.
Width	36 inches (914 mm) min.
Weight	0.8 lb/ft2 (3.875 kg/mm <sup>2</sup> ) min.
Tensile strength (machine direction)	-
ASTM D 882	275 lb/in (48.1 N/mm)
Modified <sup>[1]</sup>	200 psi (13.8 MPa)
Tensile strength ASTM D 882 (90 machine direction)	
	150 lb/in (26.2 N/mm)
Modified <sup>[1]</sup>	1000 psi (6.9 MPa)
Elongation at break ASTM D 882	
Modified <sup>[1]</sup>	100%
Brittleness ASTM D 517	Pass
Softening point (mastic) ASTM D 36	200° F (93° C) min.
Peel adhesion ASTM D 413 <sup>[1]</sup>	2.0 lb/in (0.35 N/mm)
Cold flex ASTM D 146	No cracking
2 5 inch (50 125 mm) Specimen-180 bend over 2 inch	
(50 mm) mandrel	
Heat stability	No dripping or delamination
2 5 inch (50 125 mm) specimen vertically suspended in	
a mechanical convection oven 2 hr @ 190° F (88° C)	
[1]12 inches (300 mm)/minute test speed and	1 inch (25 mm) initial distance
between the grips	

Submit certified test data and letter of certification to the Engineer.

**711.31 Reinforced Propylene Plastic Manhole Steps**. Steps shall conform substantially with details shown on the plans. Steel rods shall be continuous through the entire length of legs and tread.

Steel shall conform to the requirements of 709.01, Grade 60.

Propylene plastic shall conform to ASTM D 2146, Type II, Class 16906 or Class 43758. The manufacturer shall furnish certified test data for the propylene plastic used in each lot of steps.

# 712 MISCELLANEOUS

**712.01 Expansion Shield Anchors, Self Drilling**. Federal Specification FF-S-325, Group III, Type I (a) or (c).

The supplier and/or producer of the anchors shall provide a certification showing test results of the proof load required in Federal Specification FF-S-325.

# 712.02 Calcium Chloride. ASTM D 98.

**712.03 Sodium Chloride**. ASTM D 632 Type I, Grade 1, with the following exception:

Chemical Composition 4. Total Chlorides (NaCl, CaCl<sub>2</sub>, and MgCl<sub>2</sub> as NaCl based on dry weight) not less than 97 percent.

### 712.04 Lime.

(a) Lime for masonry purposes shall conform to ASTM C 207 Type S. Soundness Section 5 of ASTM C 110 shall replace Section 3. Section 6 shall not apply.

(b) Lime for soil and soil aggregate stabilization shall conform to ASTM C 207, except that the requirements of Sections 7, 8, 9 and 10 shall not apply. A minimum of 85 percent shall pass a No. 200 sieve when tested by wet sieving as per ASTM C 110.

**712.05** Glass Beads Used in Traffic Paint. AASHTO M 247, Type 1 without flotation properties but coated for moisture resistance, with the following exceptions:

Inspection shall be done at the project site. Random samples shall be obtained from material delivered to the project site, or at other locations designated by the Laboratory.

Flotation Test. Not applicable.

**712.06 Preservative Treatment for Structural Timber, Lumber, Piling, Posts, Braces and Blocks**. All structural timber, lumber and piling shall conform to 711.26, and all posts, braces and blocks shall conform to 710.14, except that moisture may be removed from the untreated lumber at the time of preservative treatment. Material treated within the State of Ohio shall either be inspected by the Engineer, or where such inspection is waived, the company treating the material shall submit for each charge: (1) charts from automatic recording instruments showing conditions within the treating cylinder at all times during treatment; (2) computations showing the volume of wood in the charge, the volume of preservative materials used and the final net retention of each charge; and (3) approximately one dozen representative cores taken from the material with an increment borer. The City shall be notified at least 72 hours (exclusive of Saturdays, Sunday and holidays) in advance of the treating of the material.

Material treated outside the State of Ohio shall be inspected for conformance to the current AWPA standards and the requirements of this section of the specifications. The material shall bear the identification mark of the inspection agency and a certificate of inspection for treatment shall be forwarded to the Engineer. An agency qualified and approved by the Engineer for such inspection shall make the required inspection, and the cost of this inspection and furnishing the reports shall be included in the price bid for the respective item for which the material is required.

When guardrail offset blocks are furnished by an Ohio supplier, a Notarized Certificate of Conformance shall be furnished by the supplier with each shipment of material stating the size, specie, quantity shipped, project number, vendor's order number, type of treatment and retention in pounds per cubic foot.

Materials. The timbers shall be pressure treated using Ammoniacal Copper Quaternary (ACQ), per ASTM D 5654. No CCA (Chromated Copper Arsenate) treated material shall be permitted.

Preparation for Treatment. Sorting. Whenever it is practicable, the material shall be sorted into one kind or designated group of kinds of wood and into pieces of approximately equal size and moisture and sapwood content, and separated so as to insure contact of the treating medium with all surfaces.

Framing. So far as practicable, all adzing, boring, chamfering, framing, graining, mortising, surfacing, etc., shall be done prior to treatment.

Incising. All Douglas fir, except rails and rail posts, the least dimension of which is two inches or over shall be incised by a suitable power-driven machine before treatment. Lumber having a thickness of three inches and over shall be incised on all four sides. Lumber less than three inches thick shall be incised on the wide faces only, except where indicated on the plans. The spacing and shape of the cutting teeth and the method of incising shall be such as to produce a uniform penetration. The depth of the incisions shall be not less than the following:

Size	Minimum depth of	
	incision, in.	
2 x 12	3/8	
3 x 12	7/16	
4 x 12	1/2	
8 x 10	9/16	
10 x 12	5/8	
12 x 12	3/4	

Intermediate sizes in proportions.

Amount of Preservative. The net retention in any charge shall be not less than 90 percent of the quantity of preservative specified; but the average retention by the material treated under any contract or order and the average retention of any five consecutive charges shall be at least 100 percent of the quantity specified. The minimum amounts of preservative retained shall be as specified by the American Wood-Preservers' Association Standard. All species of structure timber, lumber, piling, posts and blocks shall be treated according to the current AWPA standard specifications.

**712.08** Coating and Antistripping Agents. Coating and antistripping agents shall conform to the following requirements:

General. Coating and antistripping agents shall provide suitable coating of bituminous materials mixed with wet aggregates, and they shall prevent the bituminous coating from stripping in the presence of water. The agents shall not be deleterious to the mixture in any manner.

Materials. The aggregates and bituminous material used to test the agent shall be from sources approved by the Laboratory.

Aggregate. The standard reference aggregate shall be composed of 50 percent silica gravel and 50 percent crushed limestone, and it shall meet the following grading requirements:

Passing a 3/8 inch sieve	
Passing a 1/4 inch sieve	0%

Bituminous Material. The standard bituminous material shall meet the requirements of 702.02, MC 800.

Agent. The antistripping agent shall have the following properties:

 Flash point (Tag closed cup) ...... 46°C min. (115°F)

The maximum amount of agent that may be used to meet the coating and antistripping requirements shall not exceed two percent, by weight, of the total bituminous material used in the mixture. At least 50 grams of the standard bituminous material and agent shall be prepared for testing according to the directions of the manufacturer.

Wet Coating Test. The standard aggregate shall be washed with distilled water until free from dust and dried. One hundred grams of dry standard reference aggregate shall be placed in an 8 ounce seamless ointment can or equivalent, covered with distilled water and then placed in a 140°F constant temperature oven for 1 hour. Immediately after the heating and soaking period a wire gauze shall be placed on the can and the water drained off. While inverted, the can shall be shaken vigorously 4 times to remove excess water.

Six grams of the mixture of MC 800 and agent shall be heated to 140°F and mixed immediately with the wet aggregate. The materials shall be mixed vigorously with a small spatula for not over 5 minutes without further application of heat. At least 95 percent of the aggregate particles shall be completely coated at the end of the mixing period.

Stripping Test. The coated aggregate from the wet coating test shall be covered for 1 hour with distilled water at room temperature. At least 95 percent of the aggregate particles shall be completely coated at the end of the immersion period.

**712.09 Geotextile Fabric.** Furnish fabric composed of strong rot-proof polymeric fibers formed into a woven or non-woven fabric conforming to the following requirements:

Type A: Underdrains and Slope Drains	
Minimum Tensile Strength <sup>[1]</sup>	80 lb (355 N)
Minimum Puncture Strength <sup>[2]</sup>	25 lb (110 N)
Minimum Tear Strength <sup>[3]</sup>	25 lb (110 N)
Apparent Opening Size <sup>[4]</sup>	
Soil Type-1: Soils with 50% or less passing	$AOS \le 0.6 \text{ mm}$
No. 200 (75 µm) sieve	
Soil Type-2: Soils with 50 to 85% passing	$AOS \le 0.3 \text{ mm}$
No. 200 (75 µm) sieve	
Minimum Permeability <sup>[5]</sup>	1×10-2 cm/sec
Type B: Filter Blankets for Rock Channel Protection	
Minimum Tensile Strength <sup>[1]</sup>	200 lb (890 N)
Minimum Puncture Strength <sup>[2]</sup>	80 lb (355 N)
Minimum Tear Strength <sup>[3]</sup>	50 lb (220 N)
Minimum Elongation <sup>[1]</sup>	15%
Apparent Opening Size <sup>[4]</sup>	$AOS \le 0.6 \text{ mm}$
Minimum Permeability <sup>[5]</sup>	$1 \times 10^{-3}$ cm/sec
Type C: Sediment Fences	
Minimum Tensile Strength <sup>[1]</sup>	120 lb (535 N)
Maximum Elongation at 60 lb (265 N) <sup>[1]</sup>	50%
Minimum Puncture Strength <sup>[2]</sup>	50 lb (220 N)
Minimum Tear Strength <sup>[3]</sup>	40 lb (180 N)
Apparent Opening Size <sup>[4]</sup>	$AOS \le 0.84$ mm.
Minimum Permittivity <sup>[5]</sup>	$1 \times 10^{-2} \text{ sec}^{-1}$
Ultraviolet Exposure Strength Retention <sup>[6]</sup>	70%
Type D: Subgrade-Base Separation or Stabilization	
Minimum Tensile Strength <sup>[1]</sup>	180 lb (800 N)
Maximum Elongation at 170 lb (755 N) <sup>[1]</sup>	35%
Minimum Tear Strength <sup>[3]</sup>	70 lb (310 N)
Minimum Puncture Strength <sup>[2]</sup>	70 lb (310 N)
Apparent Opening Size <sup>[4]</sup>	Same as Type A
Permeability <sup>[5]</sup>	$1 \times 10^{-3}$ cm/sec
Type E: Pavement Reinforcement Fabric	
AASHTO M 288, Section 9, Table 7	
[1] ASTM D 4632	
[2] ASTM D 4833	
[3] ASTM D 4533	
[4] ASIM D 4/51 [5] ASTM D 4401	
[6] ASTM D 4355	

All minimum strengths shown are average roll minimum values in the weakest principal direction.

Ensure that the fabric is free of any treatment that might significantly alter its physical properties. During shipment and storage, wrap the fabric in a heavy-duty protective covering to protect it from direct sunlight, dirt, dust, and other debris.

For all fabric types, the manufacturer shall submit a certification with each shipment of material stating that it meets the specification requirements.

**712.20 Drive Posts**. Drive posts shall be fabricated from steel into a characteristic cross section which may be used alone or paired to form a heavier post by being bolted together back to back. The posts shall be of the weight per foot and length as specified. Posts shall be cut square to a length tolerance of  $\pm$  one inch and shall be free of ragged or sharp edges and cracks or other imperfections affecting strength or durability. The back of channel sections may contain raised longitudinal ribs or may be flat. The channels shall be designed for bolting back to back for use as a single post.

Posts shall be of Grade 60 material having the physical properties of ASTM A 615, A 616 or A 617.

POST	WEIGHT
SIZE	POUNDS
NUMBER	PER FOOT
1	1.12
2	2.00
3	3.00

The nominal weight of posts before punching or galvanizing shall be as follows:

The weight tolerance shall be -3.5 and +10.00 percent.

All posts shall have 3/8 inch diameter holes on the centerline spaced accurately at one inch centers beginning not more than 1-1/8 inch from the top of the post through its entire length. Punching or drilling accuracy shall be sufficient to allow bolting posts together back to back without redrilling holes, using 3/8 inch diameter bolts. Posts shall be galvanized in accordance with 711.02, after punching.

Posts shall meet the requirements of the following load deflection test. Paired posts shall be assembled with 3/8 inch diameter SAE J 429 Grade 8 bolts on four inch spacings starting two inches from one end. Drilling for bolt assembly shall be as required and the bolts shall be torqued to 150 inch-pounds.

The posts shall be loaded as horizontal beams resting on 1-1/2 inch diameter non-restricting supports six feet ten inches apart. Back to back posts shall be loaded with the axis of the bolts parallel to the direction of the applied bending load. Single U-channel posts shall be loaded with the flanges in tension.

The total bending load shall be divided into two equal loads three feet apart and applied vertically so as to be centered between the supports. The maximum rate of the testing machine cross-head movement shall be 1/2 inch per minute. Deflection shall be measured at the load application points and shall not exceed 0.55 inches under the following total applied loads:

	TOTAL BEARING
SPECIMEN	LOADS
CONFIGURATION	pounds
Single No. 1 Post	60
Single No. 2 Post	400
Single No. 3 Post	800
Two No. 2 Posts Paired	1,000
Two No. 3 Posts Paired	3,000

The permanent set after the load has been removed for one minute shall not exceed 0.10 inch.

# 713 LIGHTING AND ELECTRICAL MATERIALS

**713.00 General**. Lighting and electrical materials covered by these specifications shall be inspected and certified as follows:

1. Inspection. Lighting and electrical materials are subject to inspection at the project site. Such inspection will include, but is not limited to, the identification of the item, type, size and manufacturer's markings, and documentation of these data. When required by the Engineer, random samples will be selected from the material delivered or at the place of manufacture or warehouse prior to delivery.

2. Certification. When required by the Engineer, certified test data shall be furnished.

In the case of light poles and light towers, certified test data in triplicate covering the specified requirements for all materials incorporated in the poles, towers, and accessories and the results obtained from the deflection tests shall be furnished to the Engineer.

**713.01 Light Poles.** 1. Scope. These specifications cover materials and manufacturing methods to be used in the fabrication of light poles used to support luminaires. Any aluminum or steel material permitted by the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" may be used in this item. Pole designs shall conform to minimum requirements of the AASHTO specifications cited, except that the design wind load shall, in all cases, be based on a wind speed of 90 miles per hour.

# 2. Shafts

(a) There shall be not more than one longitudinal, automatically electrically welded seam and no transverse seams or welds, except as permitted hereinafter. The longitudinal welded seam shall be neat and uniform in appearance, the weld shall not be less than the thickness of the base material, and the bead height shall not exceed 1/16 inch. The wall shall be of uniform thickness throughout, except at the weld bead. The cross section of the shaft shall be circular, or multisided, and the diameters or cross sectional dimensions, measured at any point along the longitudinal axis, shall not vary from each other more than 3/16 inch. Poles may consist of not more than two vertical shafts joined by overlapping the sections at least 1-1/2 diameters of the bottom of top section, and by use of a 5/8 inch minimum stainless steel hex head through bolt.

(b) Shafts for steel poles shall be tapered tubes with a true continuous taper.

(c) Shafts for aluminum poles shall be tapered tubes either spun or rolled. The shaft shall have a true continuous taper except for the top and bottom sections which may be straight. No more than 40 percent of the total shaft length shall be straight.

(d) The average rate of shaft taper including straight portions of the shaft shall be between 0.06 and 0.16 inches per foot.

(e) The deflection of the unloaded shaft from the vertical position when placed under load by attachment of the bracket arm, luminaire weighing 75 pounds and lamp shall not exceed an angle of one degree and ten minutes.

(f) On poles equipped with tubular sleeve supports for bracket arms, the sleeve shall pass through a hole in the shaft and be made an integral part of the shaft by means of circumferential welds where sleeve and shaft join. The sleeve shall extend from the shaft sufficiently to insure stability of the connection.

(g) Fittings shall be as detailed on the plans and the approved shop drawings. Fasteners, washers, shims, nuts, and bolts, unless otherwise specified, shall be either stainless steel conforming to ASTM A 320 (AISI-300 series), galvanized steel conforming to 711.02 or silicon bronze conforming to ASTM B 98. Nonstructural castings for aluminum poles, including the shaft cap and transformer base door, shall be ASTM B 26 or B 108, Alloy S 5 A, Condition F.

3. Anchor type bases.

(a) Anchor bases for steel poles shall be one piece cast steel conforming to 711.07, or steel plate conforming to 711.01. The anchor bases shall be secured to the lower end of the shaft by two continuous electric arc welds. The base shall telescope the shaft with one weld at the lower end of the shaft and the other weld

at the top of the base. The two welds shall be at least 1-1/2 inches apart and the welded connection shall develop the full strength of the adjacent shaft section.

(b) Anchor bases for aluminum poles shall be one-piece cast aluminum conforming to ASTM B 26 or B 108, Alloy SG70A, Temper T6. The anchor bases shall be secured to the lower end of the shaft and the base shall telescope the shaft. When a welded connection is used, two continuous welds shall be required with one weld at the lower end of the shaft and the other weld at the top of the base. The two welds shall be at least 1-1/2 inches apart. The base connection shall develop the full design strength of the adjacent shaft section in bending.

4. Transformer type bases. Transformer type bases shall be fabricated from steel or aluminum in accordance with the following:

(a) Steel transformer bases meeting the dimensional requirements of plans and approved shop drawings shall be made from steel conforming to ASTM A 36. Bases for poles mounted on median barriers shall be one-pass welded unless otherwise noted.

(b) Aluminum transformer bases meeting the dimension requirements of the plans and approved shop drawings shall comply with the frangibility requirements specified in the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," and shall be permanently marked for exterior identification.

(c) The aluminum transformer bases designated on the plans by Styles AT-A, AT-C and AT-X shall; (1) be capable of resisting the following moments in foot pounds applied at a distance of 20 feet above the top of the base without collapsing or rupturing; (2) not produce, while supporting a full sized pole, a change in impacting weight momentum greater than 400 pound-seconds when tested in the laboratory with a ballistic pendulum or equivalent, or greater than 1,100 pound seconds when tested in the field under full scale vehicular impact.

	Bolt Circle	Base	Moment
Style	Diameter	Height	Foot Pounds
AT-A	15"	20"	37,000
AT-C	17-1/4"	20"	56,000
AT-X	10-1/2" - 13"	20"	34,000

(d) The transformer base shall be fastened to the shaft anchor base with four heavy hex head bolts and nuts conforming to ASTM A 307 and galvanized in accordance with 711.02. When aluminum transformer bases are used with steel anchor base poles, both the bottom of the steel anchor base and the top of the aluminum transformer base shall be coated or painted with a heavy film of zinc rich paint (Federal Specification TT-P641-Type II).

4. Anchor bolts.

(a) Anchor bolts conforming to the dimensions shown on the plans and approved shop drawings shall meet the requirements of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals."

(b) The threaded ends of the anchor bolts and the nuts shall be galvanized in accordance with 711.02, with galvanizing extending at least one inch beyond the threads.

5.Bracket arms.

(a) Bracket plates and other fittings shall be dimensioned and detailed as shown on the plans, the standard drawings, and the approved shop drawings. The arms shall be made of not less than two inch nominal pipe size material and have; (1) the longitudinal axis of the luminaire end canted not less than one degree nor more than four degrees above the horizontal, (2) an internal raceway of 1-3/32 inches minimum I.D. free of projections and obstructions, which when assembled to the shaft, will permit installation of luminaire supply conductors without insulation damage and with a minimum radius bend of conductors of three inches, (3) a two inch nominal pipe size slipfitter end with a minimum length of eight inches to receive a slipfitter-mounted luminaire. The bracket arm members may be formed of straight or tapered stock but shall be of a round or ovaliptic cross section. Except for poles equipped with tubular sleeve supports, the bracket arm assembly for arms eight feet or longer shall consist of an upper and lower member securely joined by means of a vertical strut or struts.

(b) Steel bracket arms supported on a circular tapered stud, integral with the pole shaft, shall be made from a one or two-piece round tapered sleeve. The bracket arm shall be securely held within the sleeve by means of a 5/8 inch machine bolt extending diametrically through both bracket arm and sleeve. A hex head nut and lock type washer shall be used to secure the bolt.

(c) The shaft end of each aluminum bracket arm member shall have a cast, wrought, or extruded aluminum fitting welded to it for attaching to the shaft.

7. Welding. Steel shall be welded as required by 513.17. Aluminum welding shall be done by the gas metal-arc process or the gas tungsten-arc process.

Fabrication and welding of aluminum poles and bracket arms shall conform to the requirements of AWS D 1.2 Structural Welding Code - Aluminum.

8. Finishing. Steel poles, except stainless, shall be hot dipped galvanized after fabrication in accordance with the requirements of 711.02.

Color and finish of aluminum poles shall be as detailed on the plans. Shaft and bracket arm assembly shall be wrapped with a heavy water-resistant paper or be otherwise suitably protected during shipment and installation. The wrapping shall not be removed until after complete installation.

9. Galvanized poles specified to be field painted shall be treated in accordance with one of the following:

(a) Given one coat of wash primer conforming to federal specifications MIL-P-15328c primer (wash) pretreatment, blue (formula No. 117-B for metals) and shall be given one shop coat of paint 708.15 immediately when the wash primer is dry.

(b) Given one shop coat of zinc-rich base paint (zinc dust paint) conforming to federal specifications TT-P-641, Type II.

Non-galvanized steel poles shall have all interior and exterior surfaces shop primed in accordance with 514.04 using materials as specified in 708.15. Two coats of an approved "matte" black paint shall then be applied to all exterior surfaces. The first coat shall be shop applied, the second coat shall be applied after erecting in accordance with 514.05. The Contractor shall submit for approval, color samples and method of painting.

Bracket arms for luminaire support on combination poles shall be 0.1196 inches thick steel ellipsoidal or round cross- section and tapered its full length. The arm shall be straight and attached with one simplex connection. The arm shall be installed at five degrees above horizontal. Bracket arms shall be painted by the same method as approved for the pole.

10. City of Akron Pole. In addition to the above, the standard City of Akron Pole shall comply with the following:

Anchor bolts shall be supplied with double nuts. The first set shall be installed 1/4 inch minimum from the top of the foundation and leveled to align and plumb the pole.

The pole shaft shall be an equilaterally diamond cross section its full length, tapered throughout.

Luminaire arm of the same shape, cross section and taper shall be welded to the pole at 6-1/2 degrees with 1/2 inch back up plate. A smooth wireway shall be provided between the pole and arm. A 2-3/8 inch schedule 40 tenon shall be welded to the end of the luminaire arm. The tenon shall project from the end of the arm.

**713.02 Electrical Cables.** 1. Scope. This item shall consist of insulated conductor cables. All cable shall meet requirements of the IPCEA standards publication S-66-524. Conductor identification shall conform to the requirements of the latest edition of the National Electric Code.

#### 713.03

2. Cable to be used for 600 volt and under (secondary class) service shall be of the sizes specified, nonjacketed, single conductor, stranded copper and shall meet the following requirements:

(a) Cable sizes No. 8 AWG and larger shall meet the requirements of Underwriters Laboratories Type THWN/THHN or USE.

(b) Cable sizes No. 10 AWG and smaller shall meet the requirements of UL Type XHHW or THWN/THHN.

3. Cable to be used for 5,000 volt (secondary class) service shall be of the sizes specified, single conductor, stranded copper having an unshielded, chemically cross-linked polyethylene insulation, and shall meet the requirements of UL Type MV-90 dry.

4. Cable to be used for 5,000 volt and above (primary class) service shall be of the sizes and types specified.

# 713.03 Unit Type Duct-Cable Systems.

- 1. Scope. This item shall consist of a factory preassembled cable in a coilable, high density polyethylene pipe type duct providing the number and size of insulated conductors which are specified. The number of conductors used in the duct and the duct fill shall conform to the requirements of the National Electrical Code.
- 2. Conductors and neutrals. The cables used as conductors and neutrals shall conform to 713.02,2.
- 3. Polyethylene duct. Duct shall conform to ASTM D 2104 with the following exceptions and additions:
- 3.5 Standard Thermoplastic Pipe Materials Designation Code. The two figures indicating hydrostatic design stress may be omitted.
- 4.4 Compound. Compound shall be grade P33 or P34.
- 6.2.3 Eccentricity. The eccentricity shall be within 20 percent.
- 6.6 Sustained Pressure. This requirement is waived.
- 6.7 Burst Pressure. This requirement is waived.
- 9.1.3 and 9.1.4 These markings are not required.
- 9.1.5 In addition to the manufacturer's name, the year of manufacture shall be included in the marking.

**713.04 Rigid Ferrous Metal Electrical Conduit and Fittings**. Galvanized steel conduit and fittings furnished under this specification shall comply with the requirements of ANSI C 80.1, C 80.4, and UL 6 for Type I rigid steel conduit. Each length of conduit shall bear the UL label.

**713.06 Reinforced Polymer Concrete Pull Boxes.** 1. Pull boxes and covers shall be composed of reinforced polymer concrete and be designed and tested to temperatures of -50°F and meet requirements of the following tests: ASTM D 756, ASTM D 543, ASTM D 1501, ASTM D 570, ASTM D 790 and ASTM D 635.

**713.07** Polyvinyl Chloride Conduit and Fittings. This specification covers polyvinyl chloride conduit, Schedule 40 for direct burial without concrete encasement, and Type DB for encased burial in concrete. Polyvinyl chloride conduit and fittings, of the size and type specified, shall conform to NEMA Standards Publication No. TC-6.

**713.08** Concrete Pull Box. 1. Pull box. Concrete pull boxes shall be constructed and installed as detailed in the plans.

2. Covers. Pull box covers shall be constructed and installed as detailed in the plans, and shall have the word "ELECTRIC," "TFC SIG" or "COMMUNICATIONS" as required, cast in the top surface of the cover forming letters one to two inches in height.

**713.09** Circular Corrugated Metal Pull Box. 1. Scope. This specification covers circular helically corrugated metal pull boxes as follows:

2. Pull box. Circular corrugated metal pull boxes shall be fabricated from 0.059 inch minimum galvanized steel with a 20 mil minimum coating of asphalt on each side, 18 or 24 inches in diameter and 30 inches long, helically corrugated pipe sections. The bottom end shall have three 4 inch by 10 inch slots with the 10 inch dimensions parallel to the long axis of the box and the center lines of the slots shall be spaced 90 degrees apart. Field cutting of slots will be permitted, subject to project requirements, and provided restoration or protection of damaged coatings acceptable to the Engineer is made.

3. Covers. Metal pull box covers shall be either of the following:

(a) 1/4 inch thick steel plate conforming to 711.01 with 1/2 inch minimum flange around the edge and galvanized to conform to 711.02.

Each steel plate cover shall have a brass or stainless steel plate approximately 1/32 inch in thickness and not less than two inches in width by ten inches in length with the word "ELECTRIC," "TFC SIG," or "TELEPHONE" etched, engraved, or die-stamped thereon in letters approximately 5/8 inches wide by 1-1/4 inches high, riveted or otherwise permanently attached to the steel plate cover.

(b) 3/8 inch minimum thickness, gray iron or ductile iron ASTM A 48 or A 536. Certification will be required. The word "ELECTRIC," "TFC SIG", or "TELEPHONE" as required, shall be cast in the top surface of the cover forming letters one to two inches in height.

4. Grade adjustment extensions. If specified on the plans, grade adjustment extensions, corrugated and coated, and of the same material as specified in 2 above, shall be furnished and installed. Extension section shall have an inside diameter of such size as to allow the corrugation to mesh with those of the outside diameter of the pull box, thereby forming a screw type vertical adjustment between the two pipe sections. Extensions and pull box sections shall overlap each other a minimum of four inches.

**713.10** Junction Boxes. 1. Scope. This specification covers junction boxes of the sizes and types shown on the plans.

2. Composition. Junction boxes shall be iron castings and shall be hot-dip galvanized in accordance with 711.02.

3. Detailed requirements.

(a) Junction boxes shall be NEMA Type 4 of the size specified, shall be UL approved, and shall be watertight.

(b) Conduit entrances shall be provided as shown on the plans.

**713.11** Luminaires for High Intensity Discharge Lamps. 1. Scope. This specification covers luminaires for high intensity discharge lamps. The luminaire shall be a complete lighting device consisting of a housing, lamp, support clamp, reflector, refractor, socket, integral ballast or separate ballast when specified and terminal block. The luminaire shall be capable of operating the lamp in a completely sealed optical assembly at the line voltage specified. The luminaire shall provide the ANSI-IES Type distribution and cut-off specified.

The use of the small, medium, or large size luminaire shall be determined by the initial lamp lumen rating of the specified lamp type as follows:

(a) The small horizontal Style A luminaire shall not be used for lamps rated over 250 watts.

(b) The medium horizontal Style B luminaire shall not be used for lamps rated over 400 watts.

(c) The large horizontal Style C luminaire shall not be used for lamps rated over 1,000 watts.

The luminaire shall be supplied with a label or decal indicating the type of source and wattage rating. With the luminaire installed in its normal operating position, the label or decal shall be clearly legible in daylight at a distance of 50 feet. Labeling shall be in accordance with the provisions of NEMA Publication No. OD-150 or EEI Publication No. TDJ-150.

### 2. Detailed requirements.

(a) Housing. The housing shall be of cast aluminum with natural finish or a painted finish using aluminum or a light gray color paint. The housing shall contain and support the reflector, refractor, socket, ballast, terminal block and support clamp. Provision shall be made for leveling to adjust the luminaire to the specified transverse and longitudinal position with respect to the roadway.

(b) Refractor retaining ring. The refractor retaining ring shall be securely latched and hinged with non-corrodible material and shall be operable and removable without the use of tools. The assembly shall provide a weatherproof enclosure for the optical system.

(c) Support clamp. The support clamp shall be the slip-fitter type adaptable to 1-1/4 or 2 inch mounting bracket. A stop shall be provided to allow an engagement of at least 4-1/2 inches of the bracket arm. Provision shall be made to adjust and hold the luminaire in its specified vertical and horizontal position.

(d) Reflector. The reflector shall be of an approved specular polished aluminum reflective surface. It shall be held firmly in the housing but shall be easily removed without the use of special tools. Silicone rubber, ethylene propylene terpolymer, or dacron felt gaskets or approved equal shall seal the optical assembly at the socket entry and between the refractor and reflector to make a dust tight optical system. The reflector shall be clean and free from scratches.

(e) Refractor-glass. The refractor shall be heat resistant borosilicate glass and shall have prisms on the inside and on the outside to provide the ANSI-IES type distribution and cutoff as specified and shall be free of striations and imperfections. The refractor shall be embossed to clearly indicate the street side and curb side prisms. The refractor shall be securely fastened to the holder but easily removed. The refractor, reflector assembly shall meet the specified ANSI-IES distribution and cutoff. The Contractor shall provide complete photometric data for every combination of each assembly.

(f) Socket. The socket shall be mogul screw shell with large center contact spring providing a firm contact with the lamp base. The socket shell shall have lamp grips to prevent the lamp from loosening. The shell may be of the skeleton type or shrouded in porcelain. The contacts shall be identifiable. Socket extension adapters will be permitted for special applications. Luminaires providing various ANSI-IES types of distribution by socket adjustment shall also include a means of identification to associate each lamp position with each distribution type. The socket adjustment shall provide positive positionings by means of index holes, lugs or notches. Slots with infinite settings will not be acceptable.

### 713.11

(g) Ballast. Ballasts shall conform to the following requirements.

(1) The mercury ballast shall be a high power factor, constant wattage or regulator type with separate primary and secondary windings and shall be rated to the circuit voltage and size of lamp specified. The ballast shall start the lamp at temperatures as low as -20°F and shall deliver rated lamp current at circuit voltage variation of plus or minus 13 percent. The regulation output of lamp wattage shall not exceed a total range of four percent for lamps rated 400 watts or less or six percent for lamps rated in excess of 400 watts.

(2) The metal halide ballast shall be a high power factor, peak load autoregulator type rated to the circuit voltage and size of lamp specified. The ballast shall start the lamp at temperatures as low as -20°F and shall deliver rated lamp watts within plus or minus 10 percent with plus or minus ten percent variation in applied voltage.

(3) The high pressure sodium ballasts for lamps through 400 watts shall be a high power factor, regulator type with isolated primary and secondary windings and shall be rated to the circuit voltage and size of lamp specified. Ballasts for 1,000 watt high pressure sodium lamps shall be a high power factor, autoregulator type rated to the circuit voltage specified. The ballast shall start the lamp at temperatures as low as -20°F and shall deliver rated lamp current at circuit voltage variations of plus or minus ten percent. All ballasts shall be complete with starter components.

The starter component shall be comprised of solid state devices capable of withstanding ambient temperatures of 100°C. The starter shall provide timed pulsing with sufficient follow through current to completely ionize and start all lamps that meet published ANSI standards. The starter component shall be field replaceable and completely interchangeable with no adjustment necessary for proper operation. It shall have push-on type electrical terminations to provide good electrical and mechanical integrity and ease of replacement. The starter circuit board shall be treated in an approved manner to provide a water and contaminant resistant coating.

The starting circuit-ballast combination shall be designed to consistently provide the following parameters:

a) Lamp wattage must be maintained within the trapezoid recommended by lamp manufacturers within the full rated input voltage range.

b) Amplitude of the pulse shall be 2,500 volts minimum and 4,000 volts maximum. Operation of the pulse at spike voltage levels near minimum is desirable.

c) The minimum pulse width shall be 1 microsecond at 2,250 volts, and shall be applied within 20 electrical degrees of the peak of the open circuit voltage wave, and have a minimum repetition rate of one pulse per cycle of the 60 cycle wave.

d) Pulses must be present when ballast is correctly wired and nominal voltage less 15 percent is applied to the ballast windings.

(4) The low pressure sodium ballast shall be a high power factor corrected (90 percent minimum) reactor type rated to the circuit voltage and size of lamp specified. The ballast shall start the lamp at temperatures as low as  $-20^{\circ}$ F and shall deliver rated lamp current at circuit voltage variations of plus or minus ten percent. Wattage regulation shall not exceed a range of -5 percent to +3 percent for lamps rated at 90 watts or more.

(h) Glare shields. Glare shields of aluminum or opaque plastic material shall be provided when specified. The shield shall be supplied by the manufacturer of the luminaire. The glare shield shall cut off the upward component of light but shall not reduce the total output of the luminaire more than three percent.

**713.12 Akron Luminaire**. Luminaires designated on the plan as "City of Akron Luminaire" shall be as specified in 713.11 except: the luminaire shall be rectangular in shape with a peaked top to provide runoff. The housing shall be an integral assembly consisting of cast or extruded aluminum. Extruded units shall have a one-piece top.

Luminaires shall be fitted with a two inch cast aluminum slipfitter connector or integral support clamp. An engagement of at least 4-1/2 inches of the arm shall be provided. A minimum of three stainless steel hex head set screws shall be provided on slipfitter connections. Slipfitter connections shall be attached to the luminaire housing with four stainless steel hex head nuts and bolts with lock washers. Luminaires and slipfitters are to be painted to match the paint designated for the poles.

**713.13** Luminaires for Underpasses. 1. Scope. This specification covers luminaires for mounting in underpasses. The luminaire shall be a complete lighting device, consisting of a housing, reflector, lamp, shrouded porcelain socket, refractor, door, integral ballast, and fuse holder with fuse.

2. Detail Requirements. (a) The fixture shall consist of a cast aluminum housing and door frame assembly containing a thermal shock resistant glass refractor attached to the frame with stainless steel latch and hinges. The glass refractor shall be protected by an approved guard or shield. (b) An alternate fixture to "(a)" may consist of a cast aluminum rear mounting plate with a one-piece luminaire housing and refractor molded of a polycarbonate material with integral prismatic design for proper beam control. The one-piece housing shall be hinged and secured to the rear mounting plate. (c) The luminaire shall provide for accommodation of lamps as specified in the plans. (d) The integral ballast, when required, shall conform with the requirements of 713.11, and shall be rated to the circuit voltage and size of lamp specified. (e) The assembly shall be prewired and when in operation shall be weatherproof and sealed against dust or bug entry.

#### 713.14

**713.14 Lamps.** 1. Scope. This specification covers mercury, metal halide, high pressure sodium, low pressure sodium, incandescent and fluorescent lamps for use in luminaires. The lamps shall be the type and wattage specified.

2. Mercury lamps. (a) Mercury lamps for use in the luminaire specified shall be first line, high quality lamps having heat resistant clear glass envelopes with a quartz arc tube interior. The horizontal initial lumens and approximate hours of life shall not be less than the values shown in the following table:

	Horizontal	Economic
ANSI	Initial Lumens	Life Hours
C78.1300 H38HT-100	3900	16000
C78.1308 H39KB-175	6950	16000
C78.1301 H37KB-250	10500	16000
C78.1305 H33CD-400	19200	16000
C78.1311 H35NA-700	34600	16000
C78.1309 H36GV-1000	53000	16000

(b) The lumen output of the mercury lamps after 12,000 hours use shall produce a minimum of 78 percent of its initial lumen rating.

3. High pressure sodium lamps. (a) High pressure sodium lamps for use in the luminaire specified shall be first line, high quality lamps having heat resistant clear glass envelopes with a ceramic arc tube interior. The horizontal initial lumens and approximate hours of life shall not be less than the values shown in the following table:

		Horizontal	Economic
ANSI	Watts	Initial Lumens	Life Hours
S62	70	5,800	14,000
S54	100	9,500	14,000
S56	150	16,000	16,000
S66	200	22,000	16,000
S50	250	25,500	16,000
S67	310	37,000	16,000
S51	400	50,000	16,000
S52	1,000	130,000	16,000

(b) The lumen output at the end of economic life shall be not less than 80 percent of the initial lumen rating.

4. Metal halide lamps. (a) Metal halide lamps for use in the luminaire specified shall be first line, high quality lamps having heat resistant clear glass envelopes with a quartz arc tube interior. The horizontal initial lumens and approximate hours of life shall not be less than the values shown in the following table:

		Horizontal	Economic
ANSI	Watts	Initial Lumens	Life Hours
M57	175	14,000	4,000
M58	250	18,000	4,000
M59	400	32,000	10,000
M47	1,000	95,000	7,500

(b) The lumen output at the end of economic life shall be not less than 65 percent of the initial lumen rating.

5. Low pressure sodium lamps. Low pressure sodium lamps for use in the luminaire specified shall be first line, high quality lamps, with a sodium resistant discharge tube contained in a clear glass envelope. The initial lumens and approximate hours of life shall not be less than the values shown in the following table:

Watts	Horizontal Initial Lumens	Economic Life Hours
35	4,000	16,000
55	8,000	16,000
90	13,500	16,000
135	22,500	16,000
180	33,000	16,000

6. Incandescent lamps. Incandescent lamps of the size, type and wattage specified shall conform to Federal Specification Number W-L-101.

7. Fluorescent lamps. Fluorescent lamps of the size, type and wattage specified shall conform to Federal Specification Number W-L-116.

**713.15** Cable Connecting Devices. 1. Scope. This specification covers cable connecting devices, including connectors, connector kits, and in-the-line type fuseholder kits for use in handholes of light poles as well as in junction and pull boxes rated for minimum 600 volt service.

2. Cable connectors. Cable connectors shall be the types which are applied to the conductor by means of a compression tool and they shall be capable of fully enclosing the conductors upon which they are compressed in accordance with the manufacturer's instructions. Connectors shall be fabricated from high strength copper alloy. Plated connectors fabricated from metals other than copper shall not be accepted. Connectors shall be available in two styles as follows:

(a) Style "H" shall be the parallel groove connector consisting of a metal body having two fully-opened grooves or slots parallel to each other, and separated by a portion of the center section of the body. The total circumference of each conductor shall be completely surrounded by metal when the connector is compressed.

#### 713.15

(b) Style "C" shall be the splicing sleeve type which consists of a crimpable plated copper sleeve with a thin metal wall or "stop" in the barrel centered between each sleeve end so the sleeve shall enclose equal lengths of the two conductors being spliced end-to-end. The barrel of the sleeve shall be manufactured to fit specific ranges of conductor sizes. The manufacturer's instructions relating thereto shall be strictly followed.

3. Cable connector kits. Each cable connector kit shall be furnished complete with all component parts described under the various listed types and each kit shall have the following:

(a) Sufficient silicone compound to lubricate metal parts and the housing for each assembly.

(b) Complete installation instructions.

The component parts of each type of kit shall comply with the following:

(c) Housing. All housings shall be made of water-resistant synthetic rubber suitable for burial in the ground or exposure to sunlight. Each housing shall form a waterseal around the cable, between each housing at the point of disconnection and between an insert body and enveloping "Y" housing.

(d) Copper pins, sockets and fuse contacts shall have a minimum conductivity of 90 percent. They shall be of at least half hard material and the crimpable portion shall be fully annealed while the rest of the device is maintained in its original state of hardness.

(e) Contact pressure between a pin and a socket shall be maintained by the use of an approved socket spring.

(f) Where a mounting hole is provided for fastening terminal lugs to a ring-tongue terminal, they shall be fastened with a bolt and self-locking nut.

(g) Plastic sleeves shall be rigid, molded insulating plastic material of sufficient outside diameter to form a watertight fit with its related housing. Wall thickness shall be 0.10 inch maximum and sleeve lengths shall be as required.

(h) All fuses shall be rated 600 volts, 100,000 amperes RMS interrupting capacity.

Each cable connector kit furnished under this specification shall conform to one of the following types:

Type I. In-line connector kit for pull box installation. Each Type I kit shall contain: (a) A copper pin crimpable to a conductor. (b) A receptacle having a centrally located, recessed socket so constructed that it is filled and retained by its housing. (c) A plug housing for retention of the copper pin. (d) A receptacle housing. Type II. Fused, Quick Disconnect "Y" Connector Kit. Each Type II kit shall contain: (a) A pair of spring loaded copper fuse contacts suitable for gripping the specified cartridge fuse. One contact shall be crimpable on a conductor and after insertion into its proper position within the load-side plug housing be capable of being securely retained therein. The other contact shall be preassembled for retention within a "Y" insert body. (b) A line-side "Y" housing with two cable ports. (c) Two terminal lugs, each having a mounting hole. (d) A bolt and self-locking nut. (e) A "Y" insert body with preassembled line side fuse contact and a ring tongue terminal. (f) A load-side plug housing permanently marked "load side." (g) A fuse of specified ampere rating.

Type III. Unfused, Quick Disconnect "Y" Connector Kit. Each Type III kit shall contain: (a) A copper pin crimpable to a conductor and suitable for retention in the load-side receptacle housing. (b) A "Y" insert body with preassembled load-side copper socket and ring-tongue terminal. (c) A line-side "Y" housing with two cable ports. (d) Two terminal lugs, each having a mounting hole. (e) A bolt and self-locking nut. (f) A load-side receptacle housing.

Type IV. Semi-permanent "Y" Cable Connector Kit. Each Type IV kit shall contain: (a) A ring-tongue terminal crimpable to a conductor. (b) Two terminal lugs, each having a mounting hole. (c) A bolt and self-locking nut. (d) A line-side "Y" housing with two cable ports. (e) A load-side insert body with one cable port.

Type V. Unfused In-line Connector Kit for Junction Box Installation. Each Type V kit shall contain: (a) A copper pin crimpable to a conductor and suitable for retention in the receptacle housing. (b) A copper socket crimpable to a conductor and suitable for retention in the plug housing. (c) A receptacle housing. (d) A plug housing.

Type VI. Fused In-Line Connector Kit for Junction Box Installation. Each Type VI kit shall contain: (a) A pair of spring loaded copper fuse contacts, both crimpable to conductors and suitable for gripping the specified cartridge fuse. Both contacts shall be capable of being securely retained in their housings. (b) A plug housing. (c) A receptacle housing.

Type VII. Splice Insulating Kit. Type VII kits shall be classified as follows: (a) Type VII A kit consisting of: two identical housings, each having a single cable port, one plastic sleeve, one Style "S" cable connector. (b) Type VII B kit consisting of: one housing having a single cable port, one housing having a twin cable port, one plastic sleeve, two style "H" cable connectors. (c) Type VII C kit consisting of: two identical housings, each having a twin cable port, one plastic sleeve, three Style "H" cable connectors.

4. In-the-line type fuseholder kits. Each in-the-line type fuseholder kit shall be provided with a breakaway receptacle to physically interrupt the circuit under impact. The breakaway unit shall be mounted on the line side and consist of a wire

connector for the external circuit and an insulating sleeve housing a deeply recessed female terminal. The assembly shall be completed by a conventional in-the-line fuseholder with its line terminal being a solid copper rod. When assembled, the male terminal of the fuseholder shall telescope into the insulating sleeve of the receptacle and make a sliding contact with the female receptacle terminal. There shall be four similar styles of breakaway receptacles differing only in the type of connector for the line side conductors as follows:

(a) Type VIII--AL Kits shall provide an in-the-line mounting for the fuseholder. It shall contain a setscrew-type connector for aluminum conductor.

(b) Type VIII--CU Kits shall provide an in-the-line mounting for the fuseholder. It shall contain a crimp type terminal that will accept a single copper conductor.

(c) Type IX--AL Kits shall provide a tee tap to the fuseholder. The setscrew connector shall be made of aluminum to accept aluminum conductors.

(d) Type IX--CU Kits shall provide a tee tap to the fuseholder. The setscrew connector shall be made of copper to accept copper conductors.

Insulating boots of water-resistant, synthetic rubber, suitable for burial in the ground or exposure to sunlight, shall be provided for both the line and load side of all fuseholder kits with breakaway receptacles.

5. Cable splicing kits. Each cable splicing kit shall contain all items necessary to complete a permanent, direct buried, water resistant, inline wye or tap splice as required by the plans. Each kit shall include the following:

(a) A sleeve or tee cable connector conforming with the general requirements of Style "C" or "H" or other connecting device approved by the Engineer.

(b) A means of containing the sealing material around the cable connector.

(c) Sufficient self-hardening compound to assure a water- tight splice.

(d) Heat shrinkable tubing, molded boots, or self-fusing hi-dielectric insulating compound.

(e) Complete installation instructions.

**713.16 Ground Rods and Ground Grid**. 1. Scope. This specification shall cover ground rods and ground grids.

2. Detail requirements. Ground rods shall have either a circular cross section with a diameter of one inch or more or, if other than circular in cross section, they shall have a periphery of 3.2 inches or more. Rods shall be ten feet long, solid, and having a driving point on one end. Rods for ground grid shall be 3/8 inch minimum

diameter solid rods with blunt ends approximately 30 feet in length. Rod material shall be stainless steel jacketed steel bearing UL label or hot-dip galvanized steel in accordance with 711.02.

In lieu of solid metal rods, ground grids composed of 5/16 inch diameter, preformed, three wire, BB Grade, Class C, messenger wire conforming to ASTM A 111 may be used.

**713.17** Structure Ground Cable. 1. Scope. This specification shall cover the cable to be used for electrical grounding of structures.

2. Requirements: Cable shall be stranded, soft-drawn, insulated, copper of the size shown, bearing a UL label or conforming to paragraph No. 2 of Section 713.02.

**713.18** Circuit and Light Pole Identification Materials. 1. Scope. This specification covers the materials to be used as identifying markings on cables and light poles.

2. Tags to be used as specified shall be circular in shape, 1-3/8 inch minimum diameter, 0.031 inch minimum thickness copper, brass or plastic except that tags within switch and device cabinets shall be of nonmetallic material. Identifying bands shall be approximately 1/32 inch thick, 3/16 inch wide and four inch minimum length nylon, self-clinching type with adequate size tab for labeling. Tags shall be permanently fastened to cables by means of tying straps of the same material and dimensions as identifying bands without tabs. Each tag or band tab shall be marked using 1/4 inch minimum lettering dies, engraving device or other equivalent permanent marking process. Markings shall indicate "GRD" for all ground and grounded neutral conductors. Companion circuit conductors shall be marked "CKT" followed by the designated letter, numeral or symbol as may be shown on the plans.

3. Pole identification shall be accomplished by means of adhesive labels with 1-1/2 inch silver white reflective characters on a black background meeting the requirements of federal specification L-S-300. The reflectivity characteristic shall be equivalent to No. 1 as described in such specification.

**713.19 Service Pole and Components.** 1. Scope. This specification covers materials and equipment normally comprising a service pole and service equipment:

2. Poles and Pole Keys. Poles and pole keys shall be Western, Red Cedar, Douglas Fir, or Southern Yellow Pine, full length, pressure treated in compliance with specifications of the American Wood Preservers Association with either a five percent solution pentachlorophenol or a high grade of pure coal tar creosote. Retention of preservative shall be not less than ten pounds of creosote type or not less than one-half pound dry chemical pentachlorophenol, per cubic foot of wood. Poles shall be 35 feet minimum length and Class 4 or heavier conforming to the applicable requirements specified by ANSI Pole Dimensions. Poles shall be reasonably straight without pronounced sweep or short crooks.

3. Wood crossarms. Wood crossarms shall be treated and of the specified dimensions. Treatment shall be as specified in No. 2 above.

4. Pole hardware. Pole hardware, including bolts, nuts, washers, clamps, screws, braces, racks, etc., shall be of specified sizes, galvanized in accordance with 711.02.

5. Ground wire supports. Ground wire fastened to the pole shall be attached with copper clad, rolled point staples of adequate size to accommodate the ground wire to be supported.

6. Ground wire moulding. Ground wire moulding shall be either wood or plastic, in sections not less than eight feet long and of sufficient width and groove depth to completely enclose the ground wire. Moulding shall be attached to pole by means of galvanized steel pipe straps and galvanized nails.

7. Anchors and anchor rods. Anchors shall be malleable iron, six inch minimum diameter, two-way or four-way expanding type. Anchor rods shall be 5/8 inch minimum diameter, eight feet minimum length galvanized steel provided with twin thimbleye.

8. Guy strand. Guy strand shall be 3/8 inch minimum diameter, conforming to ASTM A 475, galvanized steel.

9. Primary service equipment:

(a) Transformer shall be pole mounted, distribution type, oil-filled, single or double primary bushing, with taps of 2-1/2 percent above and below the specified voltage, furnished with hanger bracket or equipped for cross arm mounting and having the specified ratings for KVA capacity, primary and secondary voltages. Transformers may be self-protected with internal primary fuse and secondary breaker or conventional type.

(b) Primary fused disconnects and lightning arresters shall be open type having the specified ratings for voltage, amperage, interrupting capacity and instantaneous amperes RMS.

(c) Primary switches shall be open blade type, single-pole, single-throw; remote controlled oil immersed type or ground operated air break type.

(d) Cable pothead terminations shall have the specified ratings for phase-to-phase operating voltage, impulse voltage at  $1-1/2 \times 40$  wave, corona voltage level to ground, cable range and corona voltage acceptance level.

10. Secondary service equipment. Riser conduit shall be as specified in 713.04 with a rain tight galvanized steel service entrance head (weatherhead) threaded to fit the specified size of conduit and provided with a composition cover for two or three wire service.

The service disconnecting device shall be a fused safety switch or circuit breaker rated 600 volts AC minimum for 480 volt service or 240 volts AC minimum for 240 volts or less service. Current rating of the device shall be as specified but not less than 30 amperes. Circuit breaker shall be service equipment type. Devices shall be single throw with the specified number of poles and solid neutral not interruptible with operation of the device, but other means for disconnecting the grounded neutral shall be provided at the neutral terminal block. Fuse clips for cartridge type fuses shall be provided at the load side terminals of the switch. If the disconnecting device is a circuit breaker type and separate load side protection is required for two circuits, this shall be accomplished by the use of one single pole, single-throw circuit breaker type device, of the specified ampere rating mounted in series with the main breaker.

Line and loadside cable terminal lugs of the device should be sized to accommodate the specified wire sizes. If lugs of adequate size to enclose the total outside diameter of the cables cannot be furnished, insulated buses of specified ampere rating and dimensions and providing acceptable cable terminations shall be furnished and installed as directed by the Engineer.

The enclosure for the device shall be as specified for enclosures in 713.20. If the service pole does not support the control center, the enclosure door shall be stenciled "SERVICE SWITCH" with weather-resistant paint on the outside.

**713.20** Control Center Components. 1. Scope. This specification covers electrical devices, materials and equipment composing a control center.

2. Safety switches and circuit breakers used in the control center shall conform to 713.19, 10.

3. Lighting circuit transformers shall be dry type without taps having the specified KVA rating to step up the supply voltage of 120/240 volts to 480 volts, single-phase, 60 Hz.

4. Contactor circuit transformers shall be dry type having the specified wattage rating to step down the lighting circuit voltage of 480 volts to 120 volts, single-phase, 60 Hz. A fuse shall be provided in series with the 480 volt winding.

5. Lighting contactor shall be open type provided with an electromagnetically held, 120 volt, 60 Hz coil. The contactor shall be rated at 30 amperes minimum and have a minimum of three poles. A "HAND-OFF-AUTO" selector switch shall be provided in the photoelectric cell circuit and located within the enclosure.

6. Photoelectric control shall be a solid state, cadmium-sulfide type with hermetically sealed silicon rectifier rated 120 volts, 60 Hz and 1,000 watts maximum load. Built in surge protection shall be provided and a fail-safe operating feature shall be included so that the lighting circuits will remain energized in the event the photo control components become inoperative. Nominal operating levels of this

control shall be "turn on" at a minimum illumination value of three vertical footcandles and "turn-off" at a maximum illumination value of six vertical footcandles. These limitations shall be set by the manufacturer and maximum tolerances of plus or minus 20 percent for the specified values shall be acceptable.

Photoelectric controller shall be twist-lock type. A suitable mounting bracket with a locking type receptacle and all other necessary mounting hardware shall be furnished.

7. Lightning arrester shall be secondary type having the specified number of poles and rated 0-650 volts RMS. Arrester shall be provided with suitable mounting brackets and all other necessary mounting hardware.

8. Enclosures shall be NEMA ICS 1-110.15 Type 4 and shall be adequate to house the designated equipment for outdoor locations. All seams in sheet metal enclosures shall be fully welded. All fastenings used in assembly or mounting of the enclosures shall conform to ASTM A 320 (AISI-300 series).

Each enclosure shall be provided with a door so constructed that it may not be opened when the principal electrical dis- connecting device mounted therein is in the "ON" position. However, provision shall be made by means of a lockable double-defeater opening handle to permit intentional opening of the door with a screwdriver when the disconnecting device is in the "ON" position.

Each enclosure shall be provided with the following:

(a) A door provided with a mechanism interlocking the door latch and the operating handle, including provision for padlocking. The mechanism shall be defeatable in the following sequence when the operating handle of the disconnecting device is in the "ON" position. (1) Release door latch with one hand on door latch handle while simultaneously operating door latch defeater screw with a screwdriver in the other hand. (2) Open door

with one hand on door latch handle while simultaneously operating disconnect handle defeater screw with a screwdriver in the other hand.

The door latch defeater screw shall be sufficiently recessed within its housing so as not to be turned with a coin or flat washer.

The door latching mechanism shall provide that the door handle must be turned to fully engage its latch before the disconnect handle can be moved to the "ON" position.

(b) An insulated solid copper common neutral bus of adequate ampere rating and capable of terminating the specified sizes of wire.

(c) A schematic wiring decal of the entire control center installed on the inside of the door.

(d) An equipment warning sign reading "DANGER-HIGH VOLTAGE" stenciled on the outside of the door in red weather-resistant paint or the same wording etched on a brass plate riveted to the outside of the door. See 625.18 for other markings.

(e) A 14 gage or heavier enameled steel panel, securely fastened to the inside of the back of the enclosure and of adequate size to accommodate all devices and integral wiring on all sides and to the rear.

(f) Mounting flanges, hubs, weep holes, etc., as shown on the plans.

**713.21 Light Towers.** 1. Scope. This specification covers materials and manufacturing methods to be used in the fabrication of light towers, tower components, and anchors used to support luminaires. The design of light towers shall comply with applicable AASHTO requirements as set forth in the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," with the design wind load based on a wind speed of 90 miles per hour, with a maximum load of six luminaires, each weighing 75 pounds with a projected area of 3.5 square feet, mounted on a head frame assembly with top latched lowering device having a projected area of 5.3 square feet and weighing 340 pounds.

2. General. The integral luminaire lowering mechanism or device shall be compatible with the tower design and consist of a head frame assembly, a luminaire ring assembly, and winch assembly. The system shall permit luminaire maintenance at ground level, provide a permanently attached plug cord for energizing the lighting assembly when it is at ground level, support two to six 75 pound luminaires in a symmetrical arrangement, and include power cables and all miscellaneous electrical and mechanical equipment in the tower necessary to provide a complete and workable device. Disconnection of the electrical service at each tower shall be accomplished by means of a two-pole, 30-ampere, 480-volt breaker with a minimum symmetrical RMS interrupting capacity of 14,000 amperes, complete with NEMA 1 enclosure. The breaker shall be accessible through the tower handhole.

A complete service manual including instructions on installation, operation, and maintenance shall be furnished for each lowering device, winch assembly, and power drive system furnished on the project.

3. Shafts. Tower shafts shall consist of not more than four round or multisided tapered steel sections for shafts up to and including 100 feet in length, five sections between 101 and 120 feet, and six sections over 120 feet. Steel used in fabricating the shaft shall have a minimum yield strength of 55,000 psi after fabrication or meet the requirements of an approved alternate design. Shop drawing submissions of alternate proposed designs shall be accompanied by sufficient calculations to demonstrate to the satisfaction of the Engineer that the design proposed meets the minimum requirements of the AASHTO specifications cited.

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Sections shall either telescope with each other or be shop butt welded by electric arc welding. The lap joint produced by telescoping shall have a length not less than 1-1/2 diameters of the shaft at the joint, measured at the minimum diameter of the inner telescoping section. The sections shall be pre-fitted and match-marked at the factory. The inside surface of the shaft shall be relatively smooth to provide a cable raceway.

There shall be no more than two longitudinal welds in the tapered sections of the shaft which shall be made by automatic electric arc welding. Transverse butt welds may be used, but only under closely-controlled shop conditions. All shaft welds, except on longitudinal seams, shall have complete penetration, shall have uniform density, and shall be no thinner than the shaft material nor more than 20 percent thicker than the shaft material. Shaft welds on longitudinal seams shall have at least 60 percent penetration except in areas where the shaft section telescopes over another section. In the overlapping areas, the penetration shall be at least 95 percent complete.

The shaft shall be joined to the base plate using the American Welding Society prequalified joint TC-U4a-S or TC-U4c-GF. All handholes or openings in the shaft shall be properly reinforced to avoid stress risers, and be welded to the shaft using a joint and techniques designed to insure total penetration plus an outside fillet equal to the thickness of the shaft material. The handhole shall be gasketed to make it weatherproof. The door shall be fabricated from the same type steel as the shaft and attached with stainless steel hinges having nonremovable stainless steel hinge pins. The door shall include provisions for padlocking. A tapped hole shall be provided at the base of the tower for a 1/2x13 galvanized bolt and washer connection for the grounding cable to be carried through the electrical metallic tubing in the foundation to the ground rod. Grounding of the circuit breaker enclosure in the base of the tower shall be a jumper bonded to the incoming neutral conductor.

Shafts of material other than weathering or corrosion resistant alloy steels having four or more times the corrosion resistance of carbon structural steel shall be hot dipped galvanized after fabrication in accordance with the requirements of 711.02. Where A 588 steel is used, the exterior of the shaft shall be thoroughly shotblasted or otherwise cleaned to remove all oily or foreign matter to insure a uniform weathering pattern. The interior of the shaft shall be cleared of all mill scale and foreign matter by a pickling process or by being thoroughly shotblasted.

4. Luminaire Ring Assembly. The luminaire ring assembly shall be fabricated from steel which conforms to ASTM A 36 or material which has the same strength and weathering characteristics as the tower. The ring shall be fitted with the appropriate number of two inch nominal steel pipe mounting arms. The luminaire ring shall be prewired with copper conductor of adequate size and insulation to facilitate wiring the required number of luminaires. All power cables shall be attached to a weathertight junction box with weathertight cable connections. The main electrical supply cable and its connector shall support one and one-half times the full cable weight without cutting the conductors or insulation and without stretching the outer

jacket of the cable. If a "Kellams" grip is used, it shall be protected to prevent its rubbing against any object which is in relative motion to it during the lowering and raising of the luminaire ring assembly. The similar connection of the electrical cable to the cable termination within the tower shall meet the same requirements, but shall be capable of supporting the weight of the cable plus a wind load on the cable length due to 30 mile per hour winds. The junction box shall include a secondary line lightning arrestor and 600 volt terminal block, completely prewired. A weathertight twist lock power inlet shall be provided on the luminaire ring to allow testing of the luminaire ring while in the lowered position.

The luminaire ring shall be supported by three galvanized steel aircraft cables of seven strands, 19 wires each, with a minimum diameter of 3/16 inch. Each of the three cables shall be secured to the ring and to the cable terminating device within the tower by means of compatible corrosion resistant devices. The connection of the three cables to the terminator shall be by shop applied, swage-type fittings designed to develop a holding strength equal to the breaking strength of the cable.

Positive latching devices shall be incorporated into the ring assembly. These devices shall be designed to prevent any movement of the ring assembly when it is latched to the top of the pole and tension is removed from the ring support cables. All moving parts of the latching devices shall be a part of the luminaire ring assembly. Reflectors or flags shall be provided to indicate when the luminaire ring assembly is completely and securely latched to the head assembly. To prevent unnecessary stresses on luminaires and lamps, the latching sequence shall not exert a horizontal force sufficient to cause an excess of four g's acceleration upon the luminaires.

The ring assembly shall have nonabrasive rollers mounted on the ring interior or have a minimum of three roller-contact spring loaded centering arms to prevent the ring or luminaires from striking the pole shaft during raising and lowering of the ring. If centering arms are not used, the rollers shall be of sufficient quantity and at proper positions to prevent the pole from striking any part of the ring except the rollers. This cushioning mechanism shall be capable of reducing the shock experienced by the luminaire ring assembly when it strikes a rigid pole shaft at a speed of two feet per second, to a maximum deceleration of four g's.

5. Head Frame Assembly. The head frame assembly shall be fabricated from steel which conforms to the requirements of ASTM A 36, or steel which has the same strength and weathering characteristics as the tower. It shall consist of all necessary pulleys and rollers to guide the hoisting cables and electrical cable. The minimum tread diameter for the hoisting cable sheaves shall be 20 times the cable diameter for galvanized cable and 25 times the cable diameter for stainless steel cable. The hoisting cable sheave groove cross section shall be semicircular with a radius of one-half the cable diameter plus 1/64 inch. All hoisting cable sheaves shall be suspended on stainless steel shafts fitted with oil-impregnated bronze bushings.

The electrical cable shall not be bent at a radius less than five times the cable diameter, and the groove cross section shall prevent the cable from rolling out of the

groove if the cable is twisting. All electrical cable sheaves and rollers shall be suspended on stainless steel shafts fitted with self-lubricating bushings or be fabricated of self-lubricating material.

A guide shall be provided to separate the individual cables so that twisted or tangled cables cannot reach a pulley.

The headframe assembly shall be protected from the weather by a dome having the same weathering characteristics as the tower, by a fiberglass hood, or by a spun aluminum cover.

6. Winch Assembly. The winch drum shall have a diameter not less than four inches, and shall be supported by rigidly mounted bearings of the proper load capacity. The drum flanges shall have a diameter at least three inches greater than the drum. A set of guides or a cable follower shall be provided to prevent cable buildup at the ends of the winch drum. Keepers shall be provided to prevent cable from fouling after the tension has been relieved.

The winch shall be driven by a worm gear reducer equipped with a self-locking device. The gear reducer shall be permanently lubricated and shall be enclosed in a housing of cast aluminum, cast iron, or other approved material. The gear reducer shall have an ultimate output torque capacity five times greater than that required to lift the nominal load.

7. Winch Drive System. The winch assembly shall be externally powered by a heavy duty reversing drill motor, or NEMA frame motor, minimum 3/4 horsepower rating, 120 volt. A torque limiter of size and rating recommended by the manufacturer shall be incorporated into the system to prevent overloading the hoisting system. The system shall include a transformer to step down the existing system voltage to 120 volts. The hoisting rate shall be between 15 and 25 feet per minute. A remote hand control unit with not less than 20 feet of cord shall be provided to allow operation of the unit while positioned away from the pole.

8. Base Plates. The base plate shall be fabricated from steel which conforms to the requirements of ASTM A 36.

9. Anchor Bolts. Anchor bolts shall be steel with a 85,000 psi (minimum) yield strength and shall be galvanized in accordance with 711.02. Galvanizing shall extend at least two inches beyond the threads. In lieu of a bent end, a drilled and tapped steel plate of approved size and thickness may be used. Anchor bolt sizes, projections and length, and bolt circle diameters are optional, and plan data of this type shall not be considered as restrictive or exclusive. However, no additional compensation will be permitted for any increase of the plan foundation cross section required to accommodate the tower design proposed.

10. Fittings. 713.01, 2(g), except that galvanized steel fittings shall not be permitted.

11. Welding. 513.17. All welds in the shaft shall be tested by ultrasonic or approved alternate method, and certification of this requirement shall be furnished to the Laboratory. Acceptance level shall satisfy AWS Structural Welding Code Article 9.25.3 for tensile stress.

12. Luminaires. The luminaires shall consist of an optical assembly, lamp, ballast, and aluminum housing with side entry mounting for a two inch pipe, which shall provide adjustment for leveling. The mounting attachments shall prevent twisting of the luminaire about the bracket. The entire unit shall be of substantial design adequate to operate at 70 to 150 foot mounting heights when subjected to wind velocities of 90 miles per hour.

The lamp socket shall be a heavy duty mogul, multiple prewired, porcelain enclosed type, with integral lamp grip, and large center contact spring providing a firm contact with the lamp base. It shall be provided with a lamp support around the neck of the lamp and independent of the socket. The socket assembly shall be preset to provide the ANSI-IES distribution specified in the plans but shall have provisions for adjustment to provide vertical control of the angle of maximum candlepower. The actual projected area of the ballasted luminaire shall not exceed 3.5 square feet. The ballast shall comply with the applicable sections of 713.11 and be rated to the circuit voltage, type and size of lamp specified in the plans.

The maximum beam intensity for the Type V distribution shall not exceed 325 candlepower per 1,000 lamp lumens at angles between 55 degrees and 65 degrees from nadir (downward). The nadir initial intensity shall not exceed 100 candlepower per 1,000 lamp lumens. The Type V optical design shall be capable of producing a uniformity of illumination with a maximum to minimum ratio not greater than 6.0 to 1, and an average to minimum ratio not greater than 3.0 to 1, with luminaires mounted in a square array spaced at 4.0 times the mounting height.

The maximum beam intensity for the Type II and III asymmetric distributions shall not exceed 425 candlepower per 1,000 lamp lumens at angles between 66 degrees and 73 degrees from nadir. The nadir initial intensity shall not exceed 175 candlepower per 1000 lamp lumens. The system illumination results obtained from the asymmetric optical design shall be capable of producing a uniformity of illumination with a maximum to minimum ratio not greater than 6.0 to 1, and an average to minimum ratio not greater than 3.0 to 1, with luminaires spaced at 5.0 times the mounting height and located along one side of an area whose width is 1.5 times the mounting height.

The maximum beam intensity for the Type I asymmetric distribution shall not exceed 425 candlepower per 1,000 lamp lumens at angles between 66 degrees and 73 degrees from nadir. The nadir initial intensity shall not exceed 175 candlepower per 1,000 lamp lumens. The system illumination results obtained from the asymmetric optical design shall be capable of producing a uniformity of illumination with a maximum to minimum ratio not greater than 6.0 to 1, and an average to

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minimum ratio not greater than 3.0 to 1, with luminaires spaced at 5.0 times the mounting height and located along the center line of an area whose width is 0.75 times the mounting height on either side of the center line.

The output efficiency of all high mast luminaires shall be not less than 65 percent of the bare lamp lumens, with 25 to 35 percent of the bare lamp lumens contained in the 60 to 90-degree vertical zone.

The design of the high mast luminaires shall be such that the entire arc tube of the lamp shall be optically shielded at angles above 70 degrees from nadir.

# 715 WATER MAIN MATERIALS

**715.01 Materials-General**. The Contractor shall submit to the Engineer for approval two copies of detailed drawings and/or specifications for all materials proposed to be furnished prior to the ordering or manufacture of the materials. The drawings and/or specifications shall contain all pertinent design information required to determine compliance with the specifications given herein.

For prestressed concrete cylinder pipe, the specifications and drawings must include design data, laying schedule and details for restrained type joints.

The Engineer shall, at all times, have access to all places of manufacture where materials are being fabricated or tested, in accordance with 106.03, and shall be at liberty at all times to inspect all materials and observe all tests on the materials. Any materials which, in the opinion of the Engineer, are not in conformity with the specifications herein stated, or the drawings submitted to the Engineer as herein required, will be rejected.

Unless otherwise specified herein, materials shall be manufactured, tested and inspected by the manufacturer in the manner required by the latest revision of AWWA/ANSI specifications. Such tests shall be at the Contractor's expense. The Contractor shall furnish to the Engineer two certified copies of the results of all materials tests and inspections. Should the Engineer not be present for the tests, the Contractor shall furnish a sworn statement that the inspections and tests have been made in accordance with AWWA/ANSI standards. Materials will not be accepted until test results are approved by the Engineer.

All materials must be delivered in all respects sound and in conformance with these specifications. The inspection shall not relieve the Contractor of any of his obligations specified herein, and any material found to be defective which may have been approved by the Engineer at the foundry or elsewhere shall be at all times liable to rejection until installed, tested and accepted. Care shall be taken not to injure the coating or lining of pipe or other materials during handling and transportation of the materials.

All materials furnished by a Contractor or supplier shall be guaranteed against defects in materials and workmanship for a period of one year after these materials are put in operation. This written guarantee shall be given to the Engineer before installation of these materials.

**715.02 Ductile Iron Pipe**. All ductile iron pipe shall be centrifugally cast Class 53 with bell and spigot push-on joints, complete with gaskets, lubricants, and shall be cement lined. The pipe shall be manufactured in strict conformity with the latest revision of the American National Standard for Ductile Iron Pipe ANSI A21.51
(AWWA C 151). The pipe shall be lined in accordance with ANSI A 21.4 (AWWA C 104). When ductile iron pipe is used for sewer force main, the lining shall be ceramic epoxy, or other lining material as specified in the contract.

All pipe shall be thoroughly cleaned and subjected to a careful hammer inspection. No pipe shall be coated or lined unless entirely clean and free from rust immediately before being dipped or lined. Any pipe that is to be recoated shall first be thoroughly scraped and cleaned.

All pipe shall have an asphaltic-based seal coat applied to the exterior and interior surfaces. The seal coat material must be approved for potable water service.

All pipe shall be furnished in 18 or 20 foot laying lengths, plus or minus one inch. No cut off pipe will be accepted.

Each pipe shall be subjected to a hydrostatic test pressure in accordance with ANSI A 21.51 Section 51-10 (AWWA C 151).

Every pipe shall be marked in accordance with ANSI A 21.51 Section 51-11 (AWWA C 151).

Gaskets and lubricant for all joints furnished under these specifications shall be manufactured in accordance with ANSI A 21.11 (AWWA C 111).

No centrifugally cast pipe shall be accepted, the weight of which is less than the tabulated weight by more than five (5) percent for pipe 12 inches or smaller in diameter, and four (4) percent for pipe larger than 12 inches in diameter.

When restrained joint pipe is specified on the construction drawings, the restrained joint shall be completely boltless and shall be rated at a working pressure up to 350 psi. The joint shall be capable of being deflected 3 degrees after assembly, with uniform load distribution between the restraining components when the joint is deflected. The joint shall have a ductile iron lock ring welded to the plain end with a 360 degree continuous weld. All welds on field-cut pipe shall be made inside a shop by a certified welder. The joint shall be capable of being easily disassembled should the need rise. The joint shall meet all push-on joint requirements of the latest revision of ANSI A21.11 (AWWA C111).

**715.03 Special Castings**. Bell and spigot special castings, mechanical joint bell to shouldered Victaulic coupling adapters, and flange and bell pipe shall be manufactured in strict conformity with ANSI/AWWA C 110 or C 153. Pressure rating shall be 150 psi or 250 psi, as directed by the Engineer.

Special castings shall have mechanical joint ends. Valve adapters shall have mechanical joint and Victaulic ends. Mechanical joint bell to Victaulic adapters shall be one foot long.

Every special casting shall be marked in accordance with ANSI/AWWA C 110 or C 153. Compact fittings per AWWA C153 must be ductile iron.

All special castings shall be thoroughly cleaned and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust immediately before being dipped or sprayed.

Special castings shall be cement lined in accordance with ANSI A 21.4 (AWWA C 104), or epoxy-coated in accordance with ANSI A 21.16 (AWWA C 116) requirements.

Every casting shall have an asphaltic-based seal coat applied to the exterior and interior surfaces. The seal coat material must be approved for potable water service.

No special castings shall be accepted, the weight of which shall be less than the tabulated weight by more than ten percent for fittings 12 inches or less in diameter, or eight percent for larger sizes, and no excess above the standard weight of more than the above percentages for the several sizes will be paid for. These variations apply only to castings made from the standard patterns.

Mechanical joint bell to Victaulic adapters shall have should end and be fabricated to the dimensions shown on the plans, and have a pressure rating of 150 psi or 250 psi, as directed by the Engineer.

**715.04 Prestressed Concrete Cylinder Pipe**. Prestressed concrete cylinder pipe shall be manufactured in accordance with AWWA C 301. Special pipe sections (including but not limited to pipe with beveled ends, pipe with outlets for air release valves and access hatches, and pipe with special ends) and fittings (including but not limited to bends and tees), closure pieces, and adapters for connection to other types of pipe shall also be manufactured in accordance with the above specification.

The pipe sections and fittings shall be designed for and rated at a maximum working water pressure of 300 psi. Except for special pipe sections, the pipe shall be furnished in 20 foot lengths.

Outlets shall be provided in the pipe for items such as air release valves, blow offs, pitometer taps, and water service fittings. The locations of the outlets in the finished pipe line shall be as shown on the plans, or modified by the Engineer.

Outlets two inch and smaller in diameter shall be of brass with female threads, and shall have temporary plugs to protect the threads. Two inch and one inch size outlets for automatic air release systems shall have I.P.S. threads. One inch size outlets for manual air release systems shall have threads compatible with the corporation stop furnished with the air release assembly. All other outlets two inches and smaller shall be of the type shown on the plans.

All outlets larger than two inches shall be of the size and type shown on the plans. Access hatches shall be provided in the finished pipe line at the locations shown on the plans, or modified by the Engineer.

Pipe sections shall be provided with shouldered Victaulic or other types of ends as required for connection to butterfly valves or other types of pipe. Restrained type joints shall be provided for all special pipe sections where unbalanced pressures occur. The joints shall be a harness clamp or snap ring type, and shall be sealed with grout after installation. Bolted type joints will not be permitted. Bolts may be used for securing the harness clamp or snap ring, provided that such bolts are covered with grout. The joints shall be designed to resist the outward thrust caused by the design pressure specified above.

**715.05** Steel Water Pipe. Furnish and install steel pipe and accessories as indicated on the drawings and/or specified herein. Design pipe in accordance with AWWA M-11. Design all pipe, fittings, and specials to withstand the effects of a full vacuum of 34 feet of hydrostatic pressure.

Manufacture pipe in accordance with AWWA C-200 from steel plates spirally formed into cylinders with seams butt welded. Fabricate steel pipe, fittings, and specials to the dimensions, diameters, and shapes indicated on the drawings from steel sheets conforming to the latest revisions of ASTM A-53 Grade B, or ASTM A-139 Grade A, B, or C. Fabricate fittings in accordance with the latest revision of AWWA C-200, section 4, from pipe conforming to the standard.

Furnish pipe in 20 to 45 foot lengths in quantities as specifically requested. Stull all pipe with a diameter to thickness ratio of 100 or more during shipping and handling.

Test every pipe pursuant to the latest revision of AWWA C-200, section 3.4. Do not ship to the jobsite any pipe which has been used for testing purposes. Limit the maximum allowable deflection for all buried pipe to two (2) percent of the inside pipe diameter to prevent damage to the cement mortar lining.

The interior surfaces of all steel pipe shall be shop lined with a centrifugally-applied cement mortar coating a minimum of 5/16 inch thick for diameters up to and including 20 inches, 3/8 inch thick for 24 through 36 inch diameters, and 1/2 inch for diameters greater than 36 inch.

Apply exterior corrosion protection coating consisting of prefabricated cold-applied tapes placed by mechanical methods to all steel pipe, fittings, specials, and field joints. The primary reference standards for the exterior tape coating work of this contract shall be the latest revisions of AWWA C-214 for pipe and AWWA C-209 for fittings. Apply the tape coating system as a three-layer system consisting of a primer, an innerwrap tape for corrosion protection and a double layer or outerwrap tapes for mechanical protection.

Weld all joints in accordance with the latest revision of the AWWA Standard C-206, field welding of steel water pipe. All welds shall be butt or lap welds. Any repaired weld shall be inspected by the same means, and to the same standards, as the original weld.

In addition to the field hydrostatic testing of the entire pipeline, test each field buttwelded joint 100 percent by radiographic examination. Radiographic examination procedure and acceptability shall be in accordance of Sections 8 and G of A.P.I. Standard 1004.

Clean and mortar line all unlined ends adjacent to field welded joints, including the weld, after installation of pipe, fittings, and specials.

Handle the lined and tape-wrapped pipe at all times with wide belt slings and wide padded skids and other equipment designed to prevent damage to the wrapping and the lining. Install pipe, fittings, and specials in such a manner so as to prevent any damage to the coating. Prior to backfilling any section of the pipeline, final inspect all surfaces using an approved holiday detector. Note any defects and repair and retest the surfaces until satisfactory results are obtained.

Place granular backfill material in the trench bottom and compact to 90 percent relative density. Lay pipe on this compacted material to the required grade. Provide bell holes to permit coating the exterior pipe joints following joint welding. Support the pipe barrel uniformly for its full length.

Carefully place granular backfill material uniformly on both sides of the pipe to an elevation of four-tenths (0.4) of the outside diameter of the pipe, taking precautions not to disturb the pipe alignment. Give special attention to assure that the material flows under the pipe haunches and that vibrators are compacting this area of the backfill.

Furnish and install a cathodic protection system after the proper completion of the geotechnical survey, galvanic anode system, and follow-up baseline survey.

Bond all steep pipe and fitting joints, except dielectric insulated joints and welded joints, to make the entire pipeline electrically continuous.

Furnish and install dielectric unions at all locations where the steel transmission main connects to the existing water distribution system, whether the existing system is of prestressed concrete, cast iron, or ductile iron. Install electric isolation test stations at all dielectric insulator locations.

Install electrolysis test stations where shown on the contract drawings. Make all cathodic protection cable and wire connections by the thermite weld method. Use a bituminous coating compound for thermite welds.

**715.06 Gate valves.** Gate valves for diameters 4 inch through 16 inch shall be resilient seat wedge complying with the latest revision of ANSI/AWWA Standard C509, or C515.

Gate valves shall be cast or ductile iron body meeting AWWA C509 or ductile iron meeting AWWA C515, with inside-screw design and non-rising stem with thrust bearing washers. The stem shall be protected by a weathershield and an upper o-ring above the stem collar. Another o-ring shall be provided underneath the stem collar to seal the bearing surfaces from line content.

Gate valves shall be furnished with mechanical joint ends unless otherwise specified on the plans. If flanged-end valves are furnished, stainless steel type 304 bolts and nuts shall be used.

All bolts and nuts shall be zinc-plated steel or stainless steel with a minimum bolt size of 5/8 inch. If 5/8 inch bolts are not used, 1/2 inch diameter stainless steel type 304 bolts and nuts shall be used.

All gate valves will be installed in a vertical position without actuators and designed to operate equally well with pressure on either side of the gate. The valves shall be designed for 400 pounds per square inch test and 200 pounds per square inch working pressure with no leakage. Valves are to open by turning the red two inch square operating nut to the right (clockwise).

After inspection and testing, the valves shall be painted with two coats of paint meeting the requirements of ANSI/AWWA C509.

**715.07 Butterfly Valves**. Butterfly valves and operators shall be manufactured in conformity with AWWA C504 except as amended herein.

Butterfly valves shall have a pressure rating of 150 psi or 250 psi, as directed by the Engineer, with a cast or ductile iron short body, corrosion resistant ductile iron disc, rubber seal, stainless steel body seat ring, nylon bearings, and a replaceable rubber seat. Valve bodies shall be furnished with mechanical joint or shouldered ends compatible with the Victaulic coupling specified in 715.09. Flanged end or wafer style valves will not be permitted. Butterfly valves shall have an adjustable rubber seal mounted on the valve body.

Actuators shall be sized to minimize the number of turns required to operate the valve. Actuators shall withstand a minimum input torque of 400 foot-pounds.

Valves are to be used as control valves in the water distribution system. Valves shall be designed to work with the shaft in a horizontal position and shall have enclosed gears,

and shall be manually operated through a valve box by turning a two inch square operating nut with the stainless steel or brass retaining nut to the right or clockwise to open. The valves shall be designed for complete burial.

Valves shall receive the standard asphalt varnish finish in accordance with AWWA C504.

**715.08** Check Valves. Check valves shall be iron body, bronze mounted, horizontal swing, with the standard flange ends. The valves shall be suitable for buried service. Bolts and nuts attaching the access flange and all other flanges shall be of construction-grade stainless steel 316.

Check valves shall be factory hydrostatically tested at 300 psi. The valves shall be designed for a minimum working pressure of 125 psi.

**715.09** Couplings. Mechanical-compression sleeve type couplings shall be used for joining steel or ductile iron water mains. The couplings shall be constructed of epoxy-coated steel with a strength at least as great as that of the pipe being joined, and shall have high strength low alloy shopcoated steel bolts. The couplings shall be designed to compress rubber gasket rings against the abutting sections of pipe when the coupling bolts are tightened. The couplings shall provide sufficient flexibility so that the pipe may be installed on slight curves and grades without the use of special pipe sections, while remaining watertight.

Reducing couplings for connecting pipes of different outside diameters shall be of the same design specified above. Expansion couplings for absorbing thermal pipe movements shall be constructed of the same materials as the previously mentioned couplings, with alternate rubber sealing rings and alternate jute lubricating rings for packing material. Single-end expansion couplings shall provide up to ten inches of concentrated pipe movement. Double-end expansion joints shall permit up to eight inches movement if the body is anchored.

Style 44N Victaulic couplings shall be used for connecting butterfly valves with shouldered ends to cast or ductile iron bell to Victaulic adapters and Victaulic ends on concrete and steel pipe. Victaulic couplings shall be painted with at least one prime and one shop coat of paint, and shall be furnished with Type 304 stainless steel bolts. The style 44N Victaulic coupling is a single source item.

**715.10 Valve Boxes**. Valve boxes shall be constructed of cast iron, and shall be of the design and dimensions shown on the plans.

**715.11 Fire Hydrants**. Fire hydrants shall conform to the requirements of AWWA C502, except as hereinafter modified.

Fire hydrants shall be of the post type with compression type valves that close with the line pressure and shall be designed for a working pressure of 150 pounds per square inch in ordinary water works service. Wet barrel hydrants are not acceptable.

Fire hydrants shall meet the following specifications:

Bury length. The Bury length, the distance from the bottom of the inlet connection to the ground line, shall be five feet, six inches.

Type of shut off. Compression type closing with the line pressure and shall be of the center stem construction.

Inlet connection. The inlet shall be a six-inch or eight-inch bell end connection, as specified on the plans, suitable for a mechanical joint of Class 53 ductile iron spigot end pipe.

Hose nozzles and caps. Each hydrant shall have two 2-1/2 inch and one 4 inch bronze nozzle nipples threaded to conform with Akron, Ohio Fire Department Standard Hose Coupling as follows:

Data for nozzle threads:

Diameter of nozzle	4"	2-1/2"
Outside diam. of thread	4.875"	3.230"
Root diam.	4.627"	2.962"
Total length threaded	1-1/8"	15/16"
Flat top & valley of thread	.010"	.010"
Threads per inch	6	6

Outer end of thread left blank for 1/8 inch and terminated by "Higbee Cut" to avoid crossing and mutilation of otherwise finely drawn out thread.

4 inch nozzle form of thread:



Nipples shall be threaded directly into the hydrant barrel with left-hand thread or bayonet-style and secured. Bushings will not be permitted. Nozzle chains are not required.

Direction of opening. Hydrants shall open by turning to the left counter-clockwise). There shall be cast on the hydrant in characters raised 1/8 inch the type of hydrant,

an arrow at least 2-1/2 inches long, and the word "OPEN" in letters 1/2 inch high in relief, indicating direction to turn to open the hydrant.

Operating nut. The size and shape of the operating nut shall be a 1-1/2 inch pentagon measured from point to flat. The operating nut thrust collar shall bear against an anti-friction washer to ball bearing when the operating nut is turned in the opening direction.

Hydrant barrel. Hydrant barrels shall be in two sections. The union between the upper and lower barrels shall be made by means of a traffic safety device which will break cleanly upon traffic impact. The design shall be strong enough to withstand normal handling such as would be encountered in loading, unloading and installation. The design shall be such that the upper barrel can be rotated from 1 to 360 degrees without total disassembly of the device. Breaking devices relying on bolted flanges and weakened bolts for a safety device are not acceptable. Devices that are acceptable are a one- or two-part safety flange.

All lower barrel parts shall be made of cast iron Class "B" ASTM 126. If ductile iron is used, the wall thickness shall be a minimum of 0.40 inches and the shoe must be made of the same material. All flanges are to be integrally cast regardless of the type of material used. Threaded on flanges are not permitted. Bolts securing the lower barrel to the shoe shall be made of stainless steel.

The hydrant barrel shall be designed to permit the valve and operating mechanism to be removed without disturbing the barrel.

The hydrant shall be so constructed that if the barrel be broken, the valve will remain closed. Flange bolts shall have exposed nuts to facilitate their removal.

The ground line coupling or safety flange joint shall be two inches above grade line. The barrel shall be so designed as to permit the use of one or more standard flanged extensions, which shall be available from the hydrant manufacturer, in lengths of six inches to 60 inches in six inch increments.

Valve and drain stem. Valve and drain shall be operated by a single stem. An auxiliary stem or rod for operating the drain will not be permitted. The stem shall be designed to permit the use of standard stem extensions, which shall be available from the hydrant manufacturer in lengths of six inches to 60 inches in six inch increments. The hydrant stem shall be a two part stem jointed by a breakable stem coupling, with stainless steel pins or stainless steel bolts and nuts. The stem coupling shall be located at the same approximate elevation as the ground coupling. The valve assembly shall include no less than two positive acting drain valves.

Main valve and seat ring. All hydrants shall have a main valve opening of 5-1/4 or 6 inches in diameter, as specified on the plans. The valve gasket shall be of synthetic rubber at least one (1) inch thick.

The seat ring and main valve assembly shall be designed so that it can be removed from above ground through the upper barrel by means of a light weight seat removal wrench. The seat ring must thread directly into a bronze seat bushing. The seat ring, in conjunction with the bronze bushing, shall form an all bronze drain way. All bronze parts must contain less than 16 percent zinc. All pressure seals used between the seat ring and bronze bushing shall be rubber "0" rings.

If bolts and nuts are used to retain the drain ring and seat ring between the lower barrel and hydrant shoe, they must be made of stainless steel type 304.

Packing and stuffing box. 0-ring seals shall be used.

Gaskets. Flanged joints shall have approved rubber impregnated cloth gaskets or 'o' ring gaskets.

Materials. All hydrants shall be fully bronze mounted. All bolts and nuts shall be zinc plated, or stainless steel where specified.

Painting. All iron work shall be thoroughly cleaned and the valve rods, the inside of all iron parts, and the outside of the hydrant below the ground line shall be thoroughly painted with two coats of an approved paint complying with AWWA C550. The outside of the hydrants, including the bonnet and caps, above the ground line shall be painted with two coats of chrome yellow paint approved by the Engineer.

Testing. All hydrants shall be tested at a pressure of 300 pounds per square inch before leaving the factory as specified in AWWA C502. If required by the Engineer, the hydrants shall be subjected to a hammer test while under pressure.

Hydrants shall be fully opened and closed before shipping in order to test the freedom and strength of the parts. In order to test the strength of the operating mechanism, the operating stem nut shall be subjected to a minimum torque of 200 foot pounds in the manner specified in AWWA C 502.

Pressure loss and quantity of flow tests. Pressure loss and quantity of flow tests shall be conducted on the exact production line model of the hydrant to be furnished. The testing shall be done by a qualified reputable testing laboratory, or shall be done by the manufacturer and witnessed by an independent Professional Engineer knowledgeable in hydraulic testing. The Engineer may waive the requirement of the tests if such tests have been conducted within the last five years in the manner hereinafter specified, and the test results are available.

The testing procedure shall be in accordance with AWWA C 502 as modified to obtain the following results.

Pressure loss through a 5.25 inch main valve hydrant shall not exceed the following:

One 2 1/2" Nozzle (Both Nozzles) @ 250 GPM Flow	0.50 psi
Two 2 1/2" Nozzles @ 500 GPM Flow	1.00 psi
One 4" Pumper Nozzle @ 1,000 GPM Flow	2.90 psi
One 4" Pumper Nozzle @ 1,500 GPM Flow	5.50 psi
One 4" Pumper Nozzle @ 2,500 GPM Flow	20.00 psi

Pressure loss through a 6 inch main valve hydrant shall not exceed the following:

One 4" Pumper Nozzle @ 1,000 GPM Flow...... 2.00 psi

The results and the procedures of the testing shall be certified by the testing laboratory or independent Professional Engineer. The report of the results shall include, but shall not be limited to, the following:

1. Flow and pressure loss charts for the hydrant.

2.Name, model or catalog number and year of production of the hydrant being tested.

3.Schematic of testing arrangement with all pertinent dimensions such as the following:

- a. Interior diameter of inlet piping.
- b. Distance from meter flange to manometer inlet tube.
- c. Distance from the meter flange to the hydrant inlet.
- d. Distance from the nozzles to the manometer.
- e. Depth of hydrant bury.
- f. Interior diameter and length of discharge tube.

4. If used on these tests, recent accuracy tests or curves of meter used in measuring the flows.

5. Accuracy of all other measuring devices.

Additional testing. Teardown and traffic accident tests shall be conducted on the exact production model of the hydrant to be furnished, upon request by the City.

**715.12** Air Release Assemblies. Automatic air release assemblies shall consist of an automatic air release valve, a riser consisting of two brass nipples, and a brass gate valve. The brass nipples shall be used to connect the air release valve to the gate valve and the gate valve to the tap in the water main.

Automatic air release valves shall be composed of an air release valve and an air and vacuum valve in combination that will allow large volumes of air to escape out of the large air vacuum orifice when filling a pipeline and close watertight when the liquid enters the valve. During large orifice closure, the small air release orifice shall open to allow small pockets of air to escape automatically and independently of the large orifice. The large air vacuum orifice shall permit large volumes of air to

enter during pipeline drainage to relieve the vacuum. The combination air and vacuum valve shall be designed for a working pressure of 150 psi, and test pressure of 300 psi.

Gate valves shall be designed for a test pressure of 300 psi and a working pressure of 150 psi.

Air release valves, gate valves and brass nipples shall be I.P.S., threaded, and shall be of the sizes shown on the plans. Air release valve height shall not exceed 15 inches.

Manual Air Release Assemblies. Manual air release assemblies shall be constructed of the materials and in the configuration shown on the plans.

Corporation stops, curb stops, and elbows shall be brass with connections for copper pipe, and shall meet the requirements of 715.13. The elbow below the riser pipe shall be provided with a 1/8 inch hole for drainage. Brass fittings shall be painted with a coating of red lead as specified above.

Copper pipe shall be Type K and shall conform to AWWA C 800.

The copper riser pipe shall be provided with a galvanized iron cap with appropriate copper to iron connections.

The rod for operating the curb stop shall be constructed of the material and to the dimensions shown on the plans. The valve box shall be as specified in 715.10.

**715.13 Brass Service Fittings**. Brass fittings shall meet or exceed AWWA C800 and all other design requirements herein specified.

Corporation stops, one inch and under. All corporation stops shall be of the round way type for insertion into water mains under pressure. The inlet thread shall be AWWA and conform to Table 6 of AWWA C800. All threads shall be protected in shipment by a plastic coating or other equally satisfactory means. All corporation stops one inch and under shall be designed to rotate about the axis of the flow passageway inside a minimum of 2-7/8 inches circle of rotation. All corporation stops must be of the straight or tapered plug type using rubber "0" rings as pressure seals.

The plugs of corporation stops one inch and under shall be provided with integral cast tee heads 3/8 inch by 3/8 inch wide for shut off key. All corporation stops must operate (open and close) with a fifty foot pound maximum torque at  $40^{\circ}$ F under a head of sixty psi. The key and the body shall be tapered and shall be accurately fitted together by turning the key and reaming the body, and the seating surfaces shall be lapped together using abrasive suspension to insure accurate fit. The key shall be securely fastened in place with the 5/8 inch threaded brass nut and washer at

the bottom of the plug. The nut must be prestaked to distort the last thread and prevent accidental backing off of the nut.

The outlet connection shall be either a copper flare or compression type joint, as specified on the plans. The fitting thread for use with flared copper pipe shall be as specified in Table 3 of AWWA C 800. The coupling nut threads for the flared connections shall be as specified in Table 4. The length of the nut must be sufficient to support the pipe loading. Compression joints shall be as hereinafter specified.

Curb valves, 1, 1-1/2 and 2 inches. All curb valves are to be of the sealed ball type with a tee head to permit attachment of a slotted operating rod for on-off operation with a 90° turn of the rod. All valves when in the closed position must have zero leakage through the top, bottom, and ports at the maximum rated working pressure of 175 psi.

The body of the ball valves shall be of cast red brass containing 85% copper and 5% each of tin, lead, and zinc. The ball shall be of Teflon-coated brass, and shall be held in position by, and seal off against, seats of rubber that are held securely in place with epoxy adhesive. Valves shall be watertight against flow in either direction. The waterway shall be no smaller than the nominal size of the valve and shall be smooth with no abrupt changes in size to create resistance to flow. The stem that turns the ball shall exert no other force on it except to open or close the ball and shall be held securely in place by means of a bronze ring. The minimum diameter of the stem at the point of attachment to the valve body shall be as follows:

Valve Size	Minimum Dia.
1 inch	9/16 inch
1-1/2 inch	7/8 inch
2 inch	1 inch

The seal around the stem shall consist of two "0" rings. The stops or lugs for controlling the motion of the T-head shall be enclosed and properly positioned to line up the waterway through the ball with the water passage through the valve body.

Optional end connections shall be iron pipe threads, copper flare connections, or compression type connections for copper pipe.

All curb valves must be able to withstand minimum torque requirements of 125 ft. pounds input turning torque:

a) Against the check in the opening direction

b) Against the check in the closing direction

The inlet and outlet connections for curb valves shall be either copper flare or compression type joints as specified on the plans. The fitting thread for use with flared copper pipe shall be as specified in Table 3 of AWWA C 800. The coupling nut threads for the flared connection shall be as specified in Table 4. The length of

the nut must be sufficient to support the pipe loading. Compression joints shall be as hereinafter specified.

Service Fittings, 3/4, 1, 1-1/4 and 2 inch. All other service fittings shall fully comply with the latest AWWA Standards, and the following design requirements. The end connections shall be male iron pipe, female iron pipe, copper flare, or compression joints.

Compression joints. All compression joints must be of the conductive type. The compression nut must have a baked on coating to reduce friction and to prevent galling. All compression joints must be of the design so that the gasket cannot be over-compressed. The joint design must permit a stab connection not requiring total disassembly of the joint. All 1-1/2 inch and 2 inch compression joints must be able to withstand a pull out of 3,000 pounds tensile load. All compression joints shall be adaptable to other standard service fittings with a minimum number of adapting fittings.

**715.14 Steel Casing Pipe**. Casing pipe shall be welded steel meeting the requirements of ASTM A 139 having a nominal diameter and minimum wall thickness in accordance with the table below, unless otherwise specified by the plans. Minimum yield strength of the pipe wall material shall be 35,000 psi.

The inside diameter of the casing pipe shall be no less than six inches greater than the largest outside diameter of the carrier pipe bell. When carrier pipe is for water main, minimum casing pipe wall thickness shall be 3/8 inch.

Nominal Diameter	Nominal Thickness (inches)
(inches)	
12-3/4" and under	0.188" (3/16")
14"	0.250" (1/4")
16"	0.281" (9/32")
18"	0.312" (5/16")
20" and 22"	0.344" (11/32")
24"	0.375" (3/8")
26"	0.406" (13/32")
28"	0.438" (7/16")
30"	0.469" (15/32")
32"	0.500" (1/2")
34" and 36"	0.531" (17/32")
38"	0.562" (9/16")
40"	0.594" (19/32")
42"	0.625" (5/8")
44" and 46"	0.656" (21/32")
48"	0.688" (11/16")
50"	0.719" (23/32")
52"	0.750" (3/4")
54"	0.781" (25/32")
56" and 58"	0.812" (13/16")
60"	0.844" (27/32")
62"	0.875" (7/8")
64"	0.906" (29/32")
66" and 68"	0.938" (15/16")
70"	0.969" (31/32")
72"	1.000" (1")

**Steel Casing Pipe Diameter Vs. Minimum Thickness** 

If shown on the plans, casing pipe installed with cathodic protection may allow a minimum pipe wall thickness 0.063" (1/16") less than the thickness specified on the table, except for casing pipe diameters 12-3/4" and under.

The interior and exterior of the steel casing pipe shall be coated according to the specifications and application schedule of AWWA C210.

**715.15** Polyethylene Encasement. Polyethylene encasement shall be clear, high quality, virgin polyethylene, labeled and meeting the latest requirements of AWWA C105.

**715.16 Restrained Joints.** All valves, bends, offsets, hydrant inlets, caps, plugs, and branches of tees and wyes must be restrained using a restraining ductile iron follower gland. Follower glands employing wedgeless set screws for restraint will not be permitted. Where required, straight pipe shall be restrained using a rubber gasket employing stainless steel locking segments, molded into the gasket.

Where restrained joints are required for ductile iron pipe installed in a casing pipe, a boltless pipe locking system is required. The use of restraining gaskets with impregnated stainless steel locking segments shall not be permitted.

All restrained mechanical joints shall be made with construction-grade alloyed ductile iron, cor-ten, or passivated stainless steel 316 bolts, and 6-ounce zinc anode caps on every other T-head bolt.

**715.17 Wood Blocking**. Wood blocking for thrust blocks shall be white oak or other equivalent hardwood as defined by the National Hardwood Lumber Association, subject to the approval of the Engineer.

**715.18 Gasket Lubricant**. Gasket lubricant for concrete or ductile iron pipe joints shall be a material which is non-toxic, odorless, tasteless, and will not support bacteria.

**715.19** Sterilizing Powder. Sterilizing powder shall be a sodium hypochlorite powder containing 15% available chlorine by weight. An alternate type of sterilizing material meeting the requirements of AWWA C 651 may be used if so approved by the Engineer.

**715.20 Insulation**. Insulation for above ground water pipe shall be a rigid hydrous calcium silicate insulation, two inches thick and molded in half sections to fit the contour of the pipe. The insulation shall be held in place with a water tight aluminum jacket, with a moisture barrier between the jacket and the insulation to prevent galvanic or chemical corrosion of the jacketing surface.

The conductivity rating of the insulating material shall be a maximum of 42 at 200°F. The insulation material shall conform to Federal Government Specifications HH-I-523 (A Class 2), MIL-I-2781-D (or E), MIL-I-24244, and ASTM C 533.

The aluminum jacket and all aluminum straps and bands shall be T-3003 or T-5005 H14 alloy, 0.016 inch thick. The aluminum jackets shall be in sections a minimum length of 36 inches, and shall be held in place with a locking weatherproof continuous friction type longitudinal joint. Each circumferential joint shall be sealed with a preformed aluminum strap containing a permanently plastic weatherproof sealant. The strap shall be centered over the joint and sealed with aluminum banding. The jacket and banding system shall be constructed to allow for thermal movement of the jacket without the joints pulling apart.

The moisture barrier shall consist of one layer of one mil polyethylene film with a protective coat of #40 virgin kraft paper, or other material with similar moisture resistant properties. The moisture barrier material shall be continuously laminated to the aluminum jacket.

Factory cut mitered sections of insulation and jacketing shall be provided for all elbows or special pipe sections, and prefabricated sections shall also be provided for all valves and couplings.

Where specified on the plans or by the Engineer, insulation for buried water mains shall be free-flowing, load bearing calcium carbonate particles chemically treated to be moisture repellant and coated with adhesive. Water mains shall be insulated with a minimum of four inches of compacted carbonate particles and covered with polyethylene moisture barrier.

**715.21 Tapping Sleeves and Valves**. Tapping sleeves shall be made of cast ductile iron and shall be dual compression seal type. Tapping valves shall cast iron body, flanged by mechanical joint ends, right to open and shall otherwise comply with 715.06.

**715.22 Casing Spacers.** Casing spacers shall be two-piece bolt-on style with ribbed bolt flanges for centering the carrier pipe on all sides within the casing pipe. The casing spacer must be fabricated of minimum 14 gage 304 stainless steel and 5/16 inch 304 stainless steel bolts. The shell shall be lined with a ribbed PVC extrusion to prevent slippage. Runners shall be made from a low friction polymer attached to the stainless steel risers by threaded fasteners. The risers shall be mig welded to the shell and the welds passivated. All risers over two inches in height shall be reinforced. Casing spacers shall be installed on the carrier pipe at the manufacturer's spacing recommendations.

**715.23 Copper Tubing.** Extra soft type K copper service tubing for underground services shall conform to the latest revision of AWWA C800, Section A.2 and ASTM B-88 specifications. Tubing shall be clean, free of dirt, defects, and cuprous oxide when inspected by a microscope magnification of 75 diameters.

**715.24 Curb Boxes.** All curb boxes, lids, pentagon nuts, and rods shall conform to the dimensions and requirements shown on the drawings. Riser pipe shall be yoloy corrosion-resistant material. Each rod shall include a brass cotter pin for attachment to the curb box stop. All curb box tops shall have a brass ring insert to prevent galling of the plug to the box. Curb box rods shall be 3/4 inch square cold rolled steel.

**715.25 Tapping Saddles.** Service tapping saddles shall conform to the latest revision of AWWA C800, Section 4.3.

**715.26 Valve Stem Extensions.** Valve stem extension shall be heavy duty steel with a two-inch square operating nut. The extension shall attach to the valve operating nut and center the stem in the valve box.

**715.27** Anchoring Pipe. Anchoring pipe shall be ductile iron, furnished in sixinch increments with a fixed mechanical joint flange and rotating ring gland.

## 730 TRAFFIC SIGN AND SUPPORT MATERIALS

**730.01** Steel Tube and Pipe. ASTM A 53 Grade B or A 501 except that tubing for truss and end frame diagonals shall conform with 711.01.

**730.02** Steel Anchor Bolts. Anchor bolts shall be steel with an 85,000 psi (minimum) yield strength and shall be galvanized in accordance with 711.02. Galvanizing shall extend at least two inches beyond the threads. Ends shall be either bent or have a drilled and tapped steel plate as specified in the plans.

**730.03** Steel Poles and Arms. Poles and arms shall be steel with a 52,000 psi minimum yield strength and shall be galvanized in accordance with 711.02.

**730.04 Steel Anchor Bases**. Pole anchor bases shall be steel plate conforming to ASTM A 36 or ASTM A 572 Grade 42. The base plate shall be welded to the pole both inside and outside with fillet welds equal to the pole wall thickness, or by AWS prequalified welding joints TC U4a-S or TC U4a-GF. A cast steel base of equivalent strength may be used.

**730.05 Handhole Covers**. Handhole covers for poles and overhead sign supports shall be 0.109 inch (minimum) galvanized steel or 0.125 inch (nominal) aluminum alloy.

**730.06 Pole Caps**. Pole caps shall be aluminum or galvanized ferrous metal.

**730.07** Arm Caps. Arm caps shall be steel and cover at least 50 percent of the end area.

**730.08** Steel Hardware. Bolts 5/8 inch diameter or larger shall comply with ASTM A 325 and shall be protected against corrosion by mechanical galvanizing in accordance with ASTM B 454 Class 50. Bolts and screws less than 5/8 inch diameter shall comply with SAE J429 Grade 5, nuts of all sizes shall comply with SAE J995 Grade 2, flat washers shall comply with SAE J488, lockwashers shall comply with SAE J489, and the foregoing hardware shall be protected against corrosion by mechanical galvanizing in accordance with ASTM B 454 Class 25. U-bolts shall comply with SATM A 307 and shall be galvanized in accordance with 711.02.

**730.09** Stainless Steel. Any AISI 300 or 400 series stainless steel may be used.

**730.10** Stainless Steel Hardware. Bolts, screws, nuts, washers, handhole cover chains and U-bolts shall be passivated commercial grade. ASTM A 320 (AISI 300 series).

**730.11** Aluminum Sheet and Plate. Sheet for extrusheet panels shall be ASTM B 209, 3003-H18. Sheet for embossed copy shall be ASTM B 209, 3003-H14. Sheet

for flat sheet signs, overlay signs and flat copy, as well as plate for sign support structures, shall be ASTM B 209, 6061-T6.

**730.12** Aluminum Extrusions. Extrusions for extrusheet panels shall be ASTM B 221, 6063-T6. Extrusions for sign support structure in the form of tubes, channels, angles, zees, bars, rods, wire and other shapes shall be ASTM B 211, 6061-T6.

**730.13** Aluminum Tube and Pipe. Tubing shall be seamless drawn and shall be ASTM B 210, 6061-T6. Pipe shall be ASTM B 241, 6061-T6 or ASTM B 429, 6061-T6.

**730.14** Aluminum Castings. Sand castings shall be ASTM B 26, 356-T6 or T7. Permanent mold castings shall be ASTM B 108, 356-T6 or T7.

730.15 Aluminum Forgings. ASTM B 247, 6061-T6.

730.16 Aluminum Welding Rods. AWS ER4043.

730.17 Aluminum Hardware. Hardware shall conform to the following:

		ASTM	
	Designation	Alloy	Condition or
			Temper
Bolts, and screws	B 211	2024	T4
Studs-welded	B 211	1100	H16
Nuts-hex	B 211	6061	T6
		6262	T9
Nuts-lock	B 211	2017	T4
Washers-flat	B 209	Clad	T4
		2024	
Lockwashers	B 211	7075	T6
Rivets-solid	B 316	6053	T6
		6061	T6
Rivets-blind	B 316	2017	F
		2117	F
		5056	F

**730.18 Reflective Sheeting Type F**. Type F reflective sheeting shall comply with Section 633.06 Type II sheet reflective material of U.S. Department of Transportation "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects," FP-79.

**730.19 Reflective Sheeting Type G**. Type G reflective sheeting shall comply with Section 718 Type III sheet reflective material of U.S. Department of Transportation standard specifications FP-85.

**730.20** Nonreflective Sheeting. Nonreflective sheeting shall comply with Section 633.06 of U.S. Department of Transportation standard specification FP-79, with the exception that the sheeting shall not incorporate any optical elements.

**730.21 Reflector Units**. Reflector units shall consist of transparent units with a smooth front surface and a rear surface sculptured in such a way as to return light from a vehicle's head-lights to the driver's eye in conformance with optical performance specifications given herein. The front surface shall contain no projection or identification other than may be required for product identification. The rear surface shall be permanently sealed against dust, water or water vapor by a seal backing of similar material fused around the perimeter. Reflector units assembled with gaskets will not be acceptable.

Reflector units shall have retaining lugs which will deform within elastic limits for insertion into accurately sized holes in embossed sign copy. Retaining lugs shall be undercut, and the reflector unit size shall be such as to permit free movement in the mounting hole to allow for differences in expansion and contraction between the reflector unit and sign copy.

Reflector units shall be fabricated of colorless methyl methacrylate plastic conforming to Federal Specification L-P-380, Type I, Class 3. Reflector units may be of several sizes to fit differing sign copy.

Reflective intensity values for reflector units shall not be less than those shown in the following table. Reflective intensity values are expressed in candlepower returned at the chosen angle by a reflector per square inch of reflective surface for each footcandle of illumination at the reflector. For light incidence angles of zero and 20 degrees, the minimum intensity value is given for divergence angles of one-tenth, one-sixth and one-third of a degree.

Reflective Intensity Values						
Divergence angle		0.10°	0.17°	0.33°		
Incidence angle	$0^{\circ}$	14°	10°	7°		
-	20°	5.6°	4°	$2.8^{\circ}$		

When required by the Laboratory, not less than 50 reflector units, including at least ten of each size, shall be submitted by the manufacturer for qualification testing purposes. The manufacturer shall certify that units shipped to the project are of the same type and quality as the sample units tested and prequalified.

Reflective intensity test. Reflector units will be tested for intensity values shown on the foregoing table. Intensity value measurements at other than zero degree incidence angle will be made with reflector units in a spinning fixture so that intensity variations due to the pattern of the sculptured back surface are averaged. Failure of two or more of the 50 samples to meet minimum intensity values shall require a resampling of 100 reflector units. Failure of three or more of the 100 shall be cause for rejection of the reflector units.

Seal test. A sample of 50 reflector units will be submerged in water of room temperature and subjected for five minutes to a vacuum of five inches of mercury (gage). After restoring atmospheric pressure, the reflector units will be left submerged for an additional five minutes. When examined for water intake, failure of more than one unit shall be cause for rejection of the reflector units.

Heat resistance test. A sample of embossed aluminum sign copy containing reflector units will be placed in a horizontal position on a grid or perforated shelf of a circulating air oven so as to receive free circulation of air. The sample will be subjected to a temperature of 175°F plus or minus 5° for a period of four hours. At the conclusion of the test period the sample will be allowed to cool to room temperature and examined for any change in reflector unit shape or appearance when compared to unexposed reflector units. The reflector units will be removed from the copy and subjected to the seal test of the previous paragraph. Failure of more than one unit shall be cause for rejection of the reflector units.

**730.22** Silk Screen Paste. Silk screen paste shall be of high quality and shall consist of opaque viscous paint or transparent colored overlay fluid deposited by the screened area to form a film of the desired legend on the sign surface. When dry, the film shall be smooth, hard, tough, and free from defects such as wrinkling, sagging, checking or peeling. The ingredients of the paste shall be compatible with reflective sheeting so that when deposited on the sheeting there shall be proper adhesion with no deterioration. The paste shall not dry in the screen in less than two hours.

Opaque screen paste shall be formulated so that it will flow out of the screened area without running, sagging, or streaking to form a uniform opaque film on the sign surface which shall be entirely satisfactory as to thickness, shade and hiding power.

Colored transparent paste shall be formulated so that it may be applied by the reverse silk screen process to the surface of reflective sheeting. The transparent film shall present a true color, whether by viewing the sign in daylight or by headlight beams. The paste shall be compatible with any sheeting or clear coating used. Colored transparent silk screen paste shall conform to standard interstate color charts of the FHWA as specified for reflective sheeting in accordance with 730.18.

**730.24 Clear Coating**. Clear coating shall consist of a colorless transparent plastic fluid coating material for application to the surface of reflective sheeting by the use of roller, spray or by dipping. Clear coating material shall be compatible with and shall extend the useful life of reflective sheeting.

**730.25 Plywood**. Panels shall be exterior type, Group 1, 60/60 high density plywood with both sides overlaid with resin treated fiber surfacing material with a matte finish, in accordance with United States Product Standard PS-1. Panel surfaces shall be covered with easily removable protective materials.

**730.26** Messenger Wire. Messenger wire shall be Utilities Grade, twisted strand galvanized steel wire conforming to ASTM A 475 Class B and the following table, with the exception that tags according to section 16b shall not be required on lengths less than 1,000 feet. Strain insulators shall be the wet porcelain process type. All accessories shall have a rated loading strength equal to or greater than the messenger wire minimum breaking strength.

Nominal diameter, inches	Number of wires in strand	Minimum breaking strength, pounds
1/2	7	25,000
7/16	7	18,000
3/8	7	11,500
5/16	7	6,000
1/4	3	4,500
		4.750*

\*High strength instead of utilities grade

#### 731 SIGN LIGHTING MATERIAL

**731.01** Mercury Vapor Luminaire. Mercury vapor luminaires shall be complete lighting units consisting of a housing, door frame, refractor lens, reflector, socket and lamp. The luminaire shall have a weatherproof optical system.

The projected height of the luminaire including mounting device shall be not more than eleven inches high when positioned to provide optimum illumination of a sign face, 12-1/2 feet high.

The luminaire housing shall be cast aluminum of a natural finish or of gray baked acrylic enamel. The housing shall be adequately reinforced, and shall contain and support the reflector and lamp socket. A flexible permanent-set and heat-resistant waterproofed gasket shall be provided between the housing and door frame. The gasket shall be compressed to form a weatherproof seal when the door frame is closed. The gasket shall be suitably attached and shall be readily removable. Weepholes shall be provided in the luminaire housing or cover as required for drainage.

The door frame shall be either cast aluminum of the same finish as the housing, or an aluminum extrusion with an anodized finish. The door frame shall be hinged on one edge and fastened in place with spring loaded latches requiring no tools to open. Hinges, latches and other external hardware shall be stainless steel. When the door frame is opened, the hinge shall retain the door frame in a secure condition and shall not permit unintentional separation. The refractor or lens of the optical system shall be borosilicate glass or its equivalent, capable of withstanding thermal shock and the impact of freezing rain or hail. The waterproof seal between refractor or lens and the door frame shall consist of a heat-resistant gasket or elastic cement.

The reflector shall be fabricated from aluminum and shaped to distribute light uniformly over the sign face, in conjunction with the lens or refractor supplied with the luminaire. The surface of the reflector shall be finished to preserve the original reflective characteristics.

Mercury lamp sockets shall be a mogul screw shell with a large center contact spring providing firm contact with the lamp base. The socket shall be porcelain-shrouded and shall include lamp grips.

The manufacturer shall provide, in addition to catalog cuts submitted for determination of compliance, complete photometric data for each type luminaire as used with a 175 watt, H39KB-175 lamp. Photometric performance data shall be certified by the manufacturer or a qualified independent testing laboratory. Minimum data required shall include a tabulation of illumination values at the centers of one foot square areas over a vertically-oriented ten by ten foot square grid with the luminaire positioned four feet in front of the vertical centerline of the grid and one foot below the bottom edge of the grid. The data shall include:

- (a)the maximum value obtained,
- (b) the minimum value obtained;
- (c)the average of the 100 measured values;
- (d)the ratio of the maximum and minimum values obtained;
- (e)the maximum ratio of illumination values obtained in any two contiguous areas.

Illumination shall be measured using a cosine-corrected receptor in the plane of the grid with the receptor optical axis perpendicular to the plane of the grid. Spectral response of the measuring device shall conform to the CIE (Commission Internationale de l'Eclairage) standard "photopic" response. The luminaire shall meet the following illumination requirements when tested under the above conditions:

- (1) the maximum illumination on any one foot square area shall be 50 foot-candles.
- (2) the average of the individual measurements shall be at least 20 foot-candles.
- (3) the ratio of the maximum and minimum values obtained shall be no greater than 6.0.

(4) the maximum ratio of values obtained in any two contiguous areas shall be no greater than 2.0.

The Engineer may require a special test to confirm that a mercury-vapor luminaire meets the weatherproof requirements. A luminaire complete with mounting connections and electrical conduit connections will be mounted in a manner simulating actual service. A water spray, adjusted to be equivalent to a driving rain, will be applied to the top, sides and bottom for a period of one hour. Any entrance of water resulting in wetting of a normally live electrical component, or internal part of the optical assembly, shall be cause for rejection.

**731.02** Fluorescent Fixture. Fluorescent fixtures shall be complete lighting units consisting of a housing, plastic cover with frame, reflector, lamp sockets, and including a lamp. The fixture shall accommodate the specified lamp and shall have a completely weatherproof optical system.

Fixture design shall provide an integral wiring raceway permitting wiring from either end. When adjacent fixtures are wired together through the raceway, the wiring between fixtures shall be completely enclosed. The raceway shall be shaped to fit behind the reflector and shall be equivalent in area to at least a one inch conduit.

The fixture shall include end-mounting hubs designed to securely lock the fixture at any aiming position. Indicator graduations at increments not greater than ten degrees shall be integrally cast or stamped onto the hubs to facilitate the aiming adjustment.

The fixture housing shall be of materials which are corrosion resistant or with a high quality corrosion resistant finish. The housing shall be of sturdy construction and shall contain and support the reflector and lamp sockets. An attached flexible permanent-set resistant waterproof gasket shall be provided between the housing and cover frame. The gasket shall be compressed to form a weatherproof seal when the cover frame is closed and shall not be subject to any pulling away when the cover is opened.

The housing shall be painted in accordance with 514 with two prime coats and one finish coat which shall be baked-on enamel, matching the green sign sheeting.

The fixture cover shall be clear acrylic plastic and the cover frame shall be stainless steel or aluminum. The waterproof seal between the cover and the frame shall consist of a gasket or elastic cement. The cover frame shall be hinged on one edge and fastened in place with spring loaded latches requiring no tools to open. Hinges, latches and other external hardware shall be stainless steel. The cover frame shall not separate from the housing when opened. The reflector shall be fabricated from aluminum with a highly specular surface shaped to distribute light uniformly over the sign face. The surface of the reflector shall be finished to preserve the original reflective characteristics.

Lamp sockets shall be spring loaded, plunger type and the socket and lamp junction shall be protected against moisture by the use of flexible permanent-set resistant boots.

The fluorescent lamp shall be 48, 72, or 96 inches long; T-12 bulb size; cool white; high, super high, or very high output type (F48, 72 or 96 T-12 CW/HO, SHO or VHO).

The Engineer may require the waterproof test described in 731.01.

**731.03** Changeable-Message Sign, Lamp Type. (a) General. Changeable-message lamp type signs shall consist of units or groups of units containing arrangements of incandescent lamps so that by electrical circuitry, different messages may be displayed.

Alternate designs may be approved by the Engineer, providing the design is documented to the extent that plan requirements are shown to be met and equivalent legibility is achieved.

Housings, covers and hardware shall be of cast or sheet corrosion resistant materials fabricated by forming, welding, and riveting or bolting to provide adequate reinforcement. Synthetic elastomeric gaskets shall be used to provide a weatherproof unit. Louvers, vents or other cooling devices shall be used to maintain interior temperature within the capabilities of the components. Removable panels shall be used to physically separate wiring and lamps. Sign units shall be designed, and provided with hardware, for mounting within panel signs or to sign support structure.

Lamps shall be included and shall be the clear glass integral reflector type, of the base configuration, envelope diameter and wattage required. Lamps shall be readily accessible for replacement and shall be protected from extremes of weather conditions, shocks and vibrations of traffic, and from vandalism. Lamp sockets shall be UL approved and shall be of plated or unplated brass.

A dimmer shall be included to automatically reduce lamp output during low ambient light conditions. The dimming action shall be dual, multistage, or unlimited stage as specified.

(b) Limited message type. Changeable-message signs of this type shall contain lamps in an arrangement so that by the energizing of selected lamps two or more messages may be displayed.

Type A signs shall contain lamps on panels behind an opaque screen with holes coinciding with lamp positions. When specified, a sunscreen shall be provided to insure that no face detail is visible when lamps are not energized.

Type B signs shall contain lamps on a panel coinciding with clear or colored glass lenses mounted in an opaque cover. Lamp tunnels or shields shall insure that each lamp when energized shall illuminate only its coincident lens.

Type C signs shall contain lamps on panels with each lamp enclosed in a metal cylinder with a removable cover containing a protective glass lens.

(c) Unlimited message type. Changeable-message signs of this type shall consist of lamps arranged in full matrix or alphanumeric type modules positioned side-by-side to provide line units of the length required. Line units shall be capable of displaying messages containing letters and numerals, limited only by the number of characters which can be accommodated. Line units shall be capable of displaying alternate messages by flashing.

Lamp modules shall be attached by suitable fasteners to line units. Control logic units, load switches, monitor feedback circuits, power supply, etc., shall be integrated within the line limits, or mounted within separate weatherproof corrosion-resistant enclosures as required.

**731.04 Changeable-Message Sign, Drum Type**. Changeable- message signs of this type shall consist of a drum of the required number of faces and mechanically rotated.

Drums shall be supported by bearings or bushings in a housing structure designed for easy drum dismantling. Individual sign messages on drum faces shall be removable flat sheet overlays. The drum and its housing shall be fabricated of corrosion-resistant material.

The gap between drum edges and the housing opening at normal viewing positions shall not exceed 1/2 inch and shall be closed with a flexible reinforced elastic flap for prevention of the ingress of foreign material. Heating elements shall be provided to insure drum rotation during icing conditions.

Controls for drum face selection shall be mounted in a weatherproof compartment of the housing and shall include an electric motor, speed reducer gear box and driving mechanism. The design shall insure that the drum face selected is retained in the proper position. Drum rotational speed shall provide message changes in three to five seconds. Controls shall be provided for: (1) remote powered operation, (2) on-site powered operation from a roadside control, and (3) manual drum rotation.

**731.05** Internally Illuminated Sign. Internally illuminated signs shall be of the required legend and shall consist of an opaque housing with a face of translucent

plastic. When specified, signs shall be double faced. Signs shall be illuminated by interior lamps located so the sign face is uniformly lighted.

Signs shall be one of two types, either with legend on the exterior surface to maintain legibility when unlighted due to power failure, or with legend on the interior surface so as to be invisible when the sign is unlighted. Legend shall be black silk screening or by direct applied characters, and sign faces shall be white unless otherwise specified. Sign faces shall be designed for quick removal for maintenance and provided with a safety chain or like device. When specified, sign faces may be shielded by sunscreens, louvering or visors.

The housing shall be of corrosion-resistant material which shall be of cast, extruded or formed construction. Mounting hubs shall be provided and shall be similar to traffic signal design. The sign shall be weatherproof and shall include drainage weepholes.

The sign shall be furnished with appropriate hardware for mounting by span wire, mast arm, pedestal top, or pole type bracket arms. Lamps shall be included and shall be fluorescent type with ballast.

**731.06 Sign Flasher Assembly**. Sign flasher assemblies shall consist of a pair of flashing beacons for placement above and below a warning sign and shall include a fixture for lighting the sign, a flasher control unit with enclosure, and mounting hardware. Mounting hardware shall be compatible with the support design.

The beacons shall be of single traffic signal sections with eight or twelve inch yellow or red lenses. The sign lighting fixture shall be weatherproof and shielded to project its output downward on the sign. The flasher control unit shall flash the beacons alternately at a rate for each beacon of between 50 to 60 times per minute with the light period from one-half to two-thirds of the total cycle. EL71- Single Channel and EL72- Two Channel Electronic Time flasher control units shall include an interference filter. Control units shall be housed within a weatherproof corrosion-resistant enclosure with a lockable door. Incandescent lamps shall be included. The sign, support and foundation will be paid for separately.

**731.07** School Speed Limit Sign Assembly. School speed limit sign assemblies shall consist of a reflectorized sign with an internally illuminated speed limit display unit. The unit shall be designed so that no number is visible when the sign is unlighted. The sign shall be fitted with a pair of flashing beacons arranged above and below, backing structure members with hardware for attachment of the sign to support structure, and shall include a flasher control unit and a timer in an enclosure. The beacons may be external to the sign or visible through holes in the sign face.

The beacons shall be yellow and eight inches or greater in size. The speed limit display unit shall be weatherproof and shall have black numerals on a white background or translucent white numerals on a black background.

The flasher control unit shall flash the beacons alternately at a rate for each beacon of 50 to 60 times per minute with the light period from one-half to two-thirds of the total cycle. The timer shall permit automatic sign operation for selected times of the day and selected days in the week. The school speed limit sign assembly shall be provided with manual control of sign operation on site and from the school office. Flasher control unit, timer and switches shall be housed within a weatherproof corrosion-resistant enclosure with lockable door. Backing members with hardware shall be compatible with the method of support. Incandescent lamps shall be included.

**731.08** Flexible Conduit. Flexible conduit for wiring of lighted signs shall be galvanized steel flextube with a waterproof polyvinyl chloride (PVC) jacket.

# 732 TRAFFIC SIGNAL MATERIAL

**732.01 Vehicular Signal Heads, Conventional.** Ensure that vehicular traffic signal heads conform to the ITE "Vehicle Traffic Control Signal Heads" standard. In conformance with the above standard, provide signal heads that are of cast nonferrous corrosion resistant metal or polycarbonate, with LED plastic or glass lenses. When provided, plastic lenses are ultraviolet stabilized, weather and impact resistant, and heat resistant so that operation does not cause crazing, cracking, deformation, color change, or other changes in physical properties.

Traffic signals consist of specified assemblies of optical sections 12-inch (300 mm) diameter colored lenses, a housing, a door frame with stainless steel hinge pins and latching device, gasketing, visor, wiring, and LED Lenses. Twelve-inch (300 mm) lenses are the standard wide angle type.

Fit each optical section with tunnel type visors unless other type visors or louvering is specified. Ensure that the visors for 12-inch (300 mm) lenses are at least 9 1/2 inches (240 mm) long.

Ensure that optical sections are designed for assembly with all 8-inch (200 mm), all 12-inch (300 mm), or intermixed arrangements. Assemble using suitable hardware that forms weatherproof joints with no light leakage from one section to another. Ensure that the assembly arrangements contain the specified number of optical sections, lens size, lens color, and circular or arrow configuration. Assemble from one to a maximum of five sections as specified to form a signal face.

Furnish multi-way heads with appropriate top and bottom brackets with an opening in the center of the top bracket provided for mounting purposes. Correct signal face height inequalities for multi-way heads for proper accommodation between top and bottom brackets by the use of pipe spacers.

Furnish signal heads with required mounting hardware. Furnish signal face orientation to traffic by serrated rings or other devices on housing sections and mounting hardware. Permit adjustment in increments not greater than 5 degrees of rotation and not affected by wind gusts when locked. Furnish galvanized steel or

aluminum spacers and drop pipes 1 1/2 inches (38 mm) in diameter. Ensure that disconnect hangers have at least twelve terminals unless a greater number is required.

Paint signal external surfaces with yellow enamel paint, Color 13655, Federal Standard 595. Only paint interior surfaces of visors flat black.

**732.02** Vehicular Signal Heads, Optically Programmed, 12-inch (300 mm) Lens. Shall not be used in the City of Akron, Ohio.

**732.03** Vehicular Signal Heads, Optically Programmed, 8-inch (200 mm) Lens. Shall not be used in the City of Akron, Ohio.

732.04 Signal Lamps.

**A.** Pedestrian Signal Lamps. Ensure that pedestrian signal LED's conform to the *ITE A Standard for Traffic Signal Lamps* and Table 732.04-1.

	Lumens	Watts	Rated
Lens	min.	max.	Life,
Configuration	initial	input	hours
Pedestrian, type D-2	550	8.1/6.6	60000

**B.** Vehicular Signal Lamps. Prequalify all traffic vehicular signal lamps with the City of Akron Traffic Engineering Division. Ensure that vehicular signal LED's conform to the *ITE A Standard for Traffic Signal Lamps* and Table 732.04-2.

	Lumens,	Watts,	Rated
Lens	min.	max.	Life,
Configuration	initial	innut	hours
Comiguration	muai	mput	nours

Ensure that the LED is indelibly marked to show: original manufacturer's identification, rated voltage, rated lumens, rated average life, rated wattage, date of manufacture, and batch code.

**732.05** Pedestrian Signal Heads. Furnish pedestrian signal heads that conform to the *ITE Pedestrian Traffic Control Signal Indications*. Furnish signal heads that are complete units. Ensure that the signal heads alternately display the symbol of an upraised hand in portland orange and the symbol of a walking person in white light. Furnish material for housings that consist of cast or sheet, corrosion resistant, non-ferrous metal. Adequately reinforce the housings. Ensure that the lens frames are non-ferrous metal or polycarbonate material.

Ensure that the lenses are glass or ultraviolet and impact-resistant plastic and display the legend with translucent symbols within an opaque black background.

Seal the lens to the door frame by the use of a weatherproof seal. Furnish an elastomeric gasket between the door frame and housing to ensure a dust and weatherproof seal.

Use a signal head design that provides adequate dissipation of heat to ensure rated lamp life.

Fit each compartment of pedestrian signal heads with a visor that is at least 7 inches (175 mm) in length or, in lieu of visors, protect the entire face with a

sunshade fastened close to the lens. Furnish a black grid sunshade fabricated of high impact resistant plastic with a nominal depth of 1 1/2 inches (38 mm) and consisting of horizontal members spaced at not more than 1/2-inch (13 mm) and vertical members spaced appropriately.

Furnish pedestrian signal heads with required mounting brackets. Furnish either pipe type brackets or, when compatible with the mounting position required by the plans, two-piece hinged type brackets that support the signal head close to the pole.

Furnish 1 1/2-inch (38 mm) galvanized steel pipe brackets with necessary fittings and adapters, and that are one-way or two-way as required. Orient the signal face to crosswalks by selective meshing of serration rings or other devices provided on housings and mounting brackets. Make adjustment in increments not greater than 5 degrees of rotation and that is not affected by wind gusts when locked.

Furnish two-piece hinged brackets of cast aluminum with stainless steel hinge pins, and when closed shall be secured by a tamperproof bolt. Ensure that the mounting incorporates a terminal block for quick disconnect of field wiring. Ensure that the mounting design permits attachment to the pole by banding, bolting or by lag screws in the case of wood poles.

Paint signal exterior surfaces black with enamel paint. Only paint interior surfaces of visors flat black.

Furnish pedestrian signal head types according to Table 732.05-1.

Signal Head	Symbol Height,	
Туре	Inches, (mm)	Light Source
D2	9 (229)	LED

If specified, furnish the types listed below:

**Type D2.** Furnish a single housing signal head with an LED lens in one piece. Color and mask the lens to display in portland orange the symbol of an upraised hand and the overlayed symbol of a walking person in white.

**732.06** Pedestrian Pushbuttons. Furnish pushbuttons of sturdy construction that consist of a base housing and a removable cover. Furnish components that provide a pushbutton with normally open contacts and that include all electrical and mechanical parts required for operation. Ensure that the electrical circuitry is suitable for testing at 120 volts although a lower voltage is used when operating.

Ensure that the design of the pushbutton and its associated contacts and housing are sturdy and resistant to mechanical shocks and abuse. Ensure that a concentrated force of 50 pounds (225 N) applied to the button or any exposed portion does not damage the unit or misadjusts the contacts. Furnish a housing with a curved back surface for mounting on poles of various diameters. Integrate the curved surface with the housing or supply an adapter with a flat back type housing. Attach the cover assembly to the housing by stainless steel machine screws, resulting in a weatherproof and shockproof assembly. Furnish a hole threaded for a 1/2-inch (13 mm) pipe in the housing for conduit attachment purposes. Paint external surfaces yellow with enamel paint of Color 13655, Federal Standard 595.

Ensure that the maximum force required to operate the pushbutton is 5 pounds per foot (22.5 N). Furnish a raised or flush pushbutton with a minimum of 2 inches (50 mm) at its smallest dimension.

Furnish pedestrian pushbutton signs that are a minimum of 0.07-inch (1.8 mm) steel or 0.10-inch (2.5 mm) aluminum. Ensure that the legends and backgrounds are baked enamel paint for steel signs and enamel paint or non-reflective sheeting for aluminum signs.

# 732.07 Loop Detector Units.

**A. NEMA TS-1.** Ensure that the loop detector units comply with the requirements of NEMA TS-1, section 15, with the following modifications. Furnish shelf mounted loop detector units that are powered from 120 volts. Use solid state isolated output units for all controller applications where directly connected to a solid state digital controller unit. Ensure that the conductors in the cable harness for loop input pins are twisted three to five times per 1 foot (300 mm).

Ensure that the electrical connections for four-channel shelf-mounted units either are the 19-pin MS connector, as required by the foregoing specification, or consist of four connectors of the type required for single-channel shelf-mounted detector units.

If specified, design detector unit electrical connection plugs or wiring harness such that any multi-channel shelf-mounted detector unit may be readily replaced with single-channel detector units. Accomplish this by furnishing only units with the connector type required for single-channel shelf-mounted detector units, or by wiring the controller back panel to single-channel harnesses which are, in turn, plugconnected to an adapter harness which is mated to the multi-channel connector of the detector unit.

**B. NEMA TS-2.** Furnish loop detector units according to NEMA Standards TS-2.

**732.08 Loop Detector Units, Delay and Extension Type.** Ensure that the loop detector units of this type comply with the requirements of NEMA TS-1, section 15. Furnish shelf-mounted loop detector units that are powered from 120 volts. Use solid state isolated output units for all controller application where directly connected to a solid state digital controller unit. When specified, apply the provisions of 732.07 for possible replacement of multi-channel units with single channel units.

**732.09** Magnetometer Detector Units. Ensure that the detection system is capable of satisfactory operation when the probes are installed in locations in close proximity to steel structure such as on or within bridges. Ensure that each detector unit is suitable for connection with up to six sensor probes and with lead-in cable lengths up to 750 feet (230 m). Furnish magnetometer detector units that comply with applicable requirements of 732.07.

**732.10** Magnetometer Sensor Probes. Furnish magnetometer sensor probes that are fully compatible with the detector unit supplied. Furnish sensor probes that include attached leads of sufficient length for proper installation and ensure that the operation is satisfactory with up to six probes connected to a single lead. Furnish

probes that are moisture proof, corrosion resistant, and suitable for embedment within pavement holes with flexible sealant.

**732.11** Signal Supports. Furnish signal poles and mast arms that are continuously tapered circular tubes. Ensure that any measurements of circular tube diameter at a specific point along the longitudinal axis do not vary by more than 3/16-inch (5 mm). Ensure that the taper is between 0.54 and 1.3 percent (0.14"/ft).

Fabricate mast arms of the true continuous taper type in two portions joined by overlapping of sections with the overlap being at least 1 1/2 diameters as determined by the largest diameter of the outer portion. Assemble the sections with a 5/8-inch (16 mm) minimum stainless steel or galvanized steel hex head through-bolt.

Ensure that there is not more than one longitudinal, automatically electrically welded seam on circular poles. Ensure that the welded seams are neat and uniform in appearance and have a thickness not less than the base material and a bead height not exceeding 1/16-inch (2 mm). Ensure that the wall thickness at each pole or arm cross-section is of uniform thickness, except at weld beads. Do not place transverse seams or welds on true continuous taper type poles or arms, except on types consisting of straight sections. Weld according to 513.17.

	<b>Table 732.11-1</b>	
Pole Length (feet)	Arm Length (feet)	Number of Sections
Less than 15	Less than 10	1
15 to less than 30	10 to less than 20	2
30 to less than 40	20 to less than 30	3
40 or more	30 or more	4
	Table 732.11-1M	
Pole Length (meter)	Arm Length (meter)	Number of Sections
Less than 4.6	Less than 3	1
4.6 to less than 9	3 to less than 6.1	2
9 to less than 12	6.1 to less than 9.1	3
12 or more	9.1 or more	4

If using straight sections, relate the number of sections to pole or arm length according to Table 732.11-1. Do not use section lengths less than 20 percent or more than 50 percent of the respective pole or arm length.

After fabrication, hot-dip galvanize poles and arms according to 711.02.

Do not use guy rods or truss-type arms. Furnish poles and mast arms with attachment plates and gussets. Assemble using high-strength bolts with the connection developing the full moment-resisting capability of the arm. Do not allow the butt diameter of mast arms to exceed the nominal diameter of the pole at the point of attachment.

Fit poles with a welded-on cast or plate steel base designed to mount on an anchor bolt foundation and ensure that each pole includes the furnishing of anchor bolts and conduit ells for installation in the foundation. Furnish at least one 3-inch (75mm) and one 2-inch (50 mm) diameter conduit ell for installation in each foundation. Furnish conduit ells made from steel complying with 725.04; however, if they connect to non-metallic conduit, ensure that they are of the same non-metallic material. Use steel anchor bolts with a minimum yield strength of 85,000 pounds per square inch (586 MPa) and galvanized according to 711.02. Ensure that the galvanizing extends at least 2 inches (50 mm) beyond the threads. Ensure that ends either are bent or have a drilled and tapped steel plate as shown on the plans.

Ensure that the poles include a handhole near the base oriented as required. Reinforce the handhole with a welded-on steel frame with a grounding lug and fit it with a cover plate fastened by stainless steel screws. Ensure that the poles also include a cable and wire support J-hook welded near the top and a removable pole cap. Design poles and arms so their interiors conceal wiring and their mast arms include grommeted wire outlets for the signal heads. Furnish hanger clamps with clevises on the mast arms for the signal heads as required. Ensure that arm caps are made of steel and cover at least 50 percent of the end area.

Ensure that signal poles combining provisions for roadway lighting include an additional handhole located opposite the mast arm flange with the poles' J-hook located above.

Furnish pedestrian pushbutton access holes and blind half couplings for controllers and pedestrian signal heads as required. Plug any unused holes.

**732.12 Strain Poles.** Furnish signal strain poles for the attachment of span wire that are steel tapered tubes according to the requirements of 732.11. For embedded poles, do not use the portion below groundline in determining the taper. Ensure that all poles include a removable pole cap, and messenger wire clamps with clevis and shackle unless otherwise specified.

Furnish anchor bolt foundation type strain poles that include a welded-on cast or plate steel base, bolt covers, a handhole, and a J-hook, as required by 732.11, and that also include at least one 2-inch (50 mm) cable entrance with a weatherhead and a welded blind half-coupling. Ensure that the poles include the furnishing of anchor bolts and conduit ells for installation in the foundation. Furnish at least one 3-inch (75mm) and one 2-inch (50 mm) diameter conduit ell for installation in each foundation. Furnish steel conduit ells that comply with 725.04; however, if they connect to non-metallic conduit, ensure that they are of the same non-metallic material.

**732.13 Wood Poles.** Furnish wood poles that conform to ANSI 05.1 "Specifications and Dimensions for Wood Poles", that are made of Southern Pine or Western Red Cedar, and that are full-length pressure treated according to 713.19.

**732.14 Down Guy Assemblies.** Furnish down guy assemblies according to 713.19. Furnish insulators and hardware that conform to 732.18. Furnish expanding or screw type anchors capable of withstanding a guy tension of 8000 pounds (35 kN) when installed in firm moist soil.

**732.15 Pedestals.** Fabricate pedestals for the support of traffic control equipment of 4-inch (100 mm) schedule 40 steel or aluminum pipe. Fit the steel

pipe with a welded-on base of plate or cast steel, or when specified thread the steel pipe into a gray cast iron transformer type base. Furnish galvanized steel pedestals according to 711.02. Thread aluminum pipe into an aluminum cast transformer type base. Design pedestals to mount on an anchor bolt foundation and include the furnishing of anchor bolts and conduit ells for installation in the foundation.

**732.16 Conduit Risers.** Ensure that risers have conduit and fittings according to 713.04 and the weatherhead is made of aluminum or galvanized ferrous metal and threaded.

**732.17 Cable Support Assemblies.** Ensure that the cable grip used with cable support assemblies is of the proper size and strength for the cables and is of the flexible "closed" or "split with rod" type, of stainless steel or tin coated bronze, and equipped with a single "U" eye bale. Ensure that the smallest cable grip permitted has a minimum rated breaking strength of 250 pounds (1.1 kN).

Ensure that the slings for cable supports are made from copper clad or galvanized multi-strand steel wire with an overall diameter of not less than 1/8-inch (3 mm) and a breaking strength of at least 400 pounds (1.7 N). Use thimbles to form eyes at each end of the sling with grooves to match the wire. Adjust the sling to the proper length with the wire at each thimble lapped and secured with split bolt clamps.

**732.18 Messenger Wire.** Furnish Utilities Grade messenger wire, twisted strand galvanized steel wire conforming to ASTM A 475, Class B, with the exception that tags according to Section 19.2 are not required on lengths less than 1000 feet (300 m), and that 1/4-inch (6 mm) seven-strand be high-strength. Ensure that all accessories have a rated loading strength equal to or greater than the messenger wire minimum breaking strength. Furnish galvanized steel helical lashing rods in 5-foot (1.5 m) lengths.

**732.19 Cable and Wire.** Furnish cable and wire meeting the requirements of Table 732.19-1 and rated at 600 volts with conductors of copper unless otherwise specified. Ensure that the cable or wire jacket is indelibly marked at intervals of not more than 6 feet (2 m) with nomenclature stating the size, the type, the organization specifying the type, and the manufacturer's name or trademark.

**732.20 Power Service.** Furnish risers for power service that are 2-inch (50 mm) diameter conduit and fittings according to 713.04. Furnish weatherheads that are threaded and made of aluminum or galvanized ferrous metal or polyvinyl chloride.

	Notes											
	Conductor Type	Copper, color coded, stranded			Copper, color coded, stranded			Copper, color coded, solid			Copper, color coded, stranded	
2.19-1 CABLE AND WIRE	Specification or type	IMSA 19-1	IMSA 20-1	IPCEA S-61-402	IMSA 19-1	IMSA 20-1	IPCEA S-61-402	REA PE-39	IMSA 19-2	IMSA 20-2	IMSA 19-3	IMSA 20-3
TABLE 732	Wire Gage	As specified			As specified			As specified			As specified	
	Number of Conductors	As specified			As specified			Twisted pairs as specified			As specified	
	Cable or Wire	Signal cable			Interconnect cable						Interconnect cable, integral, messenger type	

Notes					Jacket: Black polyethylene Thickness 0.04 in (1.00 mm) (min.) Insulation: polyethylene	Jacket: High density polyethylene, Thickness 0.026 in (0.66 mm)(min.) Low conductor to conductor capacitance <sup>[2]</sup>
Conductor Type	Copper, color coded, solid			Copper, stranded	Copper, twisted pair, stranded, shielded	Copper, color coded, stranded
Specification or type	REA PE-38	IMSA 19-4	IMSA 20-4	IMSA 51-5		Heavy duty, direct burial type
Wire Gage	As specified			No. 14 AWG	No. 14 AWG	No. 18 AWG
Number of Conductors	Twisted pairs, as specified			Single conductor	Two conductor	Four conductor
Cable or Wire				Loop detector wire	Loop detector lead-in cable	Magnetometer lead-in cable

Cable or Wire	Number of Conductors	Wire Gage	Specification or type	Conductor Type	Notes
Power cable	Two conductor	As specified	UL: RHH/RHW/ USE XHHW or cross linked polyethylene w. an insulation thickness of 0.045 in (1.14 mm) (min.)	Aluminum, <sup>11)</sup> color coded, stranded	Three-conductor cable may be specified. Permitted substitution: 2 (or 3) single conductor cable.
Service cable	Two conductor (duplex)	As specified		Aluminum, <sup>[1]</sup> twisted, stranded	Three-conductor cable (triplex) may be specified. Aerial self-supporting aluminum conductor steel reinforced support wire as elec. Neutral
Ground wire	Single conductor		UL: RHH/RHW/ USE, XHHW cross linked Plyethylene	Copper, stranded	Minimum size is equal to the power or service cable, whichever is larger.
Loop detector lead-in cable, direct burial	As specified	No. 12 or 14 AWG, or as specified	IMSA 19-6 IMSA 20-6	Copper, stranded	
Copper conductors may be substituted. If used, wire gage may be one size smaller.
 18 picofarads per foot (59 pF/m), 15 picofarads per foot (49 pF/m).

# 733 TRAFFIC SIGNAL CONTROLLER MATERIAL

#### 733.01 References and Definitions.

**"NEMA TS-2," "Type TS-2/A2," and "Type TS-2/A1"** refers to equipment manufactured in conformance with the National Electrical Manufacturers Association (NEMA) Standards Publication No. TS-2.

**"NEMA TS-1" and "Type TS-1"** refers to equipment manufactured in conformance with the National Electrical Manufacturers Association (NEMA) Standards Publication No. TS-1.

**"Type 332" and "Type 336"** refers to equipment manufactured in conformance with the California Department of Transportation (CalTrans) specifications titled "Traffic Signal Control Equipment Specifications" and "Transportation Electrical Equipment Specifications", including all addenda.

**"Type 170E" and "Type 2070"** refers to equipment manufactured in conformance with the California Department of Transportation (CalTrans) specifications titled "Transportation Electrical Equipment Specifications", including all addenda. **"CalTrans QPL"** refers to the California Department of Transportation (CalTrans) "Qualified Product List" for traffic signal equipment.

#### 733.02 Controller Units.

**A.General Requirements.** Ensure that each controller unit contains internal time based coordination and, if used in a hardwired coordination system, provide an internal communication device or transceiver for connection to interconnect cables including multi-conductor 120 volt cables, twisted pair low voltage cables or fiber optic cables as shown on the plans.

If used in a closed loop system, ensure that the local intersection controller contains all of the software features necessary to operate with the system requirements given in 733.06 and 733.07. Furnish the necessary dial-up communications capability for isolated local intersections when part of the monitoring and control system described in 733.08.

When the signal timing and phasing configuration shown on the plans requires a pretimed operation, ensure that the controller unit meets all requirements of this section and can also be configured in a pre-timed, sequential phase, fixed interval mode.

Furnish controller memories that are nonvolatile and do not require batteries or other sources of energy to retain data while power is removed from the controller.

**B.Software.** Furnish a communication port for connection to a laptop computer for database upload/download. Furnish software for the personal computer to completely program all features of the controller unit. Unless otherwise shown on the plans, provide the controller unit with software that provides the following features even if not used by the signal phasing operation shown on the plans:

- 1. NEMA 8 phase, dual ring capability with four pedestrian movements, 4 overlaps, and the ability to program an exclusive pedestrian movement. Ensure that the controller is capable of being programmed for sequential phasing operation.
- 2. Volume density functions
- 3. Secondary coordination plans
- 4. Time of day/day of week scheduler
- 5. Time based coordination, minimum 3 dials, 3 offsets, 3 splits
- 6. Internal preemption for railroad and emergency vehicles
- 7. Operator selectable single or dual entry in dual ring use
- 8. Security access codes
- 9. Detector features including delay timing, carryover (extension) timing and detector switching
- 10. Simultaneous gap out feature
- 11. If operated in a system, communication capabilities to interface with hardwired masters or dial up modems
- 12. Data upload and download capability to a personal computer
- 13. Storage of detector counts utilizing phase detectors for a minimum 24 hour period in 15 minute increments
- 14. Detector failure monitoring and logging features for constant calls and absence of calls

Furnish controllers with 24-month warranties or for the manufacturers standard warranty, whichever is greater. Ensure that the warranty period begins on the date of shipment to the project. Ensure that each unit has a permanent label or stamp indicating the date of shipment.

**A.Type TS 2/A1.** Furnish a controller unit that meets NEMA TS-2 specifications and is shelf or rack mounted. Ensure that controller settings are programmable

through a keyboard on the front panel. Ensure that the front panel contains an 8-line by 40-character display.

**B.Type TS-2/A2.** Furnish a controller unit that meets NEMA TS-2 specifications and is suitable for shelf mounting. Furnish a controller unit that includes all ports and input/output connectors for complete interchangeability between NEMA TS-1 and TS-2 cabinets. Ensure that controller settings are programmable through a keyboard on the front panel. Ensure that the front panel contains an eight-line by 40-character display.

**C.Type 170E.** Furnish a controller units that meets the specifications for "Transportation Electrical Equipment Specifications", California Department of Transportation, including all addenda. Furnish a controller unit that is listed on the CalTrans QPL.

In addition to the above requirements, apply the following requirements:

- 1. Vertically mount all circuit boards. If ribbon cables are used, ensure that they terminate with properly rated and easily repairable connectors on each end. Ensure that ribbon cables do not terminate onto plug-in modules.
- 2. Furnish a power supply that is modular and easily removable from the chassis.
- 3. Furnish a unit that contains separate input and output modules.
- 4. Do not supply the controller unit with the M170E auxiliary board.
- 5. Furnish a controller unit that includes a Model 412C Program Module with the memory configuration for the software either shown on the plans or as provided by the maintaining agency.
- 6. As per CalTrans specifications, socket mount all memory, microprocessor and ACIA devices. Furnish sockets that have machined beryllium copper contacts with gold plating.

**D.Types 2070L, 2070LC, 2070LCN.** Furnish controller units that meet the specifications for "Transportation Electrical Equipment Specifications", California Department of Transportation, including all addenda. Furnish a controller unit that is listed on the CalTrans QPL.

Chapter 9, Section 1 of the CalTrans specification lists the following modules for the 2070 controller unit:

Unit Chassis	Item Description
Model 2070-1A	CPU module, two board
Model 2070-1B	CPU module, single board
Model 2070-2A	Field I/O for 170 cabinet
Model 2070-2B	Field I/O for ITS and TS-2 cabinet
Model 2070-3A	Front panel, Display A (4 lines of 40 char.)
Model 2070-3B	Front panel, Display B (8 lines of 40 char.)
Model 2070-3C	Front panel, Blank
Model 2070-4A	Power supply, 10 amp.
Model 2070-4B	Power supply, 3.5 amp.
Model 2070-5A	VME cage assembly
Model 2070-5B	MCB 1A mounting assembly
Model 2070-8	NEMA interface module
Model 2070-9	2070N backcover

The Type 2070L version controller unit consists of the following assembled modules:

Unit Chassis Model 2070-1A or Model 2070-1B Model 2070-2A Model 2070-3B Model 2070-4A or Model 2070-4B

The Type 2070LC version controller unit consists of the following assembled modules:

Unit Chassis Model 2070-1A or Model 2070-1B Model 2070-2B Model 2070-3B Model 2070-4A or Model 2070-4B

The Type 2070LCN version controller unit consists of the following assembled modules:

**Unit Chassis** Model 2070-1A or Model 2070-1B Model 2070-2B Model 2070-3B Model 2070-4A or Model 2070-4B Model 2070-8 Model 2070-9

Also, equip all versions of the Type 2070 controller unit with the following:

- 1. The appropriate communication port, cables, and connectors for communicating with a laptop computer.
- 2. Modems, ports, and cables for system communication, if the controller is to operate as part of an interconnected signal system or has a telephone drop shown on the plans.

**733.03** Cabinet. Ensure that all cabinets comply with the requirements of this Section unless otherwise stated in the specifications for the specific type of cabinet.

Unless otherwise required by the signal phasing shown on the plans, equip all NEMA specified cabinets as follows:

A.Supply two through four phase controller operation with a minimum eight position backpanel, configured for two pedestrian movements and two overlaps, with a NEMA TS-1 six channel conflict monitor or a NEMA TS-2 malfunction management unit.

B.Supply five through eight phase controller operation with a minimum 12 position backpanel, configured for four pedestrian movements and no overlaps, with a NEMA TS-1 12 channel conflict monitor or a NEMA TS-2 malfunction management unit.

C.If the signal phasing configuration shown on the plans requires a larger capacity backpanel or conflict monitor, supply the cabinet with the hardware required to perform the operational configuration.

D.When future phasing configurations are shown on the plans, provide the cabinet and hardware to accommodate the future operation through only the future addition of load switches and detector units.

E.Furnish each cabinet main door with a sturdy, permanently lubricated lock that is covered with a weatherproof tab. Key the project locks to the master key used by the agency that will maintain the equipment. Supply two keys with each lock. Also, equip the small door-in-door with a lock that is keyed to the maintaining agency's master key.

# A.Type TS-1.

**1.Cabinets.** Furnish a cabinet 58" high x 30" wide x 17" deep that provides ample space for housing the controller unit and all associated electrical devices furnished with it, together with any other auxiliary devices that are specified. Furnish a cabinet with sufficient shelf space to accommodate all existing, proposed, and designated future equipment. Ensure that the shelves do not restrict any ventilation necessary for the mounted equipment. Ensure that the space provided accommodates the appropriate controller unit frame as designated in NEMA TS-1, Section 14.

Construct the cabinets of cast aluminum or sheet aluminum, drawn or formed, with aluminum support and stiffening of members provided as necessary. Ensure that the exterior is smooth with no sharp edges. Weld all joints. Ensure that the cabinet is rigid and is designed to support all components. Ensure that the application of the following loads do not result in breakage, deformation, or loss of weatherproof qualities: a 100-pound (445 N) load applied to any 1-inch (25 mm) square surface of the cabinet or door (open or closed), in any direction; or a 300-pound (1.3 kN) load applied vertically downward to any 4-inch (100 mm) square of the top surface or to the top edge of the closed and latched door.

Unless otherwise shown on the plans, provide cabinet exterior surfaces of bare aluminum. When the plans specify a cabinet color, prime and finish all cabinet exteriors with two coats of high-grade enamel paint of the specified color. Ensure that the cabinet interior surfaces are the same as the exterior, or may be painted flat white.

Ensure that the cabinet contains at least one rain-tight louvered vent equipped with a replaceable filter. Install vents to allow for the release of excessive heat and any explosive gases that might enter the cabinet.

Ensure that the cabinets are functional in design and have a door in the front providing access to substantially the full interior area. Attach a gasket of elastomeric material to the cabinet or door to form a weatherproof seal. Furnish door hinge pins of stainless steel or equivalent corrosion resistant material. Furnish a door stop to retain the door in at least a 90 degree open position.

Include a small, hinged, and gasketed door-in-door (police door) on the outside of the main controller door. Ensure that the door-in-door does not allow entrance to the controller mechanism nor to exposed electrical terminals, but provides access to a small switch panel and compartment (police panel).

Fit the cabinet with the necessary provisions for mounting, with a bottom conduit connection provided for pole-mounted cabinets. Furnish suitable hardware and equipment for each cabinet mounting method, including bolts for drilled and tapped holes on metal supports, pole attachment clamps, pedestal slipfitter, and anchor bolts and conduit ells for installation in concrete foundations. Furnish steel anchor bolts that are galvanized at least 1 inch (25 mm) beyond the threads. Certified cabinet anchor bolts are not required.

**2.Accessory Equipment.** Directly place all equipment designed for shelf mounting on a shelf except for loop detector units (amplifiers) and similar devices designed for stacking on each other. Arrange components on shelves and devices on the door so that a 1-inch (25 mm) minimum space separates them when the door is shut. Ensure that plugs, wires, controls, or similar items do not compromise this space.

Reserve a minimum 4-inch (100 mm) clear area on the bottom of the cabinet for the routing of cables. Do not locate panel mounted equipment in the bottom 6 inches (150 mm) of the cabinet. Do not locate shelves or components within 6 inches (150 mm) of the bottom of foundation mounted cabinets.

Arrange all equipment for easy withdrawal and replacement, without the necessity of disturbing adjacent equipment. Permanently locate devices within the cabinet to allow free circulation of air and that do not restrict air flow from fan ducts or vents. Ensure that the auxiliary equipment operates within a weatherproof cabinet at ambient temperatures between -30 and 165 °F (-34 and 74 °C).

When terminals and panel mounted devices with exposed electrical contact points are located next to shelf mounted equipment, provide spacers, shelf lips, or other means to assure that component units cannot be accidentally moved into contact with any exposed electrical terminal points.

Ensure that load switches, relays, flashers, fuses, switches, terminal blocks, and other equipment mounted or plugged into the back or side panels are readily accessible. Ensure that switches, controls, and indicator lights are visible and easily operable without moving the components from their normal shelf positions.

**a.Ventilating Fan.** Equip all cabinets with a forced air ventilating fan. Furnish a fan that provides a capacity of at least 100 cubic feet  $(2.8 \text{ m}^3)$  per minute. Furnish a fan that is thermostatically controlled and adjusted to start at cabinet temperatures above 120 °F (49 °C) and to stop when the temperature has dropped below 100 °F (38 °C).

**b.Load Switches.** Furnish all cabinets with solid state, triple-signal load switches complying with NEMA TS-1, Section 5. Additionally, ensure that all load switches have both input and output indicators.

**c.Conflict Monitor.** Furnish all cabinets with a separate solid-state conflict monitor device. Ensure that the cabinet wiring, in the event of monitor disconnection, transfers the signals to a flashing condition. Furnish conflict monitors that comply with NEMA TS-1, Section 6. Additionally, ensure that all conflict monitors are capable of causing the signals to flash as a result of the following events:

- (1) All red lamps associated with a load switch are burned out;
- Within one second when red and green, or yellow and green color pairings are displayed on the same phase;
- (3) The absence of a minimum yellow interval.

Ensure that the monitor indicates the exact load switch output channel upon which the failure event occurred. Furnish conflict monitors that are capable of storing a minimum of nine fault events (event logging feature). Furnish a monitor that utilizes a LCD display and has a RS-232 port for connection to a laptop computer. Furnish software and connector cables to diagnose the conflict monitor.

**d.Flashers.** Furnish solid-state flashers that comply with NEMA TS-1, Section 8. When signals have a normal stop-and-go sequence that includes flashing, either ensure that the controller unit generates that flashing display or provide flashers. For this purpose, provide separate flashers from those provided for emergency back-up. Furnish flashers that are designed with two circuits of at least 10 amperes each.

Equip each controller cabinet with terminals that are wired so that, by an interchange of jumpers, the flashing operation is arranged to display either flashing yellow or flashing red on the vehicular signals.

**e. Relays.** Ensure that the relays required for proper operation of the specified equipment are furnished and completely wired. Furnish relays that are enclosed, readily replaceable, and designed for one-million operations without failure or need for adjustment.

**f.Lightning Protection Devices.** Furnish lightning protection on incoming power lines, interconnect lines, and detector leads.

Connect the AC power line to a surge protection device (SPD). The electrical position of the SPD shall be after the cabinet circuit breaker and the AC signal bus for the load switches and flashers, but before the traffic signal controller, monitor, coordinator and detector units. Furnish a SPD that has 5-terminals for the following connections: LINE-IN, LINE-OUT, NEUTRAL-IN, NEUTRAL-OUT, and GROUND. It may have a 6th terminal for MAIN LINE. Furnish a two stage metal oxide varistor (MOV) based SPD. Ensure that it does not contain gas tubes. Ensure that the first stage contains two MOVs, one connected between LINE-IN and GROUND and the second between the NEUTRAL-IN and GROUND. Ensure that the second stage is a filtering network with a MOV connected across LINE-OUT and NEUTRAL-OUT. The specified MOVs may be single devices or MOVs in parallel as needed to obtain the specified performance.

Mount the SPD inside the controller cabinet in a space of no more than 8 inches (200 mm) wide, 4 inches (100 mm) high, and 3 inches (75 mm) deep. Connect the IN and OUT terminals to the appropriate AC power lines and connect the GROUND terminal to the ground rod for the controller cabinet.

Furnish a SPD that meets the following performance requirements:

(1)Furnish a SPD that is capable of withstanding 20 repeated surges each of 20,000 amps with an 8 microsecond rise time to the peak current and a fall to onehalf of the peak current after 20 micro-seconds. Ensure that the surges are applied across the LINE-IN and GROUND terminals with the NEUTRAL-IN terminal externally connected to the GROUND terminal. During the application of the 20,000 amp surges, ensure that the voltage across the LINE-OUT and NEUTRAL-OUT terminals is no more than 260 volts after one nano-second.

(2)Ensure that the filtering capacity is such that there is no loss in a 60 hertz signal applied across the IN terminals and measured across the OUT terminals. Ensure that the measured losses for signals from 50 kilohertz to 5 Megahertz is at least 40 dbs.

(3)Ensure that the line switching mitigation capacity is such that during the application of an input spike voltage of  $\pm$ 700 volts by a Berkley Model 3020 spike generator connected to the LINE-IN and GROUND terminals with the NEUTRAL-IN externally connected to GROUND, the maximum excursion from the sine wave monitored across the OUT terminals is more than  $\pm$ 50 volts.

(4)Ensure that the current capacity is such that it can carry 10 amps at 120 VAC RMS continuously for one week without damage.

Furnish loop detector lead-in cable protection that consists of devices installed in each detector circuit where the lead-in connects to the terminal block. House each device in a case that consists of two stages; a 3-electrode gas tube arrestor and a semiconductor circuit. Ensure that the arrestor shunts to ground a common mode transient with a 1,000 ampere peak and an 8/20 microsecond wave-shape, ionizing at 400 volts within 100 nanoseconds when subjected to a 1,000 volt per microsecond transient. Furnish a semiconductor circuit that clamps a differential transient to 30 volts within 40 nanoseconds of the appearance of the transient, and a common mode transient to 30 volts within 500 nanoseconds of the ionization of the gas tube arrestor. Ensure that the second stage is able to withstand a peak current of 13 amperes. Furnish a device that has impedance characteristics compatible with the detector unit so as not to cause false calls or increase the loop impedance above the sensitivity of the detector unit.

Furnish pedestrian pushbutton inputs with the same protection as specified for the loop detector lead-in cables.

Protect interconnect cable against transients by devices across each conductor of the cable and ground. The devices may be either 2 or 3-terminal devices. If 3-terminal devices are used, connect two conductors and ground to the same device. Furnish a protection device that consists of a gas tube arrestor with a maximum ionization voltage of 1000 volts on a 10,000 volt per microsecond transient or a maximum ionization voltage of 950 volts on a 3000 volt per microsecond transient. Ensure that the maximum time from beginning of the transient to ionization is 1.1 microseconds on a 10,000 volt per microsecond transient. Ensure that the device is not ionized by normal voltage variations on a 120-volt AC line. Furnish a device that is able to withstand a 10,000 ampere peak with an 8/20 microsecond waveshape.

**g.** Main Power Breaker. Furnish an incoming AC+ power line that is controlled by a main circuit breaker rated at 240 volts and an auxiliary breaker, with capacity and wiring as specified in NEMA TS-1, Section 10.3.2.2 and Figure 10-4.

**h. Radio Interference Filter.** Furnish an incoming AC+ power line that contains a radio frequency interference (RFI) filter installed between the main circuit breaker and the solid state equipment. Also, provide RFI filtering for the load switches and flasher, unless the equipment furnished provides signal and flasher circuits switching at the zero voltage point of the power line sinusoid wave form.

**i.Convenience Outlet and Light.** Wire a convenience outlet into the cabinet for use by electrical maintenance equipment. Ensure that the outlet contains at least one standard duplex three-wire plug receptacle of the ground-fault circuit-interrupting type. Furnish and mount a standard incandescent lamp and socket in the upper portion of the cabinet. Furnish a door switch to control the convenience light.

**j.Manual Control and Pushbutton.** When required by the plans, provide intersection controller units with means for substituting manual operation of interval timing for automatic interval timing. Ensure that manual operation provides the same interval sequence as when the controller unit is operating automatically.

Obtain manual interval timing by a momentary pushbutton contact switch mounted on a 5-foot (1.5 m) minimum flexible weatherproof extension cord. Store that switch and cord behind the small door-in-door.

**k.Switches.** Furnish completely wired switches that are required for proper operation of specified equipment. Clearly and permanently label switches as to function and setting position, and ensure that they are accessible without the necessity of moving components.

(1)Signal Shutdown Switch. Furnish a cabinet with a signal shutdown switch for turning off the power to the signals at the intersection. Ensure that this switch only affects the power to the signals, and allows the controller to continue in operation. Locate the switch in the panel behind the small door-in-door (police door).

(2)Auto/Flash Switch. Furnish a cabinet with a flash control switch for activating the flashing of vehicular signals in a preselected emergency flash display. Ensure that the operation of the flash control switch causes a flashing display even under conditions of controller unit malfunction or of its removal from the cabinet. Ensure that the operation of the switch overrides any operation commands from a local or remote time switch. Locate the switch in the panel behind the small door-indoor (police door).

Program transfer to and from flashing operation, when called remotely or by a local time switch, to occur only at points in the cycle allowed by the OMUTCD.

(3)Automatic/Manual Transfer Switch. Furnish a cabinet with an automatic/manual transfer switch. In the automatic position, ensure that the controller unit automatically sequences the signal head displays. In the manual position, ensure that the signal phase or interval sequencing occurs only upon manual activation of the manual control pushbutton. Locate the switch in the door-in-door (police door). Ensure that it is unnecessary, when switching from manual to automatic operation, or vice versa, to do so at any certain time or to make any time adjustments.

(4)**Run/Stop-Time Switch.** Furnish a cabinet with a run/stop-time switch that activates the controller stop-time feature when in the "stop-time" position. Locate the run/stop-time switch on a switch panel in the cabinet.

(5)Controller Shutdown Switch. Furnish a cabinet with a controller shutdown switch that cuts off power to the controller unit, conflict monitor, and detector units. Ensure that power is not cut off to those components required to maintain flashing operation. Locate the controller shutdown switch on a switch panel in the cabinet.

(6)Coordinated/Free Switch. Furnish controllers operated in a coordinated system with a coordinated/free switch. Ensure that this switch allows the choice of operating the controller under the supervision of a coordination device or operating the controller independently of coordination control. Locate the coordinated/free switch on a switch panel in the cabinet.

(7)**Detector Test Switches.** Furnish momentary contact switches that will enter a vehicular or pedestrian call for any actuated phase. Furnish a switch for each actuated phase vehicular and pedestrian detection input. Conveniently group and label the switches.

**I. Terminal Blocks.** Furnish cabinets that include terminal blocks mounted on panels on the walls of the cabinet. Ensure that the blocks are not obstructed by shelf-mounted devices. Furnish sufficient terminal sets for each individual harness wire as well as for contacts of signal load switches, flasher transfer relays, flasher, and other components. Also, provide separate terminal sets for field wiring connections, including power, signal, interconnection, and detector lead-in cables. Group terminal sets to separate higher voltage (120 VAC) from lower voltage, and arrange them into logical groups. Protect terminal blocks from accidental contact during the installation and removal of shelf-mounted equipment. Locate the blocks no closer than 4 inches (100 mm) from the bottom of pole and pedestal mounted cabinets, and no closer than 6 inches (150 mm) from the bottom of foundation mounted cabinets.

Ensure that the terminal points are UL listed as suitable to carry the rated loading. Ensure that the capacity and size of the terminals are as specified in NEMA TS-1, Section 10.2.5. Ensure that the terminal points for signal field wiring for each circuit accommodates at least four No. 12 AWG conductors with spade type terminals.

Furnish terminal points for incoming power wiring that accepts either spade terminals or bare stranded wire and are suitable for either aluminum or copper conductors.

Widely space terminal sets for ease of wiring. Furnish at least six reserve terminal sets for controllers. Harnesses may terminate on the back of terminal blocks using through-panel terminals. Clearly mark terminal sets for ready identification including through-panel terminals that are identified on both sides. Ensure that the contact between adjacent terminal points are made by bus bar, or by wire jumpers having spade type terminals securely attached to each end.

**m.** Terminal Buses. Furnish a cabinet with supply terminal buses fed from the line side of the incoming 120 VAC power line, after the phase wire has passed through the main power switch. Ensure that the requirements for use of radio interference filters are according to Item 8 of this Section, with the buses supplying load switches and with flashers being filtered when required. Ensure that a signal bus relay controls power to the bus supplying power for the signal load switches.

Furnish a common terminal bus for the connection of the neutral wire of the incoming 120 VAC power line. Ensure that the common bus has sufficient terminal points to accommodate all potential cabinet wiring as well as field wiring. Use a separate common terminal, insulated from the panel, for the interconnect common.

Furnish bus terminal points that comply with Item 12 of this Section for conductor accommodation, attachment and identification.

**n. Grounding System/Bus Bars.** Furnish a cabinet that includes a grounding system as specified in NEMA TS-1, Section 10.3.2.1 with an adequate number (minimum of three) of ground terminal points. Bond the ground bus bar and the common terminal bus together with a No. 8 AWG or larger stranded copper wire.

**o.Wiring.** Neatly organize and route the harnesses and wiring bundles to individual terminals. Ensure that the harness provides a wire for each pin or contact of the device. Connect each wire to a marked terminal position. Use labeled spade type terminals or plug connections on all harness wiring. Group and lash or restrain wire bundles in such a manner that they will not interfere with the access to components, terminal blocks or buses, or the legibility of terminal identification. Ensure that the harnesses are of sufficient length to reach any point within the cabinet. Ensure that the cables and harness bundles are easily traced through the cabinet to their terminations.

Wire the cabinet so that controller pin connections associated with a given phase number matches the phase number assigned to the specified traffic movement as shown on the plans.

Furnish all wiring with stranded conductors. Ensure that the wiring is adequate for the voltage and load that represents the ultimate load of the devices connected. Ensure that the ampacity rating of the wires are as specified in NEMA TS-1, Section 10.3.3.1. Ensure that the wiring is color coded as follows:

- (1) Solid white, AC common.
- (2) Solid green or white with green stripes, safety (chassis) ground.
- (3) Solid black, AC line side power (AC+).

**p. Loop Detector Units.** Furnish loop detector units that comply with the requirements of NEMA TS-1, Section 15, with the following modifications:

- (1) Furnish loop detector units that are shelf mounted and powered from 120 volts.
- (2) Ensure that the unit uses solid-state isolated output devices.
- (3) Furnish conductors in the cable harness for loop input pins that are twisted three to five times per foot (300 mm).
- (4) Furnish detector unit electrical connection plugs or wiring harness that are designed such that any multi-channel shelf mounted detector unit is readily replaced with single channel detector units. Furnish only units with the connector type required for single channel shelf mounted detector units, or by wiring the controller back panel to single channel wiring harnesses which are, in turn, plug connected to an adapter harness that is mated to the multichannel connector of the detector unit.
- (5) When shown on the plans, supply delay and extension timing capability on the detector unit; otherwise, the controller unit software requirements of 733.02 will provide these features.
- (6) Ensure that the harness provides a wire for each pin or contact of the device.

If vehicle detector types other than "loop" detectors are required by the plans, provide these detectors by separate bid item.

# B. Type TS-2.

1.Furnish TS-2 cabinets that comply with the general requirements of 733.03. Furnish a prewired cabinet with malfunction management unit, loop detector units, and all accessory equipment as specified in NEMA TS-2, except as follows:

- a. Section 5-3-4, use detector racks for both Type 1 (A1) and Type 2 (A2) controller units.
- b. Section 5-4-2-7, provide an incandescent type light.

- c. Section 5-4-2-7-2, provide the incandescent lamp.
- d. Section 5-4-2-7-3, provide the door actuated light switch.
- e. Section 6-5-2-2-1, provide 2-channel detector units, without delay/extension features (Type A).
- f. Section 7-2, construct cabinets of cast or sheet aluminum.
- g. Section 7-3, provide a Size 5 cabinet for four phase or less pole mounted cabinets, Size 5 for four phase or less ground mounted cabinets, and Size 6 for 5 phase or more ground mounted cabinets. Supply larger cabinets if required to house the equipment to meet the plan requirements; such as master controllers, preemption devices, 16 position backpanels or special detection units.
- h. Section 7-5-7, ensure that the police panel contains switches for AUTO/FLASH, SIGNALS ON/OFF and AUTO/MANUAL in the police panel. Furnish a pushbutton with a 5-foot (1.5 m) cord.
- i. Section 7-7-3, supply unpainted cabinets.

2. Furnish loop detector and pedestrian inputs that have lightning/surge protection as specified in 733.03.A.2.f.

3.Include loop detector racks with the necessary number of two-channel loop detector units with the cabinet. When shown on the plans, supply delay and extension timing capability on the detector unit; otherwise, provide the controller unit software with these features. If vehicle detector types other than "loop" detectors are required by the plans, provide these detector units by separate bid item. If the special bid detector units use standard TS-2 detector racks, furnish the racks as part of the pre-wired cabinet.

4. Furnish switches to control the controller unit and cabinet functions as specified in 733.03.A.2.k.

5. Furnish load switches that have both input and output indicators.

# C.Type 332.

**1.General.** Furnish Model 332 cabinets that meet the specifications "Traffic Signal Control Equipment Specifications" and "Transportation Electrical Equipment Specifications", California Department of Transportation. Ensure that the manufacturer of the cabinets is listed on the CalTrans QPL at the time of the project award.

## 2. Cabinets.

- a. Ensure that the cabinets are constructed of aluminum and are supplied unpainted. An anodic coating is not required. Supply galvanized anchor bolts with nuts and washers with each cabinet. Furnish 3/4-inch (19 mm) diameter by 16 inches (0.4 m) minimum length anchor bolts with an "L" bend on the unthreaded end.
- b. Fit the cabinets with a PDA-2 power distribution assembly.
- c. When shown on the plans, provide the cabinet with door hinges that are "right" or "left" mounted when facing the front of the cabinet.

# **3.**Terminals and Wiring.

- a. "Hardwire" output files. Do not use printed circuit wiring in the output file except for the red monitor board.
- b. Ensure that the vehicle and pedestrian detector field wiring inputs connect to side mounted terminal blocks. Install terminal blocks and associated wiring to the input file. Label the field wiring terminals of the side mounted terminal block by a permanent screening process to identify the input panel (I or J), the input file slot number (1 through 14) and the channel terminal (D, E, J, or K). An example is "I4-E". Ensure that all terminals on these detector blocks are accessible without removing equipment from the EIA mounting rack.
- c. Install red monitor cabling in the cabinets. Install a program board to enable/disable red monitoring. Ship the cabinets with the red monitor jumpers set in the "enable" position.
- d. Do not connect the pedestrian yellow load switch outputs to the conflict monitor card-edge connector.
- e. Supply each cabinet with a cable approximately 5 feet (1.5 m) long to connect a laptop computer with the controller. Ensure that the cable has a DB-9 connector on one end, and a connector on the other end to mate with the C2 on the back of the controller. The cable will allow a laptop computer to upload/download data to the controller.
- f. On the output file, wire pin No. 11 of each switchpack connector to AC- so that the output indicators on dual indicator switchpacks will display properly.

# 4. Accessories.

a. Fully equip the cabinets with two channel loop detector sensors (model 222), flashers, flash transfer relays, power supply, AC and DC isolators, conflict monitor, switchpacks (with both input and output indicators), and a DC isolator in slot 14 for flash sense/stop time. Do not switch the input

file channels from the standard layout in order to minimize the number of two-channel detector units utilized. If vehicle detector types other than "loop" detectors are required by the plans, provide these detectors under a separate bid item.

- b. Furnish a rack mounted detector test panel with test switches for all vehicle and pedestrian phases. Furnish switches with three position "on/off/momentary on" switches.
- c. Furnish a police panel in each cabinet that includes a pushbutton with 5 feet (1.5 m) cord and three switches labeled AUTO/FLASH, SIGNALS ON/OFF and AUTO/MANUAL. Wire the pushbutton cord to the controller harness wiring by a molex plug connection and not through an AC isolator. When placed in the manual position, apply "manual control enable" to the controller and apply "recall" to all phases. Ensure that activation of the push button "advances" the controller, except prohibit the manual advancement during the minimum green, yellow, and red timing intervals.
- d. Furnish an aluminum shelf with integral storage compartment in the rack below the controller. Ensure that the storage compartment has telescoping drawer guides for full extension. Ensure that the compartment top has a non-slip plastic laminate attached.
- e. Ensure that each cabinet has two fluorescent lights installed at the top of the cabinet, one near each door. Wire the lights to the door switches such that opening either door will turn on both lights.

## 5. Lightning/Surge Protection.

- a. Furnish lightning protection on pedestrian and detector inputs. Furnish three terminal surrestors equivalent to EDCO models SRA-6LCA, SRA-6LCB, or SRA-6LC.
- b. Protect the cabinet's incoming power lines with an EDCO SHA1250 or approved equal surge protector in lieu of the CalTrans specified surge protection. Install the SHA1250 unit in an enclosure within the cabinet.

**6.Conflict Monitor.** Ensure that the conflict monitor unit was tested and accepted according to Supplement 1060.

**a. Materials and Warranties.** Ensure that the equipment and materials furnished are new, of first quality, of current design, and free of defects. Furnish electrical parts, switches, and other elements of the installation that are of ample capacity to carry the required current without excessive heating or drop of potential.

Use standard industrial quality components (integrated circuit chips, transistors, diodes, resistors, capacitors, etc.) wherever possible. Clearly identify these components with the original identification. Designate the other vital information such as voltage polarity, emitter or collector terminals, pin locations, etc., by an approved industrial procedure. Ensure that all components are available and in production by a reputable manufacturer.

Ensure that the major items or assemblies of equipment bear a nameplate, indelible marking, or brand that identifies it as to type, model, catalog number, and manufacturer.

Transfer that manufacturers' guarantees or warranties to the City of Akron upon delivery and acceptance of the equipment. Ensure that all conflict monitors are warranted for a period of 24 months or for the manufacturer's standard warranty period, whichever is greater, for parts and labor from date of shipment to the project or the City of Akron Traffic Engineering Division. Ensure that each unit has a permanent label or stamp indicating the date of shipment.

#### b. General Requirements.

(1)Minimum Standards. This specification establishes minimum standards for Conflict Monitoring Devices designed for use in Model 332 and 336 Traffic Signal Controller Cabinets supplied to the Department. Ensure that the specifications for connectors, components, mechanical workmanship, engineering, and environmental testing comply with CalTrans Specifications.

(2)Indicator Lights. Furnish indicator lights that are water-clear (not colored or diffused lenses), ultra- bright light emitting diodes (LED), whose states are clearly readable in direct sunlight. Ensure that each conflict monitor channel provides separate red, yellow, and green LEDs.

# (a)Furnish a GREEN AC POWER indicator light.

(b)Arrange indicator lights in a vertical pattern with FAULT status lights as the upper indications and the output channel lights as the lower indications [See 733.03.C.6.c.(1) and 733.03.C.6.c.(9)]. An acceptable alternative is to provide a single fault indication and a supplemental display that clearly indicates the fault type.

(c)Ensure that a failure causes its respective indicator light to display.

(3)Monitor Power. Ensure that the Monitor does not use the 24VDC power supply being sensed to run any of its internal circuitry. Ensure that the watchdog, stop time, external reset, and 24VDC monitor input circuits are optically isolated from the Monitor internal power supply and are conditioned to provide proper sense circuit operation throughout the operating range.

(4)Power Fail. Consider a line voltage less than 85 V ac  $\pm$  2 V ac as a power failure. Ensure that a power failure does not result in resetting the Monitor. Ensure that once the Monitor is triggered by detection of a fault that it remains in that state until a Reset Command is issued. Reset is issued only by the Front Panel Control Switch or by the External Test Reset input.

(5)Power Up. Furnish a Monitor that is compatible with the Model 170E controller as well as the Model 2070 controller unit that requires several seconds to power-up. When power is established, >  $103 \pm 2$  Vac, the 2010 will power up in the FAULT RELAY RECOVERY mode:

When power is established, initiate FAULT RELAY RECOVERY. For an interval of  $6.0 \pm 0.5$  seconds, the following will take place:

(a)The Output Relay contacts remain closed, and the Stop Time output remains active.

(b)All fault monitoring functions remain suspended.

(c)The AC POWER indicator light flashes at a 2 hertz rate.

At the end of this time interval, the Monitor begins counting Watchdog transitions from the controller and prepares to resume normal fault monitoring.

Ensure that the resumption of normal Fault monitoring occurs when either:

(a)The Monitor has counted 5 transitions between the True and False state from the controller Watchdog; or

(b)  $10 \pm 0.5$  seconds has elapsed from the time of LINE RECOVERY.

If the controller Watchdog output does not become active, ensure that the Monitor goes into a Latched Fault condition.

(6)Cabinet Signals Monitored. Furnish a Monitor designed to monitor Green, Yellow, and Red AC circuits at the field output terminals of traffic signal cabinets. In addition, monitor the cabinet 24VDC supply, and the Model 170E/2070 controller Watchdog Timer output. These signals are processed by the Monitor circuitry, and if a failure is determined to have occurred, ensure that a relay output contact closure (FAILED state) places the cabinet and intersection into flashing operation.

#### (7) Failed State Output Circuits.

(a)Use an electro-mechanical relay to provide the FAILED STATE output circuit. Ensure that the relay contacts are normally closed (FAILED STATE). In a NON-FAILED state (relay coil energized), ensure that the contacts are open. The

function of this output circuit is to initiate flash operation within the cabinet and transfer field circuits from the switch pack outputs to the flash bus during a FAILED STATE.

(b)Furnish relay contacts that are rated for a minimum of 3 amperes at 120 V ac and 100,000 operations. Ensure that the contact opening/closing time is 30 ms or less. Furnish contacts that present a minimum impedance of 50,000 ohms in the open state.

(c)Ensure that the Stop Time output is active whenever the output relay contacts are in the FAILED STATE (closed). Ensure that it is inactive whenever the output relay contacts are in the NON-FAILED (open) STATE.

(8)Monitor Unit Reset. Furnish a front panel momentary SPST pushbutton switch labeled "RESET" to reset the Monitor to a Non-FAILED state and restores normal monitoring operation. Position the switch on the front panel so that the switch can be operated while gripping the front panel handle.

Ensure that the External Test Reset input line resets the Monitor circuitry to a Non-FAILED state and restores normal monitoring operation. Optically isolate it from the internal circuitry. Ensure that a reset issuance by either source (Unit Reset) is triggered by only the leading edge of the input signal (this will prevent a constant reset due to either a switch failure or a constant external input). Ensure that a constant reset input is ignored within 5 seconds of issuance.

(9)Input Impedance. Ensure that the input impedance for all monitored AC inputs are 200 kilohms  $\pm 100$  kilohms.

(10) Connectors. Furnish PCB 28/56P Type Monitor and Conflict Program Card Connectors. Ensure that all edge connectors use the "bifurcated bellow" type contact or equivalent.

(11)Door Ajar Circuit. Connect pin 24 to pin 25 on the Monitor PCB at the edge connector and ensure that it is capable of carrying one ampere per CalTrans specifications.

(12)Handle. Ensure that the handle placement and design is such that no interference between the handle and a closed cabinet door exists.

(13) Fuse Holder. Furnish low profile fuse holders on the front panel.

## c.Functional Requirements.

(1)General. The Monitor monitors the cabinet for conflicts and unsafe operation. If an unsafe condition exists, the Monitor will enter into a FAILED state. This places the cabinet into flash operation and applies STOP TIME to the controller unit. Ensure that the Monitor is designed to monitor red circuits, yellow timing,

multiple outputs, and lack of outputs on a switch selectable, per channel basis. Specific conditions for failure follow:

(a)24VDC FAIL. The cabinet +24 volts DC does not meet the specified thresholds.

(b)CONFLICT. When the green or yellow input to one or more channels is ON and they are not programmed as permissive on the Conflict Program Card.

(c)WATCHDOG TIMER (WDT) ERROR. When the 170E/2070 controller unit watchdog output has ceased.

(d)CONFLICT PROGRAM CARD AJAR. Illuminates, if the Conflict Program Card is removed or if it is not properly seated in the connector. When it is not inserted into the monitor, ensure that the warning indicator light is displayed.

(e)MONITOR FAILURE. A fault is detected within the operation of the 2010 Monitor itself.

(f)MULTIPLE OUTPUTS. Simultaneous indications of Green, Yellow, or Red field outputs on a single channel.

(g)**RED FAIL.** No active field outputs on a single channel (green/yellow/red).

(h)YELLOW ERROR. The absence of a minimum yellow field output during a green to red sequence. Minimum yellow shall be 2.7 seconds  $\pm$  100 ms.

(2)Operating Range. Furnish a Monitor Unit that is fully operational using an 85 to 135 V ac power source. Ensure that the Monitor suspends Fault monitoring below 85 V ac  $\pm$  2 V ac, closes the output relay, and de-energizes the AC POWER indicator light.

(3)Watchdog Timing. Furnish WATCHDOG Timing Circuitry to monitor the controller unit WATCHDOG output. Ensure that the WDT Circuitry senses state changes and the time between the last change. Ensure that an absence of change for  $1.5 \pm 0.1$  seconds places the Monitor in a FAILED state.

(4)Channels Monitored. Furnish a Monitor that senses and responds to conflicts and 24 VDC failures whenever the AC line voltage is within the 85 to 135 V ac operating range of the Monitor, except during FAULT RELAY OPERATION.

(5) Yellow Inhibit. Furnish means to selectively inhibit the monitoring of a Yellow channel input.

(6)Power Fail after Fault. In the event that the Monitor senses a fault, followed by a loss of operating voltage, ensure that the initial Failure Status is retained in memory and is redisplayed after restoration of power.

(a)Once the Monitor is LATCHED in a fault condition for any reason, including the removal of the Conflict Program Card, ensure that it REMAINS LATCHED, even through a power fail/recovery, until a RESET is issued by the front panel reset switch, or by the external test reset line.

(b)Display the status of the Green, Yellow, and Red inputs of all channels, at the time the fault was latched. Ensure that a power loss does not affect the retention of this data. An acceptable alternative is to save status of all channels in memory and only display the latched fault.

(7)Insertion/Removal of Unit. Ensure that it is possible to insert and remove the Monitor while the cabinet is energized without placing the cabinet into Flash operation provided that: The cabinet door remains open and the reset switch is held depressed while the unit is being inserted or removed. Any momentary disruption of field signal indications is less than 500 ms.

(8)Microprocessor Use. If a microprocessor is used in the Monitor design, ensure that its program is written so that:

(a)Integrity tests are performed periodically on each memory cell of each memory device, relevant to each device type.

(b)Hardware external to the microprocessor circuits is employed to constantly sense proper microprocessor operation.

(c)The Monitor reverts to a FAILED state if a fault is detected with the microprocessor or during integrity tests.

(9)Front Panel Indicators. Ensure that the Monitor has red/yellow/green indicators for channel inputs and indicators to provide status and failure detection information. Furnish a GREEN AC POWER indicator. Ensure that all indicators are clearly readable in direct sunlight. Arrange and label the indicators as shown below:

(a)AC POWER. Illuminates when the incoming AC Line Voltage exceeds  $103 \pm 2V$  ac, and FLASHES during FAULT RELAY OPERATION.

(b)VDC FAIL. Illuminates when the Monitor has detected a 24VDC failure.

(c)CONFLICT. Illuminates when a conflicting signal condition is detected.

(d)WDT ERROR. Illuminates when a Watchdog error is detected. Do not provide a switch or similar device to disable WDT monitoring.

(e)PC AJAR. Illuminates when the Conflict Program Card is removed or is not properly seated in its connector.

(f)MON FAIL. Illuminates to indicate an internal Monitor failure.

(g)**RED FAIL.** Illuminates when the Monitor detects that there is no active output on any of the field outputs that comprise a monitored channel. Ensure that the failed channels are displayed on the corresponding channel indicators. If for any reason red fail is not enabled, ensure that the red fail indicator light flashes at approximately 2hertz.

(h)MULT IND. Illuminates when the Monitor detects simultaneous outputs on more than one of the field outputs that comprise a monitored channel (green/yellow/red). Ensure that the failed channels are displayed on the corresponding channel indicators.

(i) YELLOW. Illuminates when the Monitor detects the absence of a minimum period of active yellow field output during a green to red sequence. Ensure that the failed channel is displayed on the corresponding channel indicator.

(j)1, 2, 3, 48. Furnish channel indicators that illuminate a FAILED state in conformance with 733.03.C.6.c.(6).

(10) Monitor Board Edge Connector. Furnish monitor board edge connectors that conform to CalTrans specifications.

(11)Monitoring of Conflicting Voltages. Ensure that inputs to any channel that exceed the specified conflict threshold (see Section 6) are sensed as "ON" and illuminate their respective channel indicators. Ensure that the number of active channels in no way affects the conflict threshold.

Ensure that the following voltage levels and times apply: A conflict has occurred and will cause a FAILED state only when voltages appear at the field output terminals.

 $> 20 \pm 5.0$  V rms for a duration  $> 350 \pm 150$  ms.

(12)Conflict Program Card. Furnish conflict program cards that comply with CalTrans specifications.

#### d.Fault Relay Operation.

(1)Line Drop Out. Furnish a Monitor that determines that a LINE DROP OUT has occurred when:

The AC Line Voltage is:  $< 98 \pm 2$  VAC for  $> 400 \pm 100$  ms.

Within this time frame, ensure that the Monitor suspends all fault monitoring functions, closes the output relay contacts, enables Stop Time output, and the AC POWER indicator on the front panel flashes at a rate of 2 hertz  $\pm 20$  percent to indicate LINE DROP OUT status. Ensure that the Monitor remains in the FAULT RELAY mode until a LINE RECOVERY has occurred.

(2)Line Recovery. Ensure that the Monitor that determines that a LINE RECOVERY has occurred when:

The AC Line Voltage is:  $103 \pm 2$  VAC for >  $400 \pm 100$  ms.

(3)Fault Relay Recovery. When LINE RECOVERY is established, initiate the FAULT RELAY RECOVERY. For an interval of  $6.0 \pm 0.5$  seconds, the following will take place:

(a) The Output Relay contacts remain closed, and the Stop Time output remains active.

(b)All fault monitoring functions remain suspended.

(c) The AC POWER indicator light flashes at a rate of 2 hertz  $\pm$  20 percent.

At the end of this time interval the Monitor begins counting Watchdog transitions from the controller and prepares to resume normal fault monitoring.

(4)**Resumption of Normal Monitoring.** Ensure that the resumption of normal Fault Monitoring occurs when either:

(a) The Monitor has counted five transitions between the True and False state from the controller Watchdog; or

(b)  $10 \pm 0.5$  seconds has elapsed from the time of LINE RECOVERY.

If the controller Watchdog output does not become active, the Monitor shall go into a Latched Fault condition.

## e.Red Monitoring Connector.

(1)Connector. Mount a connector, 3M-3428-5302, with two 3518 polarizing keys, or equivalent, on the Monitor front panel. The pin assignments of the P20 connector and terminal assembly are defined in this specification.

Ensure that it is possible to plug and unplug the Red Monitoring Connector P20 without placing the cabinet into Flash operation.

I BO CONNECTOR R IN HESSIGNMENTS						
Pin	Function	Pin	Function			
1	CHANNEL 15 RED	2	CHANNEL 16 RED	_		
3	CHANNEL 14 RED	4	UNDEFINED			
5	CHANNEL 13 RED	6	SPECIAL FUNCTION 2			
7	CHANNEL 12 RED	8	SPECIAL FUNCTION 1			
9	CHANNEL 10 RED	10	CHANNEL 11 RED			
11	CHANNEL 9 RED	12	CHANNEL 8 RED			
13	CHANNEL 7 RED	14	CHANNEL 6 RED			
15	CHANNEL 5 RED	16	CHANNEL 4 RED			
17	CHANNEL 3 RED	18	CHANNEL 2 RED			
19	CHANNEL I RED	20	RED ENABLE			

**P20 Connector Pin Assignments** 

Ensure that keying is between pins 3/5, and 17/19. The odd numbered pins are on one side, and the even pins are on the other. Key the P20 connector and the CMU connector physically alike (to prevent the Red Monitoring cable from being inserted into the P20 180 degrees out of alignment).

(2) Red Enable Input. Ensure that pin 20 of the Red Monitoring Connector provides the Red Enable input to the Monitor. When the Red Monitoring Connector is disconnected, or Red Enable is not present, ensure that the Monitor checks for conflicting combinations of Greens and Yellows, Watchdog Timer, 24VDC, Conflict Program Card Ajar, and Monitor Fail. When enabled, ensure that the extended Monitor functions become active including: Red Fail, Multiple Output, and Yellow Fail.

## (3) Special Function 1 and 2 Inputs.

(a)PIN 8, Special Function 1: Furnish an AC input to the Monitor, which will DISABLE only the RED FAIL monitoring functions while it is active (e.g. during Railroad Preempt).

(b)PIN 6, Special Function 2: Reserved for future use.

Furnish a means to select either a PRESENCE of, or LACK of AC+ to enable these inputs.

# f.Electrical Requirements.

(1)Operation Range. Furnish a Monitor that is fully operational from an 85 to 135 V ac power source.

(2) Isolation. Isolate the Chassis Ground and AC ~ from one another.

(3)Monitored AC Inputs. The following voltage and time thresholds apply to all monitored AC inputs.

## (a) Green and Yellow Inputs.

Any inputs < 15.0 V rms are considered OFF. Any inputs > 25.0 V rms are considered ON.

Both sinusoidal and half-wave inputs of the specified RMS values are to meet these thresholds.

## (b)Red, Red Enable, and Special Function Inputs.

Any inputs < 50.0 V rms are considered OFF. Any inputs > 70.0 V rms are considered ON.

Red inputs, both sinusoidal, and half-wave, of the specified RMS values, are to meet these thresholds.

Red enable and special function inputs are to meet these thresholds for sinusoidal waveforms only.

# (c) Timing of Conflicting Inputs or Multiple Inputs.

Inputs ON < 200 ms are NOT considered a FAULT. Inputs ON > 500 ms are considered a FAULT.

# (d)Timing of Red Fail.

Lack of output < 1200 ms is NOT considered a FAULT. Lack of output > 1500 ms is considered a FAULT.

# (4)Monitored DC Inputs. (a)24VDC Input.

Input < 18.0 VDC is considered Low VDC input. Input > 22.0 VDC is NOT considered Low VDC input.

# (b)24VDC Timing.

Low VDC input < 200 ms is NOT considered a FAULT. Low VDC input > 500 ms is considered a FAULT.

# (c)Watchdog Monitor Input.

Input < 4.0 VDC is considered a LOW STATE. Input > 12.0 VDC (or OPEN) is considered a HIGH STATE.

#### (d)Watchdog Error Timing.

Lack of valid input state changes for < 1400 ms is **NOT** a FAULT.

Lack of valid input state changes for > 1600 ms is a FAULT.

#### g.Communications and Software.

(1)Install an RS232 port for laptop communications on the front panel of the Monitor.

(2)Furnish a Monitor with compatible communications software for installation on a laptop computer, capable of interfacing with the Monitor via the RS232 port on the front panel. Furnish the software on a 3 1/2-inch (85 mm) floppy disk with each Monitor. Label each disk with revision number and date.

(3)Furnish a Monitor that is capable of being programmed and set-up for intersection operation without the use of a laptop computer and communication software; consider programming the Monitor via the laptop computer a secondary method of set-up.

(4)Furnish a Monitor communications software that is capable of showing and/or programming the status of all programmable set-up parameters of the unit. Furnish a communications software that is capable of displaying the following data:

(a)Fault type
(b)Field status (must update status continuously)
(c)AC line voltage (must update status continuously)
(d)Status of Red Enable
(e)Previous fault data
(f)Program card matrix
(g)Yellow disable jumpers (if applicable)
(h)Switch settings per channel (as applicable)
(i)Option switches
(j)Current time
(k)Temperature (must update status continuously)
(l)Event logs

(5)Furnish a Monitor that is capable of storing events into memory. Typical events are fault events, AC line events, reset events, etc. When a fault event is stored into memory, the Monitor will store the fault condition (type), channel status, date, time, temperature, and line voltage. Ensure that the log history stores a minimum of 100 total events.

**h.Diode Matrix and Software.** Furnish a Monitor that loads the diode matrix programming into a non-volatile memory device. When the diode matrix is loaded into memory, the memory will regularly compare with diode card and fault condition will occur if memory does not match the diode card matrix.

D.Type 336.

**1.General.** Furnish Model 336 cabinets that meet the basic cabinet specifications "Traffic Signal Control Equipment Specifications", California Department of Transportation, latest edition. Ensure that the manufacturer of these Model 336 cabinets is listed on the CalTrans QPL for the Model 332 cabinets at the time of the project award.

## 2. Cabinets.

a.Furnish cabinets that are constructed of aluminum and is supplied unpainted. An anodic coating is not required.

b.The CalTrans Model 336 cabinet specification is only modified so that the cabinet supplied is the "stretch" type that provides approximately 10 inches of (250 mm) additional cabinet height.

c.Supply galvanized anchor bolts with nuts and washers with each base mounted cabinet. Furnish 3/4-inch (19 mm) diameter by 16 inches (0.4 m) minimum length anchor bolts with an "L" bend on the unthreaded end.

d.Furnish pole mounted cabinets with two pole mounting brackets attached and bottom plates installed. Ensure that both of the cabinet sidewalls are reinforced for pole brackets; however, also ensure that the cabinet is shipped with the brackets installed on the door hinge side of the cabinet. When a pole mounted cabinet is ordered, ensure that the door hinges are specified as "right" or "left" mounted as looking into the front of the cabinet. Ensure that the brackets are designed for banding to a pole.

e.Fit cabinets with a PDA-2 power distribution assembly.

**3. Terminals and Wiring.** Comply with the requirements of 733.03.C.3.

**4.** Accessories. Comply with the requirements of 733.03.C.4.

5.Lightning/Surge Protection. Comply with the requirements of 733.03.C.5.

**6.Conflict Monitor.** Comply with the requirements of 733.03.C.6.

**733.04** Cabinet Risers. Furnish the type (size and shape) of cabinet riser that is compatible with the type of controller cabinets specified for the project.

**A.Cabinet Riser for NEMA Cabinet.** Furnish an aluminum riser with will raise the NEMA cabinet approximately 12 inches (0.3 m) above the concrete foundation. Ensure that the bottom of the riser bolts to the standard cabinet foundation anchor bolts (not included with the riser) and the top of the riser bolts to the bottom of the cabinet. Furnish attachment hardware for connecting the riser to the cabinet.

Construct the riser in a minimum of two pieces such that an existing cabinet can be raised off the foundation without disconnecting the field wiring and the riser can

be inserted below the cabinet. Furnish hardware for rigidly connecting the riser sections together.

Fabricate the riser from 0.125-inch (3 mm) sheet aluminum with flanges on the top and bottom to provide rigidity. Furnish mounting flanges as necessary to connect with the controller cabinet and foundation anchor bolts. Ensure that the outside surface of the riser has a smooth, uniform, natural finish unless controller cabinet painting is shown on the plans. If painting is required, prepare and paint the riser to match the cabinet.

**B.Cabinet Riser for Type 332 or Type 336 Cabinet.** Furnish an aluminum riser that will raise the Model 332 or 336 cabinet approximately 8 inches (0.2 m) above the concrete foundation. Ensure that the bottom of the riser bolts to the standard cabinet foundation anchor bolts (not included with the riser) and the top of the riser bolts to the bottom of the cabinet. Furnish attachment hardware for connecting the riser to the cabinet. Manufacture the unit to CalTrans specifications. Ensure that the outside surface of the riser has a smooth, uniform, natural finish unless controller cabinet painting is shown on the plans. If painting is required, prepare and paint the riser to match the cabinet.

**733.05** Flasher Controller. Furnish solid-state flasher that complies with NEMA TS-1, Section 8, and have two circuits, each rated at 10 amperes. Furnish a cabinet that conforms to applicable requirements of 733.03.A, except that the following items are not required: a small door-in-door (police door), shelves, and a fan. Ensure that the cabinet size is not less than 12 inches (300 mm) high by 10 inches (250 mm) wide by 6 inches (150 mm) deep. Furnish cabinets that are designed for pole mounting with a 1-1/2 inch (38 mm) or larger conduit opening in the bottom. Ensure that the auxiliary equipment includes: on-off power switch with integral 20-ampere circuit breaker, lightning protection devices on incoming power lines, interference filters, terminal blocks, and a ground bus bar.

## 733.06 Controller, Master, Traffic Responsive.

**A.Description.** The traffic responsive master controller is one component of a distributive processing, traffic responsive, control, and monitoring "closed loop" system. The master controller's principal operational task is to select and implement traffic signal timing plans in response to both actual traffic conditions or time based events. The master controller monitors, in real time, local intersection activity, and overall system performance, reporting failures and status conditions to the Remote Monitoring Station.

The master controller is typically located in a local intersection cabinet; however, in special circumstances it may be located at a Remote Monitoring Station site. The master controller is capable of uploading/downloading information to local intersection controllers and the Remote Monitoring Station.

## **B.Functional Requirements.**

**1.Design.** Furnish a solid state, digital microprocessor master controller design. Furnish a controller that uses menu driven prompts, unless of Type 170 design. If the master controller is used with Type 170E or Type 2070 controllers, provide software unless otherwise shown on the plans.

Furnish a master controller that has a RS-232 port for connection to a laptop computer or printer. Furnish software and connector cables for communication with a laptop.

**2.Local Controllers.** Ensure that each master controller is able to supervise and communicate with at least 24 local intersection controllers.

**3.System Detectors**. Ensure that each master controller is able to analyze traffic sensor data from at least 32 system detectors. Distribute system detectors up to eight per intersection, but do not exceed the total system sensor capacity.

Ensure that the detectors are assignable to each of the computational channels in each group, with the channels representing cycle selection, directionality (offset), non-arterial flow (split), and special congestion indicators of queue or occupancy.

Furnish a master controller that is capable of monitoring and detecting system detector failure and removing failed detectors from volume and occupancy calculations. Upon resumption of satisfactory sensor operation, sensors shall automatically resume input to volume and occupancy calculations.

**4.Timing Patterns.** Ensure that each master controller provides a minimum of 16 selectable patterns. Ensure that each pattern shall consist of a combination of cycle, offset, and split numbers for each intersection in the system.

Furnish a master controller that is capable of implementing a "free" mode whereby all intersection controllers will operate without system coordination and a "flash" mode whereby all intersection controllers will operate in a flashing operation.

**5.Operational Modes.** Ensure that each master controller is able to operate in the following modes of operational control:

a. Traffic responsive mode whereby pattern selection is based on dynamic traffic conditions as measured by system sensors located in the control area. As a minimum, base the pattern selection on the quantitative traffic flow parameters of volume, occupancy, and directionality of the arterial traffic.

Base transfer of patterns on programmable threshold values. Furnish system sensors that are capable of selective weighting.

b. Time of day/day of week (time base) mode whereby pattern selection is based on a preprogrammed event scheduler with automatic adjustments for seasonal daylight savings time changes. Ensure that this mode of operation is able to call or override traffic responsive mode. c.Manual override mode whereby pattern selection is made by operator control at the Remote Monitoring Station or master controller site.

Ensure that the system coordination control for each master controller is selected on a priority basis. The priority from highest to lowest is as follows:

a. Manual control entry or remote command

b. Time base control

c. Traffic responsive control

**6. Reports.** Ensure that each master controller monitors and formats intersection and system information for immediate output to the Remote Monitoring Station or for storage for a minimum period of 48 hours. As a minimum, ensure that the following types of reports are generated:

a.A local intersection activity log showing the time, date and activity of all monitored local intersection failure conditions.

b.A system sensor failure log that includes time, sensor location, and type of failure.

c.A system log with pattern changes.

d.A system sensor data log that includes volume and occupancy for all system sensors.

**7.Alarms.** Ensure that each master controller continuously monitors intersection and system information for various systems and user defined critical conditions. Upon detection of an alarm condition, ensure that the master controller attempts to transmit alarm information to the Remote Monitoring Station or a preprogrammed telephone number. In case of failure to connect to the central software, the master will continue to periodically retry reporting to the Remote Monitoring Station.

**8.Communications.** Furnish a master controller that supports two-way dial-up communications to a Remote Monitoring Station computer for control, monitoring, data collection, and for timing pattern updating purposes. Through continuous, 7 days/week, 24 hours/day system monitoring, ensure that the master controller is able to automatically dial-up the Remote Monitoring Station computer upon detection of user defined critical alarm conditions.

Furnish a master controller that includes any communication devices or modems necessary to interface with the local intersection controllers within its control area.

**9.Security.** Furnish a master controller that provides for a user specified security code before any data is altered. In order to view any parameter, ensure that a security code entry is not required. Furnish a master controller that has the ability to disable security code requirements, allowing for perpetual access without requiring hardware changes.

## 733.07 Remote Monitoring Station.

**A.Description.** The Remote Monitoring Station describes a distributive processing, traffic responsive, control and monitoring "closed loop" system. The system monitors, in real time, local intersection activities, and overall system performance, reporting failures and status conditions both automatically and by operator request. In order to meet current and future traffic control needs, the system also provides extensive control monitoring, data collection, reporting, and analysis functions.

For complete user flexibility, the system provides full access of each local system intersection controller from the Remote Monitoring Station site. Full access includes the capability to upload all time settings, operation parameters, and status information, as well as the capability to download all time settings and operation parameters.

B.System Architecture. The system consists of four principal elements:

1.Local intersection controller (see 733.02)

2.Communication links

3.Traffic responsive master controller (see 733.06)

4.A Remote Monitoring Station consisting of computer equipment and software

**C.Local Intersection Controllers.** Furnish controller units conforming to 733.02 for the type of controller shown on the plans. Furnish a controller that has internal communication capability compatible with the type of interconnect cable shown on the plans. Furnish a local system controller that is capable of processing controller and detector data and provide all necessary intersection control functions.

**D.Communications.** Ensure that communication between the Remote Monitoring Station and the master controller is through an auto-answer/auto-dial external modem on standard dial-up telephone service. Furnish telephone service at the Remote Monitoring Station site by the maintaining agency, unless otherwise shown on the plans. Furnish telephone service at the master controller or the isolated local intersection location by separate bid item as specified for "Telephone Service".

Include error checking in the software to assure transmission and reception of valid data between the local controller, master controller, and the Remote Monitoring Station.

**E.Equipment.** Ensure that the Equipment provided at each Remote Monitoring Station location is as shown on the plans and, as a minimum, consists of the following items:

1.Microcomputer with monitor

2.Software

3.Modem

4.Printer

5.Accessory Items

**F.System Functional Requirements.** The system software provides a simplified user friendly, color menu format at the Remote Monitoring Station. Ensure that no special computer programming skills are required for the user to fully access and operate this control and monitoring system.

**1.Graphical Representation.** Furnish system software that enables the operator to display in color, the vehicular signals, pedestrian signals, and detector actuations in a real time mode. Ensure that the user is able to construct an intersection layout graphically by using predetermined intersection shapes.

**2.System Capacity.** Furnish a Remote Monitoring Station software that has the capacity to monitor and control at least 24 traffic responsive masters. Ensure that the central software is also capable of monitoring and controlling isolated system controllers.

Furnish a system software that has the capability to manually select any timing plan, free mode or flash mode.

Ensure that the system software has the capability of accepting, formatting, and processing data from at least 32 system detectors from each master controller.

**3.Data Transfer.** Ensure that it is possible to upload/download the signal timing database, including coordination, and preemption settings, between the Remote Monitoring Station and the master controller or local intersection.

Furnish a Remote Monitoring Station that provides a means to compare a currently uploaded timing database with a previously developed database stored in the Remote Monitoring Station memory. Ensure that it reports differences in the databases.

During either uploading or downloading operations, ensure that the normal traffic control operations are not suspended.

**4.Security.** Furnish a Remote Monitoring Station that provides for a user specified security code before any data is altered. Maintain controller access

procedures from the Remote Monitoring Station allowing the user full security control of all system components from a remote location.

**5. Isolated Intersection Management.** Furnish a Remote Monitoring Station software that includes the capability of accessing system controllers at remote intersection locations. Ensure that this capability includes total access to controller timing parameters, alarm conditions, detector data, and intersection status conditions in real time without the use of a master controller. Ensure that this feature utilizes the local intersection controller with a dial-up modem and telephone service.

**733.08 Telephone Service.** Ensure that the telephone service is a standard dialup service capable of supporting 2400 baud data transmission. Ensure that the external modem provided is a Hayes compatible, auto-answer/auto-dial unit with all connections, cables, and lightning protection on the incoming wires provided.

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