City of Dayton

DEPARTMENT OF PUBLIC WORKS
DIVISION OF CIVIL ENGINEERING

and

DEPARTMENT OF WATER
DIVISION OF WATER ENGINEERING

CONSTRUCTION AND MATERIAL SPECIFICATIONS

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100 GENERAL PROVISIONS

ITEM 101 ABBREVIATIONS

101 Abbreviations. The following abbreviations, when used in the Contract Documents, shall have the respective meaning shown below:

ANLA	American Nursery and Landscape Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
AWP	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CMS	Construction and Material Specifications of the Ohio Department of Transportation
DCE	District Construction Engineer
DDD	District Deputy Director
DET	District Engineer of Tests
DMA	Declaration Regarding Material Assistance/Non-Assistance to a Terrorist Organization
DNR	Department of Natural Resources
EEI	Edison Electric Institute
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration, Department of Transportation
FSS	Federal Specifications and Standards, General Services Administration
HRC	The Human Relations Council of the City of Dayton
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Association
ISSA	International Slurry Seal Association

ITE	Institute of Transportation Engineers
JMF	Job Mix Formula
MSDS	Material Safety Data Sheet(s)
NCHRP	National Cooperative Highway Research Program
NEMA	National Electrical Manufacturers Association
NISTN	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
ODOT	Ohio Department of Transportation
OMUTCD	Ohio Manual of Uniform Traffic Control Devices
ORC	Ohio Revised Code
ORDC	Ohio Rail Development Commission
OSHA	Occupational Safety and Health Administration
PCC	Portland Cement Concrete
RCGO	City of Dayton Revised Code of General Ordinances
REA	Rural Electrification Administration
SSP	Steel Structures Painting Council
STAR	State Treasurer's Asset Reserve
UL	Underwriters' Laboratories, Inc.

ITEM 102 DEFINITIONS

102 Definitions. The following words or terms, when used in the Contract Documents, are defined to mean as follows:

Addendum or Addenda A written or graphic instruction issued prior to the opening of Bids which clarifies, amends or interprets the Contract Documents.

Alternate A proposed change in the work described in the Contract Documents providing the City with an option to select between alternative materials, products or systems, or to add or delete portions of the Work.

Alternative Dispute Resolution A method of resolving disputes other than arbitration or litigation.

Approved Equal Article, device, material, Equipment, form of construction or other item proposed by the Bidder and approved by the Engineer for incorporation or use in the Work as being equivalent to essential attributes of a standard specified in the Contract Documents.

As-built Drawings Drawings or computer files revised by the Contractor to show changes made during the construction process.

Authorized Representative Unless otherwise specified in the Contract Documents, the City Manager of the City or any of the City Manager's duly authorized assistants or designees.

Base Bid The amount of money stated in a Bid as the sum for which the Bidder offers to perform the Work described in the Contract Documents, exclusive of adjustments for Alternates.

Bid The offer of a Bidder to perform the Work for the amount or amounts quoted, as applicable.

Bidder A Person who submits a Bid for a Contract with the City.

Bid Form - The form furnished by the City that is to be completed, signed and submitted containing the Bidder's Bid.

Bid Guaranty Bid Bond or other instrument of security furnished by the Bidder to provide assurance that the Bidder will execute the Contract Form.

Board of Review Committee consisting of the City Manager, City Attorney and Director of the Department of Public Works or any of their respective authorized assistants or designees.

Borrow Area A location from which natural materials are to be removed for use in the Work.

Bridge A Structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of the roadway of more than 10 feet between undercopings of abutments or extreme limits of openings for multiple boxes.

Length. The length of a Bridge Structure is the over all length measured along the center line of Roadway of the surface of the Roadway.

Roadway width. The clear width measured at right angles to the longitudinal centerline of the Bridge between the bottom of curbs or guard

timbers or, in the case of multiple heights of curbs, between the bottoms of the lower risers. For curb widths of 1 foot or less, the Roadway width shall be measured between the parapets or railings.

Building Department The City's Department of Building Services.

Bulletin A document issued by the Engineer after the execution of the Contract Form requesting a Proposal from the Contractor which, if approved as provided in the Contract Documents, will cause the execution of a Change Order to modify, amend or alter the Contract Documents. The Bulletin becomes a part of the Contract Documents when a Change Order related to the Bulletin is executed by all applicable Persons.

Certificate of Contract Completion A document signed by the Contractor and the Engineer certifying that Contract Completion has occurred.

Certificate of Partial Occupancy or Use A document signed by the Contractor and the Engineer certifying that City has chosen to occupy or utilize the Project or a designated portion thereof in accordance with 105.03.

Certified Test Data A test report from a manufacturer's Laboratory or an independent Laboratory approved by the City listing actual test results of samples tested for compliance with specified City requirements. The City will accept Certified Test Data from a manufacturer's Laboratory if its products have been used satisfactorily on prior City Contracts and its test data has been confirmed. The Contractor shall include a statement that the test data furnished is representative of the material furnished to a City Project or to a supplier. The report shall contain a characteristic number or date and shall identify the City Project or supplier to which the material is shipped. All reports shall be signed by an individual having legal authority to act for the manufacturer's Laboratory or independent Laboratory, as applicable.

Change Order A document issued by the City after execution of the Contract Form, which authorizes a change in the Work or an adjustment or alteration in the Contract price or the time for Contract Completion.

City The City of Dayton, an Ohio municipal corporation.

Claim Affidavit A sworn document containing a claim on funds that are due to a Contractor, created by statute in favor of a Person supplying labor, materials or services for the value of labor, materials or services supplied.

Conduit Any pipe or similar passageway for electricity, gas, water, Sewer or other utility.

Construction Schedule The schedule for the construction of the Work showing the time for completion of the Work, the planned sequence for performing the Work, the Contractor's resource loading curve and the interrelationship of the Contractor's activities with the activities of other Contractors, if any, the Engineer, and the City.

Contingency Fund Moneys reserved by the City to pay costs resulting from Change Orders, unanticipated conditions, compliance with rulings on building or other codes, incompleteness or inaccuracy of Contract Documents and settlements on judgments related to the Project.

Contract The agreement between the City and the Contractor as set forth in the Contract Documents.

Contract Bond Performance and payment bond or bonds, as applicable, furnished by the Contractor and the Contractor's Surety to provide assurance that the Contractor will perform the Contract and make required payments.

Contract Completion The date upon which all deficiencies noted in the Punch List have been corrected, the Contractor's Work is one hundred percent complete, and the Contractor has complied with all conditions precedent to final payment and release of retainage. When the Contract Documents specify a date for Contract Completion, Contract Completion shall occur on or before the specified date, even if the specified date is a Saturday, Sunday or legal holiday. When the Contract Documents provide that Final Acceptance shall occur a specified number of consecutive days after the date for commencement of Work set forth in the Notice to Proceed, that period of time shall be the time for Contract Completion.

Contract Cost Breakdown A statement furnished by the Contractor to the City reflecting the portions of the Contract price allocated to the various portions of the Work and used as the basis for reviewing the Contractor's Payment Requests.

Contract Documents Collectively, the Plans, plan notes, standard construction Drawings identified in Plans, Specifications, supplemental Specifications, Addenda, definitions, Legal Notice, instructions to Bidders, equal opportunity requirements, Bid Form, Bidder's affidavit, non-collusion affidavit, Bid guaranty, Substitution sheet, Contract Form, Contract Bond or Bonds, as applicable, wage rates and Special Provisions, Change Orders and approved Working Drawings, if any.

Contract Form The form furnished by the City that, when completed and signed by the Contractor and the City, evidences the entry into the Contract.

Contractor A Person with whom the City has entered into a Contract for the performance of Work on the Project in cooperation with other Persons and in accordance with the Contract Documents.

Culvert Any Structure not classified as a Bridge that provides an opening under a Roadway.

Day Calendar day, i.e., every day of the year, unless otherwise expressly specified to mean a business day. A business day is any day other than a Saturday, Sunday or legal holiday.

Defective When modifying the word Work, refers to Work that does not conform to the Contract Documents, or does not meet the requirements of any applicable statute, rule or regulation, policy, inspection, reference standard, test or approval, or has been damaged prior to Final Acceptance, unless responsibility for the protection thereof has been expressly assumed by the City, or that is not free from defects in workmanship, material or Equipment during the period of a Guarantee.

Director The Director of the City Department under which the Project is being performed, or the duly authorized designee of the applicable Director.

Drawings See Plans.

Engineer Unless otherwise specified in the Contract Documents, the Engineer of the Department of Public Works, the Water Engineering Manager of

the Department of Water of the City of Dayton or the Chief Engineer of the Department of Aviation under which the Project is being performed, or the duly authorized designee of the Engineer or Manager, as applicable.

Engineer's Estimate An estimate of cost for a Project or a Contract for a Project prepared by the Engineer prior to Bid opening.

Equipment All machinery and Equipment, together with the necessary supplies for upkeep and maintenance, tools and apparatus necessary for the construction of the Work.

Fabricator The Subcontractor that fabricates structural metals or prestressed concrete members.

Final Acceptance The City's acceptance of the Work from the Contractor upon approval by the Authorized Representative of the Certificate of Contract Completion.

Final Inspection Final review of the Work of the Contractor by the Engineer to determine whether certification of Contract Completion is appropriate.

Guarantee Legally enforceable assurance, for a period after Contract Completion, of quality or performance of the Contractor's workmanship, material and Equipment.

Inspector A Person assigned by the Engineer to make detailed inspections of the Work.

Laboratory The testing Laboratory designated by the City or determined in accordance with the Contract Documents.

Legal Notice The public announcement inviting Bids for Work.

Liquidated Damages The sum established in the Contract Documents as the predetermined measure of damages to be paid to the City due to the Contractor's failure to complete the Work, or portions thereof, within a stipulated time.

Maintenance Bond A bond furnished by the Contractor and the Contractor's Surety to provide assurance that the Contractor will perform the Guarantee.

Materials Any substances, supplies, products or other items specified or reasonably intended for use in the construction of the Project and its appurtenances.

Material Supplier A Person who furnishes materials for Work on the Project, in any tier.

Mathematically Unbalanced The lump sum amount or Unit Price in a Bid that does not include reasonably sufficient amounts for labor, material, Equipment, overhead and other applicable costs and profit.

Notice of Commencement The notice prepared by the City identifying the Project, the Contractor, the Surety for the Contractor and the name of the Person upon whom a Claim Affidavit may be served.

Notice of Intent to Award The notice provided to the apparently successful Bidder stating that upon satisfactory compliance with all conditions precedent for execution of the Contract Form, within the time specified, the City intends to execute a Contract Form with the Bidder.

Notice to Proceed A notice provided by the Engineer to the Contractor authorizing the Contractor to proceed with the Work and establishing the date for commencement of the Work.

Or Equal See Approved Equal.

Owner See City.

Partial Occupancy or Use The stage in the progress of the Work when the Project, or a designated portion thereof, is sufficiently complete in accordance with the Contract Documents so the City can occupy or utilize the Project, or the designated portion thereof, for its intended use, if the City chooses.

Payment Request The form furnished by the City that is to be used by the Contractor in requesting progress payments and which when signed by the Contractor shall serve as an affidavit that payment requests are in proportion to the Work completed as shown by the Contract Cost Breakdown and that payments previously paid by the City have been applied by the Contractor to discharge in full all of Contractor's obligations incurred in connection with the Work covered by all prior Payment Requests.

Pedestrian Bridge A Bridge designed and constructed to provide means of traverse for pedestrian traffic only; also known as a foot Bridge.

Permittee Any Person issued a permit by the City to perform Work in accordance with these Specifications in a street, alley, Public Way or place, but not having a Contract with the City.

Person An individual, corporation, business trust, estate, limited liability company, partnership, association or other entity, public or private.

Plans The graphic and pictorial portions of the Contract Documents, showing the design, type of construction, location, dimension and character of the Work to be provided by the Contractor, generally including Drawings, elevations, sections, details, schedules, diagrams, notes, and Specifications, in whole or in part.

Profile Grade The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal center line of a Roadbed. Profile Grade means either elevation or gradient of such trace according to the context.

Project The public improvement to be constructed, of which the Work performed under the Contract Documents may be the whole or a part.

Project Schedule The schedule for the construction of the Project showing the time for completing the Work, the planned sequence for performing the Work, the Contractor's resource loading curve and the interrelationship between the activities of the Contractor, other Contractors, the Engineer, and the City.

Proposal The offer of the Contractor to complete the Work set forth in a Bulletin.

Proposed Equal Article, device, material, Equipment, form of construction or other item proposed by the Bidder for incorporation or use in the Work as being equivalent to essential attributes of a standard specified in the Contract Documents.

Public Way (or Place) A street, road, walk, alley or path used for public travel.

Punch List A list of items of Work to be completed or corrected by the Contractor as a condition precedent to Contract Completion.

Record Drawings Drawings or computer files revised by the Engineer to show the changes made during the construction process, based on the As-built Drawings furnished by the Contractor to the Engineer.

Request for Information Written request from the Contractor to the Engineer seeking an interpretation or clarification of the Contract Documents.

Right-of-Way Land, property, or interest therein, usually in a strip, acquired for or devoted to a road and includes the Roadway, Shoulders or berm, ditch and slopes extending to the Right-of-Way limits under control of the City.

Road A Public Way for purposes of vehicular travel, including the entire area within the Right-of-Way.

Roadbed The graded portion of a road within top and slide slopes, prepared as foundation for the pavement Structure and Shoulder.

Roadside The areas between the outside edges of the Shoulders and Right-of-Way boundaries. Unpaved median areas between inside Shoulders of divided highways and infield areas of interchanges are included.

Roadside Development Those items necessary to the complete road that provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the road.

Roadway The portion of a road within the limits of construction.

Samples Physical examples furnished by the Contractor to illustrate materials, Equipment or workmanship and to establish criteria by which the Work will be judged.

Schedule of Values See Contract Cost Breakdown.

Sewer Pipe or Conduit intended for carrying storm drainage or sanitary drainage.

Shop Drawings Drawings, diagrams, illustrations, schedules, performance charts, brochures, catalog data and other data specially prepared or provided by the Contractor, a Subcontractor or Material Supplier to illustrate some portion of the Work.

Shoulder The portion of the road contiguous to the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk That portion of the road constructed for the use by pedestrians.

Special Provisions Amendments to the Specifications or supplemental Specifications, which describe conditions unique to a particular Project.

Specifications Those portions of the Contract Documents consisting of the detailed written requirements and standards for materials, Equipment, construction systems and workmanship as applied to the Work and certain procedural details applicable thereto.

Standards The items named in the Specifications to denote kind, quality or performance requirement for the Work. All Bids and Proposals shall be based on the Standards as set forth in the Specifications.

State The State of Ohio.

Street See road.

Structure Bridge, Culvert, catch basin, curb inlet, drop inlet, retaining wall, cribbing, manhole, endwall, building, curb, pavement, Sewer, water main, service pipe, underdrain, foundation drain, and any other features which may be encountered in the Work and not otherwise defined herein.

Subcontractor A Person who undertakes to perform any part of the Work on the Project under a Contract with any Person other than the City, in any tier.

Subgrade The portion of a Roadbed upon which the pavement structure and Shoulders are constructed.

Substitution An item proposed by the Bidder to be used instead of a standard, but not considered in determining the lowest and best Bidder.

Substructure The part of a structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with backwalls and wings.

Superintendent The Contractor's Authorized Representative in charge of the Work.

Superstructure The entire structure except the Substructure.

Supplemental Specifications Detailed Specifications supplemental to or amending or superseding the Specifications.

Surety A Person providing a Bid guaranty, Contract Bond or Maintenance Bond to a Bidder or Contractor, as applicable, to indemnify the City against all direct and consequential damages suffered by failure of the Bidder to execute the Contract Form or of the Contractor to perform the Contract and to pay all lawful claims of Subcontractors, Material Suppliers and laborers or to perform the Guarantee, as applicable.

Unit Price An amount stated in the Bid as the price per unit of measurement for Materials or services described in the Contract Documents, which cost shall include overhead, profit and any other expense for the applicable Work.

Warranty Legally enforceable assurance for the specified duration from Final Acceptance of quality or performance of Materials or Equipment.

Waste Area A location in which natural Materials are to be deposited when not used in the Work.

Work The construction services required by the Contract Documents, to include all labor, Materials, Equipment, tools, transportation, supplies, incidental and services performed or provided by the Contractor for the Project.

Working Drawings Stress sheets, shop Drawings, erection Plans, false work Plans, framework Plans, cofferdam Plans, bending diagrams for reinforcing steel, or any other supplementary Plans or similar data which the Contractor is required to submit for acceptance.

ITEM 103 INSTRUCTION TO BIDDERS

103.01 Contract Completion and Critical Path Scheduling
103.02 Certain Claims
103.03 Giving Notice
103.04 Examination of Contract Documents
103.05 Evaluation of Work Season and Project Site
103.06 Subsurface and Concealed Physical Conditions
103.07 Pre-bid Meeting
103.08 Request for Information or Clarification
103.09 Interpretation or Clarification by Addendum
103.10 Standards
103.11 Proposed Equals
103.12 Approval or Disapproval of Proposed Equals
103.13 Substitutions
103.14 Bid Form
103.15 Alternates
103.16 Execution of Bid Form
103.17 Submittals with Bid Form
103.18 Unit Prices
103.19 Changes to Unit Price Work
103.20 Change in Bid Amount
103.21 Delivery of Bids
103.22 Bid Opening
103.23 Bid Opening Extension
103.24 Bid Evaluation Criteria
103.25 Bid Evaluation Procedures
103.26 Lowest Bidder
103.27 Responsive Bidder
103.28 Best Bidder
103.29 Information
103.30 Award Procedures
103.31 Rejection
103.32 Notice of Intent to Award
103.33 Withdrawal of Bid
103.34 Refusal to Accept Withdrawal
103.35 Effect of Withdrawal
103.36 Bid Estimate
103.37 Review of Low Bid
103.38 Bid Guaranty
103.39 Bid Guaranty Forfeiture
103.40 Exception to Bid Guaranty Forfeiture
103.41 Contract Bond
103.42 Personal Property Tax Statement
103.43 Conditions Precedent for Execution of Contract Form by City

103.44 Time Limits
103.45 Notice to Proceed and Submittals
103.46 Wage Rates and Payment Dates

103.01 Contract Completion and Critical Path Scheduling. Unless otherwise provided in the Contract Documents, the time for completion of the Project indicated on the Bid Form shall be the time for Contract Completion applicable to the Bidders. Critical path scheduling methods shall be utilized, unless waived by the Authorized Representative in writing.

103.02 Certain Claims. Except when the cause of a delay is the proximate result of the City's act or failure to act as required by Section 4113.62, ORC, the Bidder agrees that the Bidder will make no claim against the City for additional compensation or mitigation of Liquidated Damages for any interference, disruption, hindrance, delay or impact, and will accept as full satisfaction any extension of time which may be provided by the City in accordance with the Contract Documents. This provision is intended to be, and shall be construed as, consistent with, and not in conflict with, Section 4113.62, ORC, to the fullest extent permitted.

103.03 Giving Notice. Whenever any provision of the Contract Documents requires the giving of notice prior to the execution of the Contract Form, such notice shall be deemed to have been validly given if delivered personally to the Person for whom the notice is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address of such Person known to the giver of the notice. All notices provided to the Bidder by the Engineer shall be copied to the Authorized Representative. All notices provided to the Engineer by the Bidder shall be copied to the Authorized Representative. All notices provided to the Authorized Representative by the Bidder shall be copied to the Engineer.

103.04 Examination of Contract Documents. Contract Documents are available at the location stated in the Legal Notice upon payment to the City of the non-refundable amount stated in the Legal Notice and will be mailed upon payment of such amount and the expense of mailing. The Bidder shall examine all Contract Documents, including without limitation the Drawings and Specifications for all divisions of Work for the Project, noting particularly all requirements which will affect the Bidder's Work in any way prior to submitting the Bidder's Bid. Failure of a Bidder to be acquainted with the amount and nature of Work required to complete any of the Work, in conformity with all requirements of the Project as a whole wherever set forth in the Contract Documents or reasonably inferred therefrom, will not be considered as a basis for additional compensation.

103.05 Evaluation of Work Season and Project Site. The Bidder shall evaluate when the Work may be performed and examine and evaluate the Project site and related Project conditions where the Work will be performed prior to submitting the Bidder's Bid, including without limitation the following:

(a) The condition, layout and nature of the Project site and surrounding area, including Borrow Areas and Waste Areas, if any;

(b) The availability and cost of labor;

(c) The availability and cost of Materials, supplies and Equipment;

(d) The cost of temporary utilities required;

(e) The cost of any permit or license required by a local or regional authority having jurisdiction over the Project;

(f) The usual weather conditions;

(g) Conditions bearing upon transportation, disposal, handling, and storage of Materials and waste.

103.06 Subsurface and Concealed Physical Conditions. During the progress of the Work, if subsurface or concealed physical conditions are encountered at the site differing materially from those indicated in the Contract Documents, or if subsurface or concealed physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract Documents, are encountered at the site, the Contractor shall notify the Engineer of the specific differing conditions before they are disturbed or the affected Work is performed. Upon notification, the Engineer will investigate the conditions and if it is determined that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, a Change Order may be issued in accordance with Item 117. The City may decline to issue a Change Order if the notice required by 117.11 is not timely provided by the Contractor. If the Contractor fails to timely provide the notice required by 117.11, the Contractor shall be deemed to have waived any and all claims for additional compensation or time extension for the related subsurface or concealed physical conditions.

103.07 Pre-Bid Meeting. All Bidders are required to attend the pre-Bid meeting, where the Engineer will answer questions regarding the Contract Documents. If not given in the notice to Bidders, notice of the time and place of any pre-Bid meeting to be held will be given by the Engineer to each Person of record holding Contract Documents. Failure of the Bidder to be present for the

entire duration of the pre-Bid meeting will result in the Bidder's Bid being rejected.

103.08 Request for Information or Clarification. If the Bidder finds any perceived ambiguity, conflict, error, omission or discrepancy on or between any of the Contract Documents, including without limitation the Drawings and Specifications, or between any Contract Documents and any applicable provision of law, the Bidder shall submit a written request to the Engineer for an interpretation or clarification. The Bidder shall be responsible for prompt delivery of such request. In order to prevent an extension of the Bid opening, the Bidder is encouraged to make all requests for interpretation or clarification a minimum of seven Days before the Bid opening.

103.09 Interpretation or Clarification by Addendum. If the Engineer determines that an interpretation or clarification is warranted, the Engineer shall issue an Addendum and provide a copy to each Person of record holding Contract Documents. Any interpretation or clarification of the Contract Documents made by any Person other than the Engineer, or in any manner other than a written Addendum, shall not be binding and the Bidder shall not rely upon any such interpretation or clarification. The Bidder shall not, at any time before or after the execution of the Contract Form, be compensated for a claim alleging insufficient data, incomplete, ambiguous, conflicting or erroneous Contract Documents, any discrepancy on or between Contract Documents or incorrectly assumed conditions regarding the nature, extent or character of the Work, if no request for interpretation or clarification regarding such matter was made by the Bidder prior to the Bid opening.

103.10 Standards. The articles, devices, Materials, Equipment, forms of construction, fixtures and other items named in the Specifications to denote kind, quality or performance requirement for each significant portion of the Work shall be known as Standards and all Bids shall be based upon those Standards. Where two or more Standards are named, the Bidder may furnish any one of those Standards. Items which are not Standards may be used only if accepted pursuant to the requirements of 103.11 and 103.12.

103.11 Proposed Equals. If the Bidder proposes to use an article, device, material, Equipment, form of construction, fixture or item other than those Standards named in the Specifications, the Bidder shall certify that the item is equal in quality, and in all aspects of performance and appearance, to the Standards specified. In addition, the Bidder shall submit information to the Engineer not later than ten Days prior to the Bid opening, which information shall include:

(a) The name and a complete description of the Proposed Equal, including Drawings, performance and test data, and other information necessary for a complete evaluation of the Proposed Equal;

(b) A statement setting forth any changes which the Proposed Equal will require in the Contract Documents or the Project.

103.12 Approval or Disapproval of Proposed Equals. If the Engineer, in the exercise of the Engineer's discretion, approves the Proposed Equal as a standard, the Engineer shall issue an Addendum to that effect to each Person of record holding Contract Documents. If the Engineer does not approve the Proposed Equal as a standard, the Engineer shall inform the Bidder of the disapproval in writing, no later than ninety-six hours prior to the Bid opening, excluding Saturdays, Sundays and legal holidays, stating the reason for the disapproval, which decision shall be final. The Engineer shall have the discretion to reject a Proposed Equal for the reason that the Bidder failed to provide sufficient information to enable the Engineer to completely evaluate the Proposed Equal without delaying the scheduled Bid opening.

103.13 Substitutions. If no Addendum is issued approving the Proposed Equal as a standard, the Bidder may list the item on the Substitution sheet. A Bidder desiring consideration for the use of an article, device, material, Equipment, form of construction, fixture or item other than those Standards named in the Specifications shall submit a Proposal for the Substitution of same for the applicable standard, using the Substitution sheet attached to the Bid form and listing, for each proposed Substitution: the standard specified, the Substitution, and the change in Bid amount, (or indicate no change, if applicable). The name and a complete description including Drawings, performance and test data, and other information necessary for a complete evaluation of each Substitution shall be furnished to the Engineer by the Bidder promptly upon request. Any Substitution accepted by the City must be incorporated in the Contract in writing. Substitutions shall not be considered in determining of the lowest and best Bid but may be considered in rejecting all Bids.

103.14 Bid Form. Each Bid shall contain the name of every Person interested therein, be submitted on the Bid Form and be sealed in an envelope clearly marked as containing a Bid, indicating the Project name, the date and time of the Bid opening and the Contract or scope of Work, if applicable, on the envelope. Any change, alteration or addition in the wording of the Bid Form may cause a Bid to be rejected as nonresponsive. Unless the Bidder withdraws the Bid as provided in 103.33, the Bidder will be required to comply with all requirements of the Contract Documents, regardless of whether the Bidder had actual knowledge of the requirements and regardless of any statement or omission made by the Bidder which might indicate a contrary intention. The

Bidder shall fill in all relevant blank spaces in the Bid Form in ink or other permanent means and not in pencil. The Bidder shall show the final total amount of the Base Bid and the amounts of any Alternates. When the Bidder's intention and the meaning of the words are clear, omissions or misspellings of words will not render the words ambiguous. Where there is a conflict between the separate amounts for labor and Materials and the total thereof, the separate amounts shall govern and a corrected total shall be used for the comparison of the Bids. Any alteration or erasure of items filled in on the Bid Form shall be initialed by the Bidder in ink or other permanent means and not in pencil.

103.15 Alternates. When an Alternate is listed on the Bid Form, the Bidder shall fill in the applicable blank with an amount which will increase or decrease the Base Bid. The City reserves the right to accept or reject any or all Bids on Alternates, in whole or in part, and the right to reject any Alternate or Alternates and to accept any remaining Alternate or Alternates. Alternates may be accepted or rejected in any order. If no change in the Bid amount is required, indicate "No Change" or zero dollars. Failure to make an entry or an entry of "No Bid," "N/A," or similar entry for any Alternate may cause the Bid to be rejected as nonresponsive, but only if that Alternate is selected.

103.16 Execution of Bid Form. If the Bidder is a corporation, limited liability company, partnership or sole proprietorship, an officer, member, partner or principal of the Bidder, as applicable, shall print or type the legal name of the Bidder on the line provided and sign the Bid Form. If the Bidder is a joint venture, an officer, member, partner or principal, as applicable, of each participant of the joint venture shall print or type the legal name of the applicable participant on the line provided and sign the Bid Form on behalf of that participant. All signatures must be original. By submitting a Bid, the Bidder warrants that it is not now, and will not become subject to an unresolved finding for recovery under Section 9.24 ORC, prior to the award of any Contract arising out of this Project, without notifying the City of such findings. Section 9.24, ORC prohibits the City from awarding a Contract to any Bidder against whom the Auditor of State has issued findings for recovery if the findings for recovery are unresolved at the time of award. In addition, by submitting a Bid, the Bidder warrants that it has not provided material assistance to any organization listed on the United States Department of State Terrorist Exclusion List. Section 2909.33 O.R.C. prohibits the City from awarding to any Bidder who provided material assistance to any organization listed on the United States Department of State Terrorist Exclusion List. The completed Bid Form of the Bidder with whom the City executes a Contract Form shall be incorporated into the Contract Form as if fully rewritten therein.

103.17 Submittals with Bid Form. A Bid shall be rejected as nonresponsive if the Bidder fails to submit the following submittals with the Bid Form in a sealed envelope:

(a) A Bid guaranty as provided in 103.38;

(b) Power of Attorney of the agent signing for the Surety;

(c) An executed non-collusion affidavit in the form provided.

103.18 Unit Prices. When Unit Prices are requested on the Bid Form, any scheduled quantities listed by the City are to be considered as approximate and are to be used only for the comparison of Bids for purposes of determining the lowest and best Bidder and to determine the maximum quantity to be provided without a Change Order. If Unit Prices are stated to be sought only for informational purposes, they shall not be used for comparison of Bids. Unless otherwise specified in the Contract Documents, the Unit Prices and the totals or extensions thereof set forth shall include all Materials, Equipment, insurance, labor, delivery, installation, overhead, profit and any other cost or expense, in connection with or incidental to, the performance of that portion of the Work to which the Unit Prices apply. The Bidder shall submit Unit Prices for all items listed unless other instructions are stated on the Bid Form. Where there is a conflict between a Unit Price and any total or extension thereof made by the Bidder, the Unit Price shall govern and a corrected total or extension of such Unit Price shall be made and such corrected total or extension shall be used for the comparison of the Bids and to determine the maximum quantity to be provided without a Change Order.

103.19 Changes to Unit Price Work. The Bidder agrees that the City may increase, decrease or delete entirely the scheduled quantities of Work to be done and Materials to be furnished after execution of the Contract Form without invalidating the Contract. Payments, except for lump sum items in Unit Price Contracts, will be made to the Contractor only for the actual quantities of Work performed or Materials furnished in accordance with the Contract Documents, but not in excess of the maximum set by the scheduled quantities. The Contractor must obtain a Change Order prior to performing Work or furnishing Materials in excess of the scheduled quantities in order to be compensated for the excess.

103.20 Change in Bid Amount. Any change to a previously submitted Bid shall be made in writing and must be received by the City before the time scheduled for the Bid opening, as determined by the employee or representative of the City designated to open the Bids. Changes shall provide an amount to be added to or subtracted from the Bid amount, so that the final Bid

amount can be determined only after the sealed envelope is opened. If the Bidder's written instruction reveals the Bid amount in any way prior to the Bid opening, the Bid may be rejected as nonresponsive.

103.21 Delivery of Bids. It is the responsibility of the Bidder to submit the Bid at the office designated by the City for the opening Bids prior to the time scheduled for Bid opening. If the Bid envelope is enclosed in another envelope for the purpose of delivery, the exterior envelope shall be clearly marked as containing a Bid with the Project name, applicable Contract and the date and time of the Bid opening shown on the outer envelope. No Bid shall be considered if it arrives after the time set for the Bid opening, as determined by the employee or representative of the City designated to open the Bids.

103.22 Bid Opening. Sealed Bids will be received at the office designated by the City until the time stated when all Bids will be opened, read and the tabulation made public. The public opening and reading of Bids is for informational purposes only and is not to be construed as an acceptance or rejection of any Bid submitted. The contents of the Bid envelope shall be a public record and open for inspection, upon request, at any time after the Bid opening, except for any information which is not subject to disclosure as provided by applicable law.

103.23 Bid Opening Extension. If any Addendum is issued within Seventy-two hours prior to the published time for the Bid opening, excluding Saturdays, Sundays and legal holidays, the Bid opening shall automatically be extended one week, with no further advertising required. If any Addendum is issued more than seventy-two hours prior to the published time for the Bid opening, excluding Saturdays, Sundays, and legal holidays, the Bid opening date may be revised by the Addendum.

103.24 Bid Evaluation Criteria. The City reserves the right to accept or reject any or all Bids, in whole or in part, and reserves the right to reject any Bid or Bids and to award the Contract to any remaining Bidder the City determines to be the lowest and best Bidder. The City reserves the right to accept or reject any or all Alternates, in whole or in part, and the right to reject any Alternate or Alternates and to accept any remaining Alternate or Alternates. Alternates may be accepted or rejected in any order. The City may reject the Bid of any Bidder who has engaged in collusive Bidding, been involved in violations of ethics laws or who has an unresolved finding against it by the Auditor of State as provided in Section 9.24, ORC, as not the lowest and best Bid. The City reserves the right to waive, or to allow any Bidder a reasonable opportunity to cure a minor irregularity or technical deficiency in a Bid, provided the irregularity or deficiency does not affect the Bid amount or otherwise give the Bidder a

competitive advantage. Noncompliance with any requirements of the Contract Documents may cause a Bid to be rejected.

103.25 Bid Evaluation Procedures. The Contract will be awarded to the lowest and best Bidder as determined in the discretion of the City or all Bids will be rejected in accordance with the procedures set forth in 103.26 through 103.31.

103.26 Lowest Bidder. In determining which Bidder is the lowest, the City shall consider the Base Bid and any Alternate or Alternates which the City determines to accept. Substitutions shall not be considered. The total of the Bids for the accepted Alternate(s) shall be added to or deducted from the Base Bid, as applicable, for the purpose of determining the lowest Bidder. If the Project involves multiple Contracts, the City may also receive combined Bids for two or more Contracts, if provided on the Bid Form, but no Contract for the entire job or for more than one Contract shall be awarded unless the separate Bids do not cover all the Work and Materials required or unless the combined Bid is lower than the applicable separate Bids in the aggregate. The City may also receive Bids for multiple Projects if provided on the Bid Form.

103.27 Responsive Bidder. A Bidder for a Contract shall be considered responsive if the Bidder's Bid responds to the Contract Documents in all material respects and contains no irregularities or deviations from the Contract Documents which would affect the amount of the Bid or otherwise give the Bidder a competitive advantage. A Bidder shall be rejected as nonresponsive if the Bidder's Bid contains a Bid guaranty executed by a Surety not licensed in Ohio or a Bid guaranty that is otherwise determined to be insufficient by the City. A Bidder may be rejected if the Bidder's Bid is Mathematically Unbalanced. A Bidder may be rejected as nonresponsive if the Bidder's Bid does not contain an executed Non-collusion affidavit. A Bidder may be required to furnish Samples and a complete statement of the origin, composition and manufacture of any or all Materials to be used for the Work. A Bidder may be rejected as nonresponsive for failure to provide requested Samples or if Samples fail to demonstrate that Materials are of sufficient quality or fitness for the Work.

103.28 Best Bidder. In determining whether a Bidder is best, factors to be considered include, without limitation:

(a) Preferences required by law, where applicable;

(b) The experience of the Bidder;

(c) The financial condition of the Bidder;

(d) Compliance by the Bidder and related Persons with ethics laws and City ordinances and regulations, including without limitation submission of an affirmative action program in accordance with Section 35.16 R.C.G.O.;

(e) The conduct and performance of the Bidder on previous Bids and Contracts, which shall include, without limitation, compliance with prevailing wage laws, Workers' compensation, income tax laws and equal opportunity requirements;

(f) The facilities of the Bidder, including without limitation machinery, plant and Equipment, as applicable;

(g) The management skills of the Bidder;

(h) The ability of the Bidder to execute the Contract properly, including whether the Bidder's existing workload may hinder or prevent timely completion of the Work;

(i) The ability of the Bidder to perform at least fifty-one percent of the Work with its own employees;

(j) The evaluation of a Bid below the median of other Bids pursuant to 103.37.

A Bidder who submits a Bid for Work for electrical, plumbing, hydronics, refrigeration or heating, ventilating and air conditioning shall provide evidence of a valid Contractor's license from the Ohio Construction Industry Licensing board or successor.

103.29 Information. The Engineer shall obtain from the lowest and best Bidder any information the Authorized Representative deems appropriate to the consideration of factors showing that such Bidder's Bid is best, including without limitation the following:

(a) Overall experience of the Bidder, including number of years in business under present and former business names;

(b) Names and qualifications of key Bidder personnel;

(c) Complete listing of all ongoing and completed public and private construction Contracts of the Bidder in the last three years, including the nature, status and value of each Contract and a name, address, and phone number for a representative of the Owner of each related Project;

(d) Complete listing of any EPA, (OSHA) or other regulating entity issues or citations in the last ten years;

(e) Complete listing of all outstanding liens against the Bidder;

(f) Certified financial statement with trade and bank references;

(g) Description of relevant facilities of the Bidder;

(h) Description of the management experience of the Bidder's Project manager(s) and Superintendent(s);

(i) Complete list of all Subcontractors and Material Suppliers;

(j) To support a Contract Bond, a current and signed certificate of compliance required under Section 9.311 ORC, issued by the Department of Insurance, showing the Surety is licensed to do business in Ohio;

(k) Current Ohio Workers' Compensation Certificate.

If the Bidder is a foreign corporation, i.e., not incorporated under the laws of Ohio, a certificate of good standing from the Secretary of State showing the right of the Bidder to do business in the State; or, if the Bidder is an individual or partnership, the Bidder has filed with the Secretary of State a Power of Attorney designating the Secretary of State as the Bidder's agent for the purpose of accepting service of summons in any action brought under Section 153.05, ORC, or under Sections 4123.01 through 4123.94, inclusive, ORC.

The Engineer may obtain such information from several Bidders simultaneously, but shall review each Bidder's information separately and not comparatively. Each Bidder shall provide requested information within such time limits as the Engineer shall establish.

103.30 Award Procedures. If the lowest responsive Bidder is best, the Contract shall be awarded to such Bidder unless all Bids are rejected. If the lowest responsive Bidder is not best, and all Bids are not rejected, the City shall follow the procedure set forth in 103.26 and 103.31 with each next lowest responsive Bidder until the Contract is awarded, all Bids are rejected or all responsive Bidders are determined to be not best.

103.31 Rejection. If the lowest Bidder is not responsive or best, the City shall reject such Bid.

103.32 Notice of Intent to Award. The City shall notify the apparent successful Bidder that upon satisfactory compliance with all conditions precedent for execution of the Contract Form, within the time specified, the Bidder will be awarded the Contract. The City reserves the right to rescind any Notice of Intent to Award if the City determines the Notice of Intent to Award was issued in error.

103.33 Withdrawal of Bid. A Bidder may withdraw a Bid after the Bid has been received by the City, provided the Bidder makes a request in writing and the request is received by the City prior to the time of the Bid opening, as determined by the employee or representative of the City designated to open the Bids. All Bids shall remain valid and open for acceptance for a period of at least sixty Days after the Bid opening; provided, however that during that period a Bidder may withdraw a Bid from consideration if the Bid amount was substantially lower than the amounts of other Bids, providing the Bid was submitted in good faith, and the reason for the Bid amount being substantially lower was a clerical mistake, as opposed to a judgment mistake, and was actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of Work, labor or material made directly in the compilation of the Bid amount. Notice of a request to withdraw a Bid must be made in writing filed with the Authorized Representative within two business Days after the Bid opening. The City reserves the right to request that the Bidder submit evidence substantiating the Bidder's request to withdraw the Bid. No Bid may be withdrawn after Bid opening when the result would be the awarding of the Contract on another Bid to the same Bidder. If a Bid is withdrawn after Bid opening, the City may award the Contract to another Bidder that the City determines to be the lowest and best Bidder, or reject all Bids and advertise for other Bids. If the City advertises for other Bids, the withdrawing Bidder shall pay the costs, in connection with the rebidding, of printing new Contract Documents, required advertising and printing and mailing notices to prospective Bidders, if the City finds that such costs would not have been incurred but for such withdrawal. A Bidder may withdraw its Bid at any time after the expiration of the described sixty Day period by written notice to the Authorized Representative.

103.34 Refusal to Accept Withdrawal. If the City intends to contest the right of the Bidder to withdraw a Bid after Bid opening, a hearing shall be held by the Authorized Representative within ten Days after the Bid opening and an order shall be issued by the City allowing or denying the claim of such right within five Days after such hearing is concluded. The City shall give the withdrawing Bidder timely notice of the time and place of any such hearing. The City shall make a stenographic record of all testimony, other evidence, and rulings on the admissibility of evidence presented at the hearing. The Bidder shall pay the costs of the hearing. If the City denies the claim for withdrawal and the Bidder elects to litigate or otherwise refuses to perform the Contract, the City may reject all Bids or award the Contract to the next lowest and best Bidder, as determined by the City, without waiving any claims against the non-performing Bidder.

103.35 Effect of Withdrawal. No Bidder who is permitted to withdraw a Bid after Bid opening shall for compensation supply any material or labor to, or perform any subcontract or other Work agreement for, the Person to whom the Contract is awarded or otherwise benefit, directly or indirectly, from the performance of the Project for which the withdrawn Bid was submitted, without the written approval of the City. The Person to whom the Contract is awarded and the withdrawing Bidder shall be jointly liable to the City in an amount equal to any compensation paid to or for the benefit of the withdrawing Bidder without such approval. A Bidder who is permitted to withdraw a Bid after Bid opening may be considered not the best for future City Contracts.

103.36 Bid Estimate. In no instance shall Contracts be let either as a whole, or in aggregate, if Bids for parts of the Work are taken, which exceed the estimate for the improvement contemplated.

103.37 Review of Low Bid. No Bidder shall be best if the Bidder's Bid is more than twenty percent below the median of all higher Bids received for a Contract where the estimate is one hundred thousand dollars or more, and no Bidder shall be best if the Bidder's Bid is more than twenty-five percent below the median of all higher Bids received for a Contract where the estimate is less than one hundred thousand dollars, unless the following procedures are followed:

(a) The Engineer conducts an interview with the Bidder to determine what, if anything has been overlooked in the Bid, and to analyze the process planned by the Bidder to complete the Work. The Engineer shall submit a written summary of the interview to the Authorized Representative;

(b) The Bidder submits to the City a certified financial statement and a list of recent public Contracts which the Bidder has performed;

(c) The City reviews and approves the Bidder as best pursuant to 103.27 through 103.32;

(d) The City notifies the Bidder's Surety in writing that the Bidder with whom the City intends to enter a Contract submitted a Bid determined to be substantially lower than the median of all higher Bids.

103.38 Bid Guaranty. The Bidder must file with the Bid a Bid guaranty, payable to the City of Dayton, in the form of either:

(a) The signed Bid guaranty and Contract Bond contained in the Contract Documents, for the full amount of the Base Bid plus add Alternates; or

(b) A certified check or bonds issued by the United States or the City in the amount of ten percent of the Base Bid plus add Alternates.

The Bid guaranty shall be in form and substance satisfactory to the City and shall serve as an assurance that the Bidder will, upon acceptance of the Bidder's Bid, comply with all conditions precedent for execution of the Contract Form and execute the Contract Form within the time specified by the City. ANY BID GUARANTY MUST BE PAYABLE TO THE CITY OF DAYTON. A Bid may be rejected if the Bid guaranty is payable to any other Person. IF THE BLANK LINES FOR THE AMOUNT ON THE BID GUARANTY AND CONTRACT BOND ARE NOT FILLED IN, THE PENAL SUM WILL AUTOMATICALLY BE THE FULL AMOUNT OF THE BASE BID PLUS ADD ALTERNATES. If those blank lines are filled in, the amount must not be less than the full amount of the Base Bid plus add Alternates, stated in dollars and cents. A PERCENTAGE IS NOT ACCEPTABLE. The Bid guaranty and Contract Bond must be signed by an authorized agent with Power of Attorney from a Surety. The Bid guaranty and Contract Bond must be issued by a Surety authorized by the Department of Insurance to transact business in Ohio. The requirements of Section 3905.41, ORC, may be applicable to require the Bid guaranty and Contract Bond be countersigned by an Ohio resident agent. The Bidder must determine whether this requirement is applicable to the Bidder's Surety. Bid guaranties will be returned to all unsuccessful Bidders seventy-five Days after the Bid opening or upon execution of the Contract Form by the apparently successful Bidder, whichever is earlier. If used, a certified check, cashier's check or letter of credit will be returned to the apparently successful Bidder upon providing the Contract Bond required by law in form and substance, and from a Surety, satisfactory to the City.

103.39 Bid Guaranty Forfeiture. If for any reason, other than as authorized by 103.33 or 103.40, the Bidder fails to execute the Contract Form, and the City awards the Contract to another Bidder which the City determines is the lowest and best Bidder, the Bidder who failed to execute the Contract Form shall be liable to the City for the difference between such Bidder's Bid and the Bid of the lowest and best Bidder, or for a penal sum not to exceed ten percent of the defaulting Bidder's Bid amount, whichever is less. If the City then awards a Contract to another Bidder which the City determines is the lowest and best Bidder and such Bidder also fails or refuses to execute the Contract Form, the liability of such lowest and best Bidder shall, except as provided in 103.40, be the amount of the difference between the Bid amounts of such lowest and best Bidder and another Bidder which the City determines is the lowest and best Bidder, but not in excess of the liability specified in 103.33. Liability on account of an award to each succeeding lowest and best Bidder shall be determined in like manner. If the City does not award the Contract to the another Bidder which the City determines is the lowest and best Bidder but resubmits the Project for Bidding, the Bidder failing to execute the Contract Form shall, except as provided in 103.40, be liable to the City for a penal sum not to exceed ten percent of such

Bidder's Bid amount or the costs in connection with the resubmission, of printing new Contract Documents, required advertising and printing and mailing notices to prospective Bidders, whichever is less.

103.40 Exception to Bid Guaranty Forfeiture. A Bidder with the City for a Contract with the City costing less than five hundred thousand dollars may withdraw a Bid from consideration if the Bidder's Bid for some other Contract with the State or any political subdivision, district, institution or agency thereof, excluding ODOT, costing less than five hundred thousand dollars has already been accepted, if the Bidder certifies in good faith that the total price of all such Bidder's current Contracts is less than five hundred thousand dollars, and if the Bidder's Surety certifies in good faith that the Bidder is unable to perform the subsequent Contract because to perform such Contract would exceed the Bidder's Bonding capacity. If a Bid is withdrawn pursuant to 103.40, the City may award the Contract to another Bidder which the City determines is the lowest and best Bidder or reject all Bids and resubmit the Project for Bidding, and neither the withdrawing Bidder nor such Bidder's Surety shall be liable for the difference between the Bidder's Bid and that of another Bidder which the City determines is the lowest and best Bidder, for a penal sum, or for the costs of printing new Contract Documents, required advertising and printing and mailing notices to prospective Bidders.

103.41 Contract Bond. If the Bidder executes the Contract Form, the Bidder shall, at the time of signing the Contract Form, provide the Contract Bond required by law in form and substance, and from a Surety, satisfactory to the City. The Contract Bond shall be in the full amount of the Contract to indemnify the City against all direct and consequential damages suffered by failure of the Contractor to perform according to the provisions of the Contract Documents and in accordance with the Plans, Specifications, details and bills of material therefore and to pay all lawful claims of Subcontractors, Material Suppliers, and laborers for labor performed or Materials furnished in carrying forward, performing or completing the Contract. A Contract Bond must be signed by an authorized agent with Power of Attorney from the Surety.

103.42 Personal Property Tax Statement. The successful Bidder shall provide a properly completed and executed affidavit in a form satisfactory to the City in order to fulfill the requirements of Section 5719.042 ORC, which provides as follows:

> After the award by a taxing district of any Contract let by competitive Bid and prior to the time the Contract is entered into, the Person making a Bid shall submit to the district's fiscal officer a statement affirmed under oath that the Person with whom the Contract is to be made was not charged at the time the Bid was submitted with any delinquent personal

property taxes on the general tax list of personal property of any county in which the taxing district has territory or that such Person was charged with delinquent personal property taxes on any such tax list, in which case the statement shall also set forth the amount of such due and unpaid delinquent taxes and any due and unpaid penalties and interest thereon. If the statement indicates that the taxpayer was charged with any such taxes, a copy of the statement shall be transmitted by the fiscal officer to the county treasurer within thirty Days of the date it is submitted.

A copy of the statement shall also be incorporated into the Contract, and no payment shall be made with respect to any Contract to which 103.42 applies unless such statement has been so incorporated as a part thereof.

103.43 Conditions Precedent for Execution of Contract Form by City. The award of the Contract and the execution of the Contract Form are based upon the expectation that the lowest and best Bidder will execute the Contract Form and comply with all conditions precedent for execution of the Contract Form within ten Days of the date of the Notice of Intent to Award. Failure to execute the Contract Form or noncompliance with the conditions precedent for execution of the Contract Form within ten Days of the date of the Notice of Intent to Award shall be cause permitting the City to cancel the Notice of Intent to Award for the Bidder's failure to be best, and to award the Contract to another Bidder which the City determines is the lowest and best Bidder or to resubmit the Contract for Bidding, at the discretion of the City. The City may extend the time for submitting the conditions precedent for execution of the Contract Form for good cause shown. No extension shall operate as a waiver of the conditions precedent for execution of the Contract Form. The conditions precedent for execution of the Contract Form are as follows:

(a) Executed Contract Form;

(b) Contract Bond and to support the Contract Bond, a power of attorney for any attorney-in-fact signing the Contract Bond and a certificate of compliance issued by the Ohio Department of Insurance showing the Surety is licensed to do business in Ohio;

(c) Ohio Workers' Compensation Certificate;

(d) Certificate of Insurance (ACORD form is acceptable) clearly setting forth all exclusions and deductibles and copy of additional insured or loss payee endorsement. The City reserves the right to request a certified copy of the Contractor's insurance policies, including all endorsements.

(e) If the Bidder is a foreign corporation, i.e., not incorporated under the laws of Ohio, a Certificate of good standing from the Secretary of State showing the right of the Bidder to do business in the State will be required. If the Bidder is an individual or partnership, the Bidder has filed with the Secretary of State a Power of Attorney designating the Secretary of State as the Bidder's agent for the purpose of accepting service of summons in any action brought under Section 153.05 ORC, or under Sections 4123.01 through 4123.94, inclusive, ORC.

(f) Personal property Tax Statement; and

(g) Evidence of registration of the Contractor and all of the Contractor's Subcontractors with the Building Department and the City's Department of Finance, Division of Revenue and Taxation.

(h) Material Declaration of Assistance/Non-Assistance to Terrorist Organization, when required.

(i) If requested by the City, the Bidder shall immediately submit evidence that the Person signing the Contract is authorized to bind the Bidder.

103.44 Time Limits. A Contract Form is not executed until it has been signed on behalf of both the Bidder and the City by Persons authorized to bind the Bidder and the City, respectively. The failure to award the Contract and to execute the Contract Form within ninety Days of the Bid opening invalidates the entire Bid process and all Bids submitted, unless the time is extended by written consent of the apparent lowest and best Bidder and the City concurs with such extension. If the Contract is awarded and the Contract Form is executed within ninety Days of the Bid opening, any increases in material, labor and subcontract costs shall be borne by the Bidder without alteration of the amount of the Bid. If the cause of the failure to execute the Contract within ninety Days of the Bid opening is due to matters for which the City is solely responsible, the Contractor shall be entitled to a Change Order authorizing payment of verifiable increased costs in Materials, labor or subcontracts. If the cause of the failure to execute the Contract within ninety Days of the Bid opening is due to matters for which the Contractor is responsible, no request for increased costs will be granted.

103.45 Notice to Proceed and Submittals. The Authorized Representative shall issue the Contractor a Notice to Proceed which shall establish the date for commencement of the time for Contract Completion. The Contractor shall, within ten Days of the date of the Notice to Proceed, furnish the Engineer the following submittals:

(a) Contract Cost Breakdown;

(b) Preliminary schedule including shop Drawings and submittals;

(c) List of Subcontractors;

(d) List of Material Suppliers;

(e) Outline of qualifications of proposed Superintendent.

103.46 Wage Rates and Payment Dates. The Bidder shall base its Bid upon the prevailing rates of wages as ascertained by the Ohio Department of Commerce, Division of Labor & Worker Safety, Wage and Hour bureau or the U.S. Department of Labor, as applicable, for the Project as provided in Sections 4115.03 and 4115.14, ORC, or the Davis-Bacon Act, respectively. The Contractor shall, within ten Days of the date of the Notice to Proceed, provide to the Engineer for the prevailing Wage Coordinator a schedule of dates during the term of the Contract on which wages will be paid to employees for the Project.

ITEM 104 GENERAL REQUIREMENTS

104.01 Contract Documents
104.02 Applicable Law and ODOT Matters
104.03 Jurisdiction
104.04 Assignment of Antitrust Claims
104.05 Captions
104.06 Nondiscrimination Generally
104.07 City's Nondiscrimination Requirements
104.08 Notice of Commencement
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104.13 Requests for Information
104.14 Ownership and Use of Drawings and Specifications
104.15 Access to Documents
104.16 As-Built Drawings
104.17 Substitutes for Standards or Approved Equals
104.18 Sales and Use Taxes

104.01 Contract Documents. The Contractor, the Engineer and the Authorized Representative shall be familiar with all provisions of the Contract Documents.

104.02 Applicable Law and ODOT Matters. The Contractor and the City shall comply with all applicable Federal, State and local codes, statutes, ordinances and regulations in the performance of the Work on the Project. When the Federal government or the State pays all or any portion of the cost of the Project, the Work shall be subject to the inspection of the appropriate federal or State agency. No such inspection shall make the Federal government or State a party to the Contract and will in no way affect the rights and obligations of the City and the Contractor under the Contract. Any such inspection is solely for the benefit of the City and the Federal or State agency making it, and neither the Contractor nor the Surety shall be entitled to rely upon it for any purpose. References to ODOT matters shall be as set forth in the CMS current as of the date of the opening of Bids. In such instances, the CMS is incorporated only to the extent that it is not inconsistent with the Specifications.

104.03 Jurisdiction. The Montgomery County Court of Common Pleas, or the United States District Court for the Southern District of Ohio if required by law, shall be the exclusive jurisdiction in which any action or proceeding concerning any Bid, Contract, agreement or performance under the

Contract Documents or in connection with the Project shall be filed. In any such action or proceeding the Contract Documents shall be construed in accordance with the laws of the State which shall govern to the exclusion of the law of any other jurisdiction.

104.04 Assignment of Antitrust Claims. By executing the Contract Form, the Contractor assigns, conveys and transfers to the City any right, title and interest to any claims or causes of action it may have or acquire under State or Federal antitrust laws relating to any goods, products, or services purchased, procured or rendered to the City pursuant to the Contract.

104.05 Captions. Captions throughout the Contract Documents are for convenience and reference only and the words contained in a caption shall in no way be held to explain, modify, amplify or aid in the interpretation, construction or meaning of the provisions of the Contract Documents. Rights and responsibilities of the Contractor, the Engineer and the City are set forth throughout the Contract Documents and are included under different titles, articles and paragraphs for convenience.

104.06 Nondiscrimination Generally. During the performance of the Contract, the Contractor agrees that in the hiring of employees for the performance of Work, including without limitation Work to be performed by a Subcontractor, no Contractor or Subcontractor, and no Person acting on behalf of the Contractor or Subcontractor, shall, by reason of race, religion, national origin, age, sex, disability, or color, discriminate against any citizen in the employment of labor or workers who are qualified and available to perform the Work to which the employment relates. The Contractor further agrees that no Contractor or Subcontractor, and no Person acting on behalf of the Contractor or Subcontractor, shall, in any manner, discriminate against or intimidate any employee hired for the performance of Work on account of race, religion, national origin, age, sex, disability, or color. In the event of the Contractor's noncompliance with the nondiscrimination clauses, the contract may be terminated or suspended in whole or in part, and the Contractor may be declared not responsive or responsible for further City Contracts or such other sanctions as provided by law. Any provision of a hiring hall Contract or agreement which obligates a Contractor to hire, if available, only such employees as are referred to the Contractor by a labor organization shall be void as against public policy and unenforceable with respect to employment under any public improvement Contract unless, at the date of execution of such hiring hall Contract or agreement, or within thirty Days thereafter, such labor organization has in effect procedures for referring qualified employees for hire without regard to race, color, religion, national origin, or ancestry and unless such labor organization includes in its apprentice and journeymen membership, or otherwise has available for job referral without discrimination, qualified employees.

104.07 City's Nondiscrimination Requirements. The Contractor shall comply with RCGO, Section 35.14 which provides as follows and any amendments thereto:

(a) The Contractor or vendor shall not discriminate against any employee or applicable for employment because of race, color, religion, sex, ancestry, national origin, or place of birth. The Contractor or vendor shall take affirmative action in accordance with terms outlined in its Proposal and the provisions of this Contract to insure that applicants are employed; and that employees are treated during employment, without regard to their race, color, religion, sex, ancestry, national origin, or place of birth. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor or vendor agrees to post in conspicuous places, available to employees and applicants, notices to be provided by the City setting forth the provisions of the nondiscrimination clauses.

(b) The Contractor or vendor shall in all solicitations or advertisements for employees placed by or on behalf of the Contractor or vendor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, ancestry, national origin, or place of birth.

(c) The Contractor or vendor shall send to each labor union or representative of workers with which the Contractor or vendor has a collective bargaining agreement or other Contract or understanding, a notice to be provided by the City advising the labor union or workers' representative of the notice in conspicuous places available to employees and applicants for employment.

(d) The Contractor or vendor shall comply with all rules, regulations, and relevant orders promulgated by the Human Relations council pursuant to its duties created by ordinance.

(e) The Contractor or vendor shall file, and shall cause each of the Subcontractors and Material Suppliers to file, compliance reports with the Human Relations Council as may be directed. Compliance reports shall be filed within such times and shall contain such information as to the practices, policies, programs, and employment policies, programs and employment statistics of the Contractor, vendor, Material Supplier, or Subcontractor and shall be in such form as the Human Relations Council may prescribe.

(f) The Contractor or vendor shall furnish all information and reports required by this Contract and by the rules, regulations, and orders of the Human Relations Council pursuant hereto, and shall permit reasonable access to the Contractor's or vendor's books, records, and accounts by the Human Relations Council or its representative, as necessary for purposes of investigation to ascertain compliance with this Contract and rules, regulations and orders.

In the event of the Contractor's or vendor's failure to comply with the equal employment opportunity and affirmative action provisions of this Contract, including the affirmative action undertaking outlined in it is Proposal, or with any of the rules, regulations, or orders herein referred to, it is agreed that the City, at its option, may do any or all of the following:

(a) Cancel, terminate, or suspend this Contract, in whole or in part.

(b) Declare the Contractor or vendor ineligible for further City Contracts.

(c) Recover from the Contractor or vendor by set-off against the unpaid portion of the Contract, the sum of fifty dollars per Day, as Liquidated Damages and not as a penalty, for each Day that the Contractor or vendor shall fail to comply with these provisions of the Contract, as determined by the Human Relations Council in accordance with its rules and regulations, the said sum being fixed and agreed upon by and between the Contractor and the City because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages which the City would sustain in the event of such a breach of Contract, and that amount is agreed to be the amount of damages which the City would sustain.

(d) Impose such other sanctions as may be imposed by the Human Relations Council pursuant to ordinances passed by the commission, or seek such other remedies as may be provided by law.

The Contractor or vendor shall include the provisions of this Contract in every subcontract, so that such provisions shall be binding upon each Subcontractor. The Contractor or vendor shall take such action with respect to any subcontracts as the Human Relations Council may direct as means of enforcing such provisions, including sanctions for noncompliance. However, in the event the Contractor or vendor becomes involved in, or is threatened with litigation with a Subcontractor as a result of such direction by the Human Relations Council, the Contractor or vendor may request the City to enter into such litigation to protect the interests of the City.

104.08 Notice of Commencement. The Authorized Representative shall prepare a Notice of Commencement in affidavit form identifying the name and address of the City, the Project, the name, address of the Contractor, the date of execution of the Contract, and the name and address of the Surety for the Contractor, in addition to the name and address of the Authorized Representative upon whom a Claim Affidavit may be served. The Notice of Commencement shall be made available upon request.

104.09 Giving Notice. Whenever any provision of the Contract Documents requires the giving of any notice after the execution of the Contract Form, such notice shall be deemed to have been validly given if delivered personally to the Person for whom the notice is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address of such Person known to the giver of the notice. All notices provided to the Contractor by the Engineer shall be copied to the Authorized Representative. All notices provided to the Engineer by the Contractor shall be copied to the Authorized Representative. All notices provided to the Authorized Representative by the Contractor shall be copied to the Engineer.

104.10 Computation of Time. When any period of time is referred to in the Contract Documents by Days, it shall be computed to exclude the first and include the last Day of such period. If the last Day of any such period falls on a Saturday, Sunday or a legal holiday, such day will be omitted from the computation and such period shall be deemed to end on the next succeeding day which is not a Saturday, Sunday or legal holiday.

104.11 Facsimile Transmission and Electronic Mail. Any notice required to be given by the Contract Documents may be given by facsimile transmission or electronic mail, provided the original signed notice is delivered within two Days after the date of the facsimile transmission or electronic mail. Facsimile transmittals in excess of 10 pages are discouraged.

104.12 Intent. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. The Contractor shall provide all labor, Equipment and Materials necessary for the entire completion of the Work described in the Contract Documents and reasonably inferred therefrom to produce the intended results. The Specifications may not be superseded or amended by the Drawings unless so provided in supplemental Specifications or Special Provisions prepared by the Engineer and approved in writing by the Authorized Representative. The Drawings shall generally govern dimensions, details and locations of the Work and calculated dimensions shall govern over

scaled dimensions. The Specifications shall generally govern quality of Materials and workmanship. The organization of the Specifications in divisions, sections and articles, and the arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. In the event of inconsistencies within or between the Contract Documents, the Contractor shall provide the better quality or greater quantity of Work, and shall comply with the stricter requirement. Unless otherwise specified in the Contract Documents, words which have well-known technical or construction industry meanings are used in accordance with such recognized meanings.

104.13 Requests for Information. If the Contractor finds any perceived ambiguity, conflict, error, omission or discrepancy on or between any of the Contract Documents, including without limitation, the Drawings and Specifications, or between any of the Contract Documents and any applicable provision of law, the Contractor, before proceeding with the Work, shall submit a written Request for information to the Engineer for an interpretation or clarification. The Contractor shall be responsible for the prompt delivery of any such Request for information. The Engineer shall respond in writing to any and all requests for information within three business Days of receipt. Any interpretation or clarification of the Contract Documents made by any Person other than the Engineer, or in any manner other than in writing, shall not be binding and the Contractor shall not rely upon any such interpretation or clarification. If any change to the Work is made to accommodate unforeseen circumstances, the Engineer shall initiate the appropriate action and notify the Authorized Representative.

104.14 Ownership and Use of Drawings and Specifications. All Drawings and Specifications are the property of the City. In making copies of the Drawings and Specifications available, the City does not confer a license or grant permission for any use other than Work on the Project. Unless otherwise specified in the Contract Documents, the Engineer shall furnish to the Contractor, free of charge, 7 sets of Drawings and Specifications if the Contract price is five hundred thousand dollars or less, and 10 sets of Drawings and Specifications if the Contract price is in excess of five hundred thousand dollars. The Contractor may obtain additional copies of the Contract Documents from the Engineer, upon request, at the cost of reproduction, if any.

104.15 Access to Documents. The Contractor shall maintain in good order at the Project site one copy of all Drawings, Specifications, Bulletins, Addenda, approved Shop Drawings, catalog data, manufacturer operating and maintenance instructions, certificates, warranties, Change Orders, and other modifications, including As-built Drawings. The Contractor shall at all times

permit access to the documents described in 104.15, and any other Contract Documents by the Authorized Representative and the Engineer.

104.16 As-Built Drawings. For Projects administered by the Water Engineering Manager of the City's Department of Water, the Contractor shall keep an accurate record of all approved changes made to the Drawings to show Work as actually performed where such Work varies from Work as originally shown, including the exact location and depth of underground utility lines. During the performance of the Work, the Contractor shall record, prior to the submission of each Contractor Payment Request, any approved changes on the Drawings, neatly in a contrasting color, noting new information not shown on the original Drawings. Failure to so record such changes may cause payment to be withheld or delayed. Where shop Drawings are used, the Contractor shall cross reference the corresponding sheet numbers on the Drawings and sections of the Specifications. The Contractor shall note related Change Order numbers where applicable. The Contractor shall keep a record of any change made to the Specifications, noting particularly any variation from manufacturer's instructions and recommendations. 104.16 shall not apply to any Project administered by the Engineer of the Department of Public Works unless required in the supplemental Specifications or Special Provisions for the Project.

104.17 Substitutes for Standards or Approved Equals. Requests for substitutes for standards or Approved Equals shall not be considered after the Bid opening unless listed on the Substitution sheet or after the Contractor can conclusively demonstrate to the Engineer one of the following conditions:

(a) All applicable standards and Approved Equals are not available through no fault of the Contractor or the Contractor's Subcontractors and Material Suppliers;

(b) All applicable standards and Approved Equals are no longer produced;

(c) All applicable standards and Approved Equals will not perform as designed or intended.

104.18 Sales and Use Taxes. Only those Materials which ultimately become a part of the completed Structure or improvement which constitutes the Project will be exempt from State sales tax as provided in Section 5739.02 ORC, and State use tax as provided in Section 5741.01 ORC. The purchase, lease or rental of material, Equipment, parts or expendable items such as form lumber, tools, oils, greases and fuels, which are used in connection with the Work, are subject to the application of State sales tax and State use tax.

ITEM 105 CITY'S RIGHTS AND RESPONSIBILITIES

105.01 Generally
105.02 Right to Perform and Backcharge
105.03 Right to Partial Occupancy or Use
105.04 City's Right to File Suit
105.05 No Personal Liability of Public Officials
105.06 No Waiver of Legal Rights
105.07 No Estoppel

105.01 Generally. Information and services required of the City may be furnished through the Engineer or the Authorized Representative and shall be furnished in good faith and in a timely manner to avoid interference with, delay, hindrance, disruption or impact to the progress of the Project. The City and the City's officials, employees, consultants, agents and representatives as determined by the Engineer shall at all times have access to the Work whenever the Project is in preparation or progress. Upon the issuance of the Notice to Proceed or at a reasonable time thereafter, the City shall provide the Contractor the Project site in such condition to permit the Contractor to perform the Work. The foregoing are in addition to other rights and responsibilities of the City enumerated herein and especially those in respect to the City's right to prosecute the Work, approve payments and accept the Project.

105.02 Right to Perform and Backcharge. If the Contractor provides Defective Work or fails or neglects to perform the Work with the necessary diligence so as to complete the Work within the time specified in the Contract Documents or any portion of the Work by the applicable milestone completion date as set forth in the current Project, the Engineer shall notify the Contractor in writing of such failure or neglect. If the Contractor fails or refuses to cure such Defective Work or failure or neglect within three business Days after receipt of the written notice, the Engineer shall recommend enforcement of the Contract to the City pursuant to 106.02 and 106.03. Without prejudice to any other remedy the City may have, the City may employ upon the Work the additional force, or supply the Materials or such part of either as is appropriate, to correct the deficiency in the Contractor's Work, as determined by the Authorized Representative. In such case, a Change Order shall be issued deducting from payments then or thereafter due the Contractor the costs of correcting such Defective Work, failure or neglect, including without limitation Liquidated Damages. If the payments then or thereafter due the Contractor are not sufficient to cover such costs, the Contractor and the Contractor's Surety shall pay the amount of the insufficiency to the City. The decision of the Authorized Representative to backcharge the Contractor shall be final, subject to proceedings in accordance with 118.01 through 118.11.

The City reserves the right to furnish at any time such Materials and labor and to prosecute such Work in addition to the Work of the Contractor as the City may desire; provided, however, that if such prosecution of additional Work should interfere with, disrupt, hinder, delay or impact the Work of the Contractor, the Contractor shall be entitled to a reasonable extension of time in accordance with these general conditions. This provision is intended to be, and shall be construed as, consistent with, and not in conflict with, Section 4113.62 ORC, to the fullest extent permitted.

105.03 Right to Partial Occupancy or Use. If the City finds it necessary to occupy or use the Project, or a designated portion of the Project prior to Contract Completion, such use may be accomplished if the Engineer informs the City that the portion in question has been approved for occupancy use, including by the Department of Building Services, if applicable. If Partial Occupancy or Use is approved by the City, the Engineer may process either a Change Order or a Certificate of Partial Occupancy or Use for the applicable portion of the Project listing the uncompleted or Defective Work under the Contract for approval by the City, provided that no such occupancy or use shall commence before any insurers providing property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. From the date of execution of the Change Order or Certificate of Partial Occupancy or Use by the Engineer, the Contractor shall be relieved of obligation to maintain the accepted portion of the Work, but shall remain obligated to correct any incomplete or Defective Work, including, without limitation any Punch List items then uncorrected. The Contractor shall continue to carry the appropriate insurance during performance of any such Work. Partial Occupancy or Use of the Project by the City shall not constitute acceptance of any Work not in conformity with the Contract Documents. Partial Occupancy or Use shall not relieve the Contractor of liability for any express or implied warranties or from responsibility for Defective Work.

105.04 City's Right to File Suit. The City may maintain an action in its own name for violations of any law relating to the Project, for any injury to Persons or property pertaining to the Work or for any other cause which is necessary in the performance of the City's duties.

105.05 No Personal Liability of Public Officials. In carrying out the provisions of the Contract Documents, or in exercising any power or authority granted to them by or within the scope of the Contract Documents, there shall be no liability upon the officers and employees of the City, whether 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.

105.06 No Waiver of Legal Rights. No action or omission by the City or the City's officers and employees, nor any approval of any request for payment, claim, or Change Order, nor any payment for or acceptance of any Work, nor any extension of time, nor any possession taken by the City or the City's officers or employees shall operate as a waiver of any provision of the Contract Documents, or of any power herein reserved to the City, or any right to damages herein provided; nor shall any waiver of any breach of the Contract be held to be a waiver of any other subsequent breach.

105.07 No Estoppel. The City shall not be precluded or estopped by any return or certificate given by the Contractor either before or after the final completion and acceptance of the Work from showing the true and correct amount and character of the Work done and Materials furnished, or from showing at any time that any such return or certificate is untrue and incorrect or improperly made, or from showing that the Work, Materials or Equipment do not conform to the Contract Documents or from demanding and recovering from the Contractor such damages as the City may sustain by reason of the Contractor's failure to comply with the Contract Documents.

ITEM 106 THE ENGINEER

106.01 Project Inspection
106.02 Rejection of Work
106.03 Contract Administration
106.04 Monitoring Progress
106.05 Interpretation
106.06 Authorization of Inspection, Testing and Approval
106.07 Review of Payment Requests
106.08 Review of Submittals
106.09 Preparation of Change Orders
106.10 Final Inspections
106.11 Claims Services
106.12 Project Rules and Hours
106.13 Construction Schedule

106.01 Project Inspection. The Engineer or Inspector shall inspect the progress and quality of the Work, including the preparation, fabrication or manufacture of Materials and Equipment, for conformity to the Contract Documents. The Engineer shall be provided access to all parts of the Project and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. Inspection by the Engineer or an Inspector is solely for the benefit of the City and shall not relieve the Contractor of any of its responsibilities under the Contract Documents. When any unit of government, political subdivision or railroad corporation is to pay a portion of the cost of the Work, its representatives shall have the right to inspect the Work. Such inspection shall in no sense make any unit of government, political subdivision or railroad corporation a party to the Contract, and shall in no way interfere with the rights of the City or the Contractor under the Contract. The Inspector is not authorized to issue instructions contrary to the Contract Documents or to act for, or for the benefit of, the Contractor. Changes to the Contract Documents must be made in accordance with 117.01 through 117.12.

106.02 Rejection of Work. The Engineer or an Inspector shall have the authority to disapprove or reject any item of Work which is Defective, or that the Engineer or Inspector believes will not produce a Project that conforms to the Contract Documents, or that will prejudice the integrity of the design concept of the Project as a functioning whole as indicated by the Contract Documents. The Engineer or Inspector shall immediately notify the Authorized Representative and the Contractor at any time that Work has been disapproved or rejected. The Engineer or Inspector shall not be responsible for construction means, methods, manners, techniques, sequences, procedures, safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.

106.03 Contract Administration. The Engineer shall provide administration of the Contract for the Project as provided by the applicable agreement between the City and the Engineer, if any, and the Contract Documents. The Engineer shall secure any required NPDES general permit by submitting a notice of intent application form to the Ohio EPA at least forty-five Days prior to the start of construction. When required by law, the Engineer shall prepare and certify a storm water pollution prevention plan and process the required notice of termination prior to completion of the Project. The Engineer shall attend any and all progress and coordination meetings. The Engineer shall prepare a written report of each progress and coordination meeting and transmit it to the Authorized Representative within three business Days of the meeting. The Engineer shall not delegate the duty to prepare the written report of any Project and coordination meeting attended. The Engineer or Inspector may authorize minor changes or alterations in the Work not involving additional costs or time and not inconsistent with the overall intent of the Contract Documents but has no authority to authorize the Contractor to perform additional or extra Work for which the Contractor will seek compensation in addition to the Contract price or extension of the time for Contract Completion. The Engineer shall review and approve, or recommend approval, of all forms required under the Contract Documents. The Engineer shall render decisions in connection with the Contractor's responsibilities under the Contract Documents and submit recommendations to the Authorized Representative for enforcement of the Contract as necessary.

106.04 Monitoring Progress. The Engineer shall monitor the progress of the Work for conformance with the Construction Schedule and shall initiate revisions of the Construction Schedule as required by the Contract Documents. In the event of default by the Contractor, the Engineer shall cooperate with the Contractor's Surety to Contract Completion. The Engineer shall keep a daily log containing a record of weather, number of workers on site, identification of Equipment, Work accomplished, problems encountered, and other similar relevant data.

106.05 Interpretation. The Engineer will be the initial interpreter of all requirements of the Contract Documents. All decisions of the Engineer shall be subject to final determination by the City.

106.06 Authorization of Inspection, Testing and Approval. The Engineer shall authorize special inspection, testing or approval of the Work, as provided in 107.31, whenever in the Engineer's reasonable opinion such action is necessary or advisable to insure conformity with the Contract Documents.

106.07 Review of Payment Requests. Based upon the Engineer's on-site observations and evaluation of the Contractor's Payment Request, the Engineer shall review and certify the amounts due the Contractor. The Authorized Representative may recommend to the City that payment be withheld from, or Liquidated Damages be assessed against, a Contractor's Payment Request, stating the reasons for such recommendation. The Engineer's certification for payment shall constitute a representation to the City that the Work has progressed to the point indicated and that, to the best of the Engineer's knowledge, information and belief, the Work is in conformity with the Contract Documents and the Contractor is entitled to payment in the amount certified.

106.08 Review of Submittals. The Engineer shall review and approve or take other appropriate action upon the Contractor's submittals within the required time for the purpose of checking for conformity with the Contract Documents.

106.09 Preparation of Change Orders. The Engineer shall prepare all Bulletins and Change Orders, including a cost estimate and supporting documentation and data.

106.10 Final Inspections. The Engineer shall conduct inspections to determine the date of Contract Completion and shall receive, review and forward to the appropriate Person all Project record submittals required by the Contract Documents.

106.11 Claims Services. The Engineer shall render analyses, written recommendations, or decisions, within the time specified, on all claims, disputes, or other matters in question between the Contractor and the City and shall provide information or services to the City until final disposition of all such claims, disputes, and matters.

106.12 Project Rules and Hours. The Engineer shall consult with the Authorized Representative to obtain full knowledge of all City rules, regulations or requirements affecting the Project. The Engineer shall establish the regular working hours with the Contractors, subject to approval of the Engineer.

106.13 Construction Schedule. The Engineer shall review the Construction Schedule together with a schedule of submittals which is coordinated with the Construction Schedule in accordance with 109.05 through

109.09. If the Contractor fails to prosecute the Work in accordance with the Construction Schedule, the provisions of 105.02 may be invoked.

ITEM 107 THE CONTRACTOR

107.01 Construction Procedures
107.02 Cutting, Fitting and Patching
107.03 Excavation
107.04 Borrow and Waste Areas
107.05 Construction and Demolition Debris
107.06 Manufacturer's Recommendations
107.07 Construction Supervision
107.08 Protection of Project, Property and Utilities
107.09 Load Restrictions
107.10 Materials and Equipment
107.11 Storage
107.12 Labor
107.13 Maintenance of Utilities
107.14 Maintenance of Traffic
107.15 Safety Precautions
107.16 Work Stoppage Due to Hazardous Materials
107.17 Vehicle Damage Claims
107.18 Fire Hydrants
107.19 Engineer Facilities
107.20 Meeting Spaces
107.21 Temporary Heat
107.22 Water
107.23 Hoists and Elevators
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107.25 Temporary Facilities
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107.27 Environmental Protection
107.28 NPDES General Permit
107.29 Building Permits
107.30 Other Permits
107.31 Inspection, Testing, and Approval
107.32 Uncovering the Work
107.33 Correction of the Work
107.34 Interruption of Existing Services
107.35 Clean Up
107.36 Explosives and Blasting
107.37 Emergency
107.38 Royalties and Patents

107.01 Construction Procedures. The Contractor shall be responsible for and have control over all construction means, methods, manners, techniques, sequences and procedures for all portions of the Contractor's Work and shall be responsible for any injury or damage which may result from the

Contractor's Work or from improper construction, installation, maintenance or operation to the fullest extent permitted by law. Unless otherwise specified in the Contract Documents, the Contractor shall be responsible for properly and accurately laying out all lines, levels, elevations, grades and measurements for all the Work required by the Contract Documents and for the preservation of all related stakes and markers.

107.02 Cutting, Fitting and Patching. The Contractor shall do any cutting, fitting or patching required for the Contractor's Work and shall not endanger the Project by cutting, excavating or otherwise altering the Project, or any part of it. If Contractor requires sleeves, the Contractor shall furnish and coordinate the installation of the sleeves. The Contractor shall be responsible for the exact location and size of all holes and openings required to be formed or built for the Work, to permit coordination with any Work performed by other Persons on the Project. The Contractor shall allow sufficient time for installation of any Work performed by other Persons before covering or closing the applicable portion of the Project. Patching shall match and blend with the existing or adjacent surface. Any patching required because of Defective or ill-timed Work shall be done by and at the expense of the Contractor.

107.03 Excavation. The Contractor shall not cut away any Structure or dig under any foundation or into any wall, or any other part of the Project, without the written approval of the Engineer. Unless otherwise specified in the Contract Documents, the Contractor, prior to starting excavation or trenching, shall give notice at least two business Days in advance to the Owners of underground utilities registered with the Ohio Underground Utility Protection Services (OUPS) at www.oups.org, or by phone at (800) 362-2764 and the Owners of underground utilities shown on the Drawings and Specifications who are not registered members of OUPS. The Owner of an underground utility is required within forty-eight hours of notice, excluding Saturdays, Sundays and legal holidays, to stake, mark or otherwise designate the location of its utilities in the construction area together with its approximate depth. If any underground utility Owner fails to timely perform, the Contractor shall immediately notify the Engineer and contact the Owner of the underground utility. If any underground utility must be moved or adjusted, the Contractor shall notify the Owner of the underground utility in a timely manner so that the Work will not be delayed. Unless otherwise provided in the Contract Documents, any movement or adjustment of any underground utility or utility appurtenances, including without limitation electrical and gas meters, water and gas valves and light standards within the Project site is made by the Owner of the utility at the utility Owner's expense. In performing any excavation or trenching, the Contractor shall exercise caution and implement appropriate safety precautions to avoid property damage and personal injury. The Contractor shall backfill any excavation with the material specified and approved by the Engineer. The right to construct or reconstruct any utility service in the street or right of way or to grant permits for

same, at any time, is hereby expressly reserved to the City and the Contractor shall not be entitled to any damages for the digging up of the street or Right-of-Way in accordance with such a permit. Any Person wishing to make an opening in the street must secure a permit from the City. The Contractor shall allow Persons bearing such permits, and only those Persons, to make openings in the street or Right-of-Way. When required by the Engineer, the Contractor shall make all necessary repairs due to such openings under the same conditions as the Work. Any adjustment of the Contract price or of the time for Contract Completion resulting from any such opening or repair may be made by Change Order. When the Work includes construction of underground lines and Structures, the Contractor shall make temporary restoration of street surfaces immediately upon completion of the underground lines and Structures, shall remove surplus excavated Materials and shall grade the street and put it into a safe and passable condition. The Contractor shall immediately refill any settlement in or adjacent to trenches for such construction to the proper grade.

107.04 Borrow and Waste Areas. A Change Order may be issued in accordance with 117.01 to 117.12 to permit the Contractor to use natural Materials found on the site of the Project. Whenever Materials are to be borrowed or wasted in borrow or Waste Areas or, if allowed by the Contract Documents, wasted on the Project site, the Contractor shall prior to beginning borrow or wasting operations, obtain the Engineer's written approval of a detailed operation plan that addresses the following concerns:

(a) Control of drainage water;

(b) Cleanup, shaping, and restoration of disturbed areas;

(c) Disposal of regulated Materials;

(d) Avoidance of regulated areas;

(e) Excavation and filling of waste and Borrow Areas;

(f) Saving of topsoil;

(g) Measures to minimize sediment runoff, including keeping sediment and other contaminants from leaving the Project site and from entering streams, lakes, or reservoirs by using methods provided in the Contract Documents.

The Contractor shall use the current versions of ODOT's *Sediment and Erosion Control Handbook* and the *Location and Design Manual, Volume 2, Drainage Design* to design and plot a sedimentation and erosion control plan on Project plan sheets and ensure the plan complies with all current provisions of ORC, Chapter 6111 and the NPDES permit. The Contractor shall not waste

material and discharge dredge or fill Materials into the "Waters of the United States" or an isolated wetland without the required permits from U.S. Army Corps of Engineers (404 Permit) and the Ohio EPA (401 Permit). The Contractor shall have the proposed borrow and Waste Areas reviewed by a qualified environmental consultant approved by the City and have the environmental consultant certify that the proposed borrow and waste operations will not impact the "Waters of the United States" or an isolated wetland. If consultant certification is not provided, the Contractor shall obtain the 404/401 Permits necessary to perform the operations as proposed and have the environmental consultant certify that the Work conforms to the requirements of the permits. The Contractor shall provide copies of all documentation submitted to obtain the appropriate permits and copies of the permits to the Engineer. The Contractor shall not waste or borrow material from a cultural resource site or a site eligible for the national Register of Historic Places. For sites found to have historic or prehistoric human remains, the Contractor shall comply with the requirements of Sections 2909.05 and 2927.11, ORC. If the Contract Documents require a cultural resource investigation, a qualified environmental consultant approved by the City for cultural resource investigation shall be used to review and certify that the waste or Borrow Area:

(a) does not impact a cultural resource;

(b) is not a cultural resource;

(c) is not eligible for the national Register of Historic Places; or

(d) does not consist of historic or prehistoric human remains.

If burning is permitted under the OAC-3745-19 and Section 1503.18, ORC, the Contractor shall submit a copy of the Ohio EPA permit and the Ohio DNR permit to the Engineer and copies of all information used to obtain the permit. All damage to surrounding property resulting from the instability of borrow and Waste Areas, the removal of borrow Materials, the placement of waste Materials, or the hauling of material to and from these areas is the sole responsibility of the Contractor. Prior to the disposal of waste Materials outside the Project site, the Contractor shall submit to the City an executed copy of the Contract or permission statement from the property Owner. The Contract or permission statement must indicate that the waste Materials are not the property of the City, that the City is not a party to the Contract or permission statement and that the Contractor and property Owner will hold the City harmless from claims that may arise from their Contract or permission statement. Restoration of all borrow and Waste Areas includes cleanup, shaping, replacement of topsoil, and establishment of vegetative cover by seeding and mulching according to the Contract Documents. The Contractor shall ensure that the restored area is well drained unless approval is given by the Engineer to convert a pit area into a pond or lake, in which case the Contractor shall confine restoration measures to the disturbed areas above the anticipated normal water level, and that any proposed

waste location is not within the FEMA mapped one hundred year floodplain. If the proposed waste location is within the FEMA mapped one hundred year flood plain, the Contractor shall submit written approval from the local floodplain coordinator for the site. The floodplain coordinator contacts for each county are available through the Ohio DNR, Division of Water, (614) 265-6750. No extension of time or additional compensation will be paid for any delays due to not having the written permit(s) to waste in a floodplain.

107.05 Construction and Demolition Debris. OAC-3745-37, OAC-3745-400, and Chapter 3714 ORC, regulate the use and disposal of construction and demolition debris. The Contractor shall notify the local Board of Health or the local Ohio EPA office seven Days before placing clean hard fill off the Project site or Right-of-Way and submit copies of this notification to the Engineer. The Contractor shall dispose of debris containing wood, road metal, or plaster at a licensed construction and demolition debris site. The disposal of brush, trees, stumps, tree trimmings, branches, weeds, leaves, grass, shrubbery, yard trimmings, crop residue, and other plant matter is restricted. If allowed by the Contract Documents, the Contractor may waste brush, trees, stumps, tree trimming, branches, weeds, leaves, grass, shrubbery, yard trimmings, crop residue, and other plant matter within the Project site or the Right-of-Way. Otherwise, the Contractor shall submit a plan and any required permits to legally dispose of these Materials off the Project site or Right-of-Way to the Engineer and shall provide all documents submitted to obtain this permit to the Engineer. If the Project contains garbage or solid and hazardous waste, the Contractor shall comply with applicable laws and any applicable provisions of the Contract document for the removal of these items. When wasting PCC, the Contractor shall mix the PCC with at least thirty percent natural soil to construct an inner core in the Waste Area, cover this inner core with 3 feet of natural soil on the top and eight feet on the side slopes and place and compact the material according to the Contract Documents to prevent future settlement and sliding.

107.06 Manufacturer's Recommendations. The Contractor shall install all Work in accordance with the Contract Documents and any recommendations of the manufacturer, including required temperature and humidity for installation of the various Materials.

107.07 Construction Supervision. The Contractor shall provide continuous supervision at the Project by a competent Superintendent when any Work is being performed, unless waived by the Authorized Representative. The Superintendent shall have responsibility and authority to act on behalf of the Contractor. All communications to the Superintendent shall be as binding as if given directly to the Contractor. The Contractor shall submit an outline of the qualifications and experience of the Contractor's proposed Superintendent, including references, to the Engineer within ten Days of the Notice to Proceed.

The City reserves the right to reject the Contractor's proposed Superintendent. Any such rejection shall be determined by the Authorized Representative. Failure of the Authorized Representative to notify the Contractor of such rejection within thirty Days of receipt of the required information shall constitute notice that the City has no objection. If the City rejects the Contractor's proposed Superintendent, the Contractor shall replace the Superintendent at no additional cost to the City. The Contractor shall not change or terminate the Superintendent without written approval of the Authorized Representative. If the Contractor proposes to change or terminate the Superintendent, the Contractor shall submit to the Engineer a written justification for the change or termination, along with the name and an outline of qualifications experience of the Contractor's proposed new Superintendent, not less than ten Days prior to any change or termination. The procedure provided above shall be applied to evaluate the Contractor's proposed new Superintendent.

107.08 Protection of Project, Property and Utilities. The Contractor shall protect the Work from weather, and shall maintain the Work and all Materials, including Materials delivered to the Contractor by the City, apparatus, fixtures and other items on or adjacent to the Project site free from injury or damage until Final Acceptance. Non-rubber tired vehicles or Equipment shall not be moved on City streets and off road vehicles shall not be used on bases or pavements without the written approval of the Engineer. Work or items likely to be damaged shall be covered or protected at all times to prevent damage. Any Work or item damaged by failure of the Contractor to provide coverage or protection shall be removed and replaced with new Work or a new item, as applicable, at the Contractor's expense. The Contractor shall perform the Work within the site of the Project and any applicable easement or Right-of-Way. Any adjacent property, including without limitation roads, walks, shrubbery, plants, trees or turf, damaged during the Contractor's Work shall be properly repaired or replaced at the Contractor's expense. Unless otherwise specified in the Contract Documents, the Contractor shall protect the Project and existing or adjacent property and utilities from damage at all times and shall erect and maintain necessary barriers, furnish and keep lighted necessary danger signals at night, and take precautions to prevent injury or damage to individuals or property. When mailboxes, road or street name signs and supports are within the Project site, the Contractor shall remove and erect them in a temporary location during construction in a manner satisfactory to the Engineer. After completion of the Work, the Contractor shall erect the mailboxes, road or street name signs and supports in a permanent location in accordance with the Drawings unless otherwise required by Change Order. Removal, temporary erection and permanent erection shall be in accordance with United States postal regulations. When cornerstones, monuments and property corner pins are encountered in the performance of the Work, and monument covers are not listed in the Bid, the City will supply them and supervise their precise location and installation, and the Contractor will furnish all the labor, Materials and Equipment required for such installations. 105.02 may be invoked for the cost to the City for repair, re-

evaluation of location and replacement of any cornerstone, monument or property corner pin within the Project, damaged, destroyed or made inaccessible during the progress of the Work by the Contractor. Existing surface or overhead Structures or utility lines are not necessarily shown on the Drawings and the locations of those shown are approximations. The Contractor shall make such investigations as are necessary to determine the extent to which existing surface or overhead Structures may interfere with the performance of the Work. Any sizes, locations, and depths for such Structures are approximations and the Contractor shall make such investigation or exploration as may be necessary to determine the actual sizes, locations and depths. The Contractor shall field locate all existing utilities before setting line and grade. Unless otherwise specified in the Contract Documents, the Contractor shall remove all snow and ice as may be required for access to and performance of the Work.

107.09 Load Restrictions. The Contractor shall not load, nor permit any part of the Project to be loaded, in any manner that will endanger the Project, or any portion thereof, nor shall the Contractor subject any part of the Project or existing or adjacent property to stress or pressure that will endanger the Project or property. The Contractor shall provide all temporary bracing, shoring and other structural support required for safety of the Project and proper execution of the Work, including without limitation all necessary support and protection of the property of any utility. The Contractor shall comply with all legal load restrictions in the hauling of Materials on public roads and shall operate Equipment of a weight or so loaded as to not cause damage to Structures, Roadway, or other construction. A special permit will not relieve the Contractor of sole liability for damage which may result from the moving of Equipment or Materials. The Contractor shall not haul on concrete pavement, base or Structures before the expiration of the curing period.

107.10 Materials and Equipment. The Contractor shall provide only new Materials and Equipment of the quality specified in the Contract Documents. The Contractor shall immediately remove Materials or Equipment not conforming to the requirements of the Contract Documents. The Contractor shall not incorporate Materials or Equipment, the defects of which have been corrected without written approval from the Engineer. If the City is to furnish any Materials, the City shall deliver them in accordance with the Contract Documents. The Contractor shall coordinate and schedule sufficient time for any such delivery. The Contractor shall provide domestically produced steel as required by law including Sections 153.011 and 5525.21, ORC, and Federal laws and regulations, if applicable. The Contractor shall furnish documentation to the Engineer evidencing the domestic origin of applicable steel and iron products before they are incorporated into the Project. Steel and iron products without a traceable, documented domestic origin will be treated as non-domestic products. The City may reject any item or material provided by a Contractor in violation of this requirement. The Contractor shall notify the Engineer of proposed sources

of Materials prior to delivery. The Engineer may approve Materials at the source of supply before delivery. If the proposed source of supply cannot produce the specified Materials, the Contractor shall furnish Materials from Alternate sources without adjustment of the Contract price or the time for Contract Completion.

107.11 Storage. Only the material and Equipment which are to be used directly in the Work shall be brought to or stored at the Project by the Contractor and the Contractor's Subcontractors and Material Suppliers. The Contractor shall be responsible for the proper handling and storage of all material and Equipment brought or delivered to the Project to assure preservation of their quality and fitness for the Project and to facilitate inspection of them. Aggregates shall be transported from any storage site to the Project 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 Project as loaded, and the quantities as actually received at the site of the Project. After any material or Equipment is no longer required for the Work, the Contractor shall promptly remove such material and Equipment from the Project. The Contractor's Materials and Equipment shall not be stored in any Right-of-Way unless the location of such storage is approved by the Engineer. The Contractor shall, before storing Materials in gutters, lay suitable drains of sufficient size to carry all the storm water flowing in such gutters. Where the drainage from cross streets or alleys is interfered with or cut off by reason of the nature of the Work, the Contractor shall provide suitable crossings for pedestrians. No material or Equipment shall be stored within 20 feet of any fire hydrant. Private property shall not be used for storage of material and Equipment without the prior written permission of the Owner or lessee of the private property, and if requested by the Engineer, the Contractor shall provide a copy of the written permission to the Engineer. The Contractor shall restore all storage sites to their original conditions. The Contractor's material and Equipment shall not cause damage to the Project or adjacent property and shall not endanger any individual at, or in the vicinity of, the Project. Any injury to any individual or damage to property resulting from the Contractor's material or Equipment shall be the responsibility of the Contractor.

107.12 Labor. The Contractor shall maintain a sufficient workforce to timely perform the Work and enforce good discipline and order among the Contractor's employees and the employees of the Contractor's Subcontractors and Material Suppliers. The Contractor shall not permit employment of individuals not skilled in tasks assigned to them. The Contractor shall dismiss from the Project any individual employed by the Contractor or the Contractor's Subcontractors and Material Suppliers who is found by the Authorized Representative, pursuant to a recommendation from the Engineer, to be incompetent, guilty of misconduct, or detrimental to the Project. The Contractor shall employ all legal efforts to minimize the likelihood or effect of any strike,

Work stoppage or other labor disturbance. Informational pickets shall not justify any Work stoppage.

107.13 Maintenance of Utilities. The Contractor shall at all times provide and maintain access to fire hydrants, water valves, water service boxes, gas valves, gas service boxes, manholes and other similar appurtenances. During the course of construction, the Contractor shall be solely responsible to notify any utility or other service when such utility or service is encountered. The Contractor shall protect all above ground utilities, Structures and appurtenances and shall replace any damaged portions thereof. The Contractor shall protect all below ground utilities, Structures and appurtenances that may be accurately located by removing manhole covers, valve box covers, and other access point coverings with reasonable effort using hand tools for such removal and shall replace any damaged portions thereof.

107.14 Maintenance of Traffic. Vehicular and pedestrian public traffic shall be maintained during the Project whether it is traffic through the Project or only cross traffic at intersections, unless otherwise provided in the Contract Documents. The Contractor shall make all repairs to roads necessary to maintain traffic to the satisfaction of the Engineer. If there are locations on the Project where Sewer or water line construction only is called for and a part of the existing pavement will remain in place, traffic shall be maintained and ingress and egress to all public and private entrances shall be provided. The Contractor shall provide all necessary flaggers. The Contractor shall provide and maintain access to adjacent property including by constructing necessary temporary walks, driveways, Bridges, crossings, and Roadways. The Contractor shall notify the applicable fire and police department whenever a street or alley, or a portion of a street or alley is about to be closed to traffic and shall provide notice when such street or alley or portion thereof is to be opened. In the event of the complete closure of any street, alley or private drive, the City shall give notification to the occupants of all premises affected by the closure. The Contractor shall promptly notify the Engineer of all unforeseen effects of the Project on traffic. Unless the Contract Documents provide otherwise, all traffic control devices shall be furnished, erected, maintained and removed by the Contractor in accordance with the OMUTCD.

107.15 Safety Precautions. The Contractor shall take reasonable, diligent precautions and shall be responsible for the safety of individuals on or adjacent to the Project and shall comply with all applicable provisions of federal, State and municipal safety laws, regulations, and building codes to prevent injury to individuals on or adjacent to the Project. The Contractor shall comply with the rules, regulations and orders of OSHA. The Contractor shall be responsible for any fine or cost incurred as a result of any violation or alleged violation of such rules, regulations or orders. The Contractor shall take reasonable, diligent

precautions and shall be responsible for the safety of the Project, including without limitations all Materials and Equipment incorporated or to be incorporated in the Project. Prior to the start of any Work, the Engineer shall meet with the Contractor and other applicable Person to coordinate the Contractor's methods and Equipment for protecting the Project, other property and individuals from damage or injury, in accordance with applicable regulations. The Engineer efforts at coordination shall not relieve the Contractor of any responsibility for safety or ensure the Engineer to become responsible for safety. Methods and Equipment for protecting the Project, other property and individuals shall be subject to inspection and approval of the appropriate authority having jurisdiction over the Project site.

107.16 Work Stoppage Due to Hazardous Materials. In the event the Contractor, except a licensed abatement Contractor, encounters Materials reasonably believed to contain asbestos, polychlorinated biphenyl (PCB) or other hazardous waste or material, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Authorized Representative and the Engineer in writing. A licensed abatement Contractor shall report the condition to the Authorized Representative and the Engineer in writing and shall remove the waste or material or render it harmless. The Work in the affected area shall be resumed upon written notice from the Engineer that the waste or material has been removed or rendered harmless. The term "rendered harmless" shall mean that the level of exposure is less than any applicable exposure standards set forth by OSHA or other applicable regulations. Hazardous Materials to be used at the Project shall be identified by a MSDS. The applicable MSDS shall be prepared by the Contractor and submitted to the Engineer prior to a hazardous material being brought to the Project site. The Contractor shall maintain all applicable MSDS on site whenever Work is in preparation or progress.

107.17 Vehicle Damage Claims. When a Person reports damage to a vehicle, whether orally or in writing, to the Contractor, the Contractor shall file a written report, including copies of applicable police reports, with the Authorized Representative within three Days.

107.18 Fire Hydrants. The Contractor shall make any necessary arrangements with the City Department of Water for any use of fire hydrants in connection with the Work and shall pay for all water used from the hydrants. Permits from the Department of Water for use of fire hydrants shall be provided to the Engineer upon request.

107.19 Engineer Facilities. Unless otherwise specified in the Contract Documents, the Contractor shall provide and maintain in a clean

condition the following temporary facilities, Equipment and services for use by the Engineer:

(a) If space is available near the Project, 2 separate office spaces, both of which shall be adequately heated, lighted, air conditioned, and with doors which lock, the keys to which shall be provided to the Engineer;

(b) If space is not available near the Project, a standard width job trailer shall be provided, which shall be adequately heated, lighted, air conditioned, and with doors which lock, the keys to which shall be provided to the Engineer;

(c) Each office space shall be equipped with at least 1 desk, 1 desk chair and 2 side chairs and reasonable circulation space;

(d) Each office space shall have 1 four-drawer filing cabinet or equivalent;

(e) A plan rack and 4 by 8 foot plan table shall be provided in 1 office space;

(f) Each office space shall have at least 1 telephone in service;

(g) Use of a facsimile and copy machine shall be provided for use either in one of the office spaces or in an adjacent office space;

(h) One office space shall have a computer to the City's criteria with electronic mail capabilities.

107.20 Meeting Spaces. Unless otherwise specified in the Contract Documents, the General Trades Contractor shall provide adequate space, Equipment and furnishings to conduct progress and coordination meetings for the Project. The meeting area shall be furnished with an appropriate meeting table and an appropriate number of folding or stacking chairs to adequately seat all participants at the meetings.

107.21 Temporary Heat. Unless otherwise specified in the Contract Documents, the Contractor shall provide temporary heat necessary so that the Work shall proceed expeditiously during inclement weather, and to protect the Contractor's Work and Materials from damage. From a date of partial occupancy, the City is responsible for the cost of providing heat for the occupied portion of the Project.

107.22 Water. Unless otherwise specified in the Contract Documents, the Contractor shall provide all water necessary for the Contractor's Work. From a date of partial occupancy, the City is responsible for the cost of water consumed for the occupied portion of the Project.

107.23 Hoists and Elevators. The Contractor shall provide and maintain adequate hoisting and elevator facilities as required for the Contractor's Work in coordination with the Engineer. If electric service requirements of hoisting or elevator facilities differ from that available at the Project site, the Contractor requiring use of such hoisting or elevator facilities shall make and pay for all necessary connections. Unless otherwise specified in the Contract Documents, the Contractor requiring use of hoisting or elevator facilities, after the Project is enclosed, shall be responsible for transporting individuals and Materials as required for the Contractor's Work.

107.24 Electricity. Unless otherwise specified in the Contract Documents, the Contractor shall make all arrangements for temporary light and power services and shall pay all charges, both for service installation and removal, if required, and for energy consumed until Final Acceptance of the Project. Unless otherwise specified in the Contract Documents, the Contractor requiring any electrical service requirements relating to temporary hoists, cranes, welding Equipment or elevators shall subcontract with a licensed Contractor for such service requirements and shall be responsible for all costs of such services. From a date of partial occupancy, the City is responsible for the cost of energy consumed for the occupied portion of the Project.

107.25 Temporary Facilities. Unless otherwise specified in the Contract Documents, the Contractor shall provide, and maintain in a clean condition, adequate and approved sanitary facilities for use by all Persons at the Project in coordination with the Engineer.

107.26 Drainage. The Contractor shall be responsible for all temporary drainage necessary for the Contractor’s Work and shall employ pumps, trenches, drains, sumps or other necessary elements as required to afford satisfactory working conditions for the protection, execution and completion of the Project.

107.27 Environmental Protection. The Contractor shall comply with all applicable federal, State and local laws and regulations relating to pollution of the environment and shall take precautions to prevent pollution of water with fuels, oils, bitumens, calcium chloride and other Materials. When the work area is located in or adjacent to streams and other watercourses, the area shall be

separated from the main stream by a dike or barrier to keep sediment from entering the stream. The Contractor shall take care during the construction and removal of such barriers to minimize siltation of the stream and watercourse. Control of ground water and water in excavations shall be accomplished in a manner that will prevent degradation of the 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, watercourses, lakes, ponds, or other areas of water impoundment. Such prevention may require, without limitation, the use of ditch check dams, sediment traps, sediment basins, sediment pits or other control devices and methods necessary to prevent adverse effects to surface waters as provided in Chapter 3745-1-04 OAC. The cost of constructing and maintaining these measures shall be borne by the Contractor. Water from aggregate washing or other operations containing sediment shall be treated by filtration, settling basins or other measures sufficient to reduce the sediment concentration to not more than that of the stream, watercourse, lake, pond or the area of water impoundment. The Contractor shall not cause or permit the handling or transporting or storage of any material in a manner which allows or may allow unnecessary amounts of particulate matter to become airborne or cause or permit the Project to be constructed, used, repaired or demolished without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne. The Engineer may require necessary measures to prevent particulate matter from becoming airborne including without limitation the paving or frequent cleaning of roads, driveways and parking lots, the application of dust-free surfaces, the application of water and the planting and maintenance of vegetative ground cover. When dust, fumes, gases, mist, odorous matter, vapors, or any combination thereof escape from the Project or Equipment in such manner and amount as to cause a nuisance or to violate any regulation, the Engineer may require that the Project or Equipment in which processing, handling and storage are done be tightly closed and ventilated in such a way that all air and gases and air or gas-borne material leaving the Project or Equipment are treated by removal or destruction of air contaminants be discharged to the open air.

107.28 NPDES General Permit. The Contractor shall comply with all requirements and conditions of any NPDES general permit, including, but not limited to, implementing and maintaining the control measures specified in the storm water pollution prevention plan, maintaining records of construction activities, and removing Materials no longer required and taking proper action if there is a reportable quantity spill.

107.29 Building Permits. Unless otherwise specified in the Contract Documents, the Contractor shall secure the required general building permits. The Contractor shall schedule and attend all intermediate and Final Inspections

required for any permit certification. The Contractor shall schedule inspection for occupancy permits with the appropriate local fire authority and State Fire Marshal. The Contractor shall give the Engineer and the Authorized Representative reasonable notice of the date arranged for any inspection.

107.30 Other Permits. Unless otherwise specified in the Contract Documents, the Contractor shall apply for, secure and pay the fees for any permit, license or tap in required by State or local authorities having jurisdiction over the Project, except the NPDES permit and the general building permits secured by the Engineer in accordance with 107.29. The Contractor shall give the Engineer and the Authorized Representative reasonable notice of the date arranged for any related inspection.

107.31 Inspection, Testing and Approval. Unless otherwise specified in the Contract Documents, the Contractor shall apply for, secure and pay for any inspection, testing or approval required by the Contract Documents, laws, ordinance, rules, regulations or orders of any public authority having jurisdiction over the Project. The Contractor shall give the Engineer and the Authorized Representative reasonable notice of the date arranged for such inspection, testing or approval. The Contractor shall provide an original report of the inspection, testing or approval to the Engineer for approval. If, after the commencement of the Work, the Engineer determines that any portion of the Work requires special inspection, testing or approval, in addition to any inspection, testing or approval provided for or required by the Contract Documents, in order to insure conformance to the Contract Documents, the Engineer may instruct the Contractor in writing to order such special inspection, testing, or approval, or the Engineer may make the arrangements for same. If such special inspection, testing or approval reveals a failure of the Work to comply with the requirements of the Contract Documents, the Contractor shall pay all costs associated with such special inspection, testing or approval. If such special inspection, testing or approval reveals that the Work is in compliance with the Contract Documents, the Contractor will be paid, by appropriate Change Order, for all costs associated with such special inspection, testing or approval. Neither the observations of the Engineer in the administration of the Contract, nor any inspections, tests or approvals by Persons other than the Contractor shall relieve the Contractor from the Contractor's obligation to perform the Work in conformity with the Contract Documents.

107.32 Uncovering the Work. If any Work is covered contrary to the requirements of the Contract Documents or contrary to the written request of the Engineer, such Work must, if required by the Engineer in writing, be uncovered for observation and replaced, if not in conformity with the Contract Documents, and recovered at the Contractor's expense. If any Work has been covered in accordance with the Contract Documents and is Work which the Engineer had

not requested the opportunity to observe prior to covering, the Engineer may request that such Work be uncovered by the Contractor. If such Work is found not to be in conformity with the Contract Documents, the Contractor shall pay all costs of uncovering, replacing, and recovering the Work. If such Work is found to be in conformity with the Contract Documents, a Change Order will be processed to pay the Contractor for the cost of uncovering and replacing and recovering the Work, subject to final approval by the City Commission.

107.33 Correction of the Work. The Engineer shall notify the Contractor in writing if any Work is found by the Engineer to be Defective, whether observed before or after Contract Completion. The Engineer shall specify in the written notice the time within which the Contractor shall correct the Defective Work. The Contractor shall bear all costs of correcting such Defective Work, including the cost of any consequential damages. If the Contractor fails to correct any Defective Work within the time fixed in the written notice, the City may correct such Work and obtain recovery of all costs, including without limitation any consequential damages, from the Contractor or the Contractor's Surety.

107.34 Interruption of Existing Services. Whenever it becomes necessary to interrupt existing services in use by the City or its residents, such as Sewer, water, gas, and steam lines, electric or telephone and cable service, the Contractor responsible for the Work shall continue the Work on a non-stop twenty-four hour per Day basis until the Work is completed and the service restored, or at such Alternate time required by the Authorized Representative. Before beginning such Work, the Contractor shall apply in writing to and receive approval in writing from the Authorized Representative and the Person with appropriate jurisdiction over the Project, to establish a time when interruption of the service will cause a minimum of interference with the activities of the City, its tenants, if any, and the public.

107.35 Clean Up. During the progress of the Work, the Contractor shall be responsible for the removal and off-site disposal of all waste, excess Materials and rubbish, including without limitation layout stakes, sediment control devices and temporary Structures, attributable to the Work to an appropriate disposal site. Temporary on-site storage of waste, excess Materials and rubbish may be permitted as designated by the Engineer. Unless otherwise provided in the Contract Documents, the Contractor shall perform daily broom cleaning in the area of the Contractor's Work and shall, at the end of each working Day or upon notice from the Engineer, remove all waste Materials and rubbish from the Project. The Contractor shall, as required for the Project or upon notice from the Engineer, clean and remove any waste Materials or rubbish from areas adjacent to the Project. The Contractor shall, as required for the Project or upon notice from the Engineer, take all necessary actions to minimize and clean dust and

mud from the Project and adjacent property in accordance with City ordinances and regulations. If the Contractor fails to clean up during the progress of the Work, the provisions of 105.02 may be invoked. If the Contractor fails to maintain the areas adjacent to the Project clean and free of dust, mud, waste, excess Materials and rubbish, upon written notice from the Engineer, the Authorized Representative shall direct the local jurisdiction having responsibility for the area to clean the area or shall employ City employees or another Person to clean the area. The cost of cleaning the area adjacent to the Project shall be deducted from the responsible Contractor as the Engineer recommends and the Authorized Representative determines to be appropriate. The decision of the Authorized Representative shall be final, subject to proceedings in accordance with 118.01 through 118.11.

107.36 Explosives and Blasting. Blasting will not be permitted and explosives may not be brought onto or kept on the site of the Project, except with prior written approval of the Authorized Representative and any other authorities having jurisdiction, including without limitation the City's Fire Department. All blasting and all purchasing, storing and handling of explosives shall be done as prescribed in any applicable federal, State or City statutes, ordinances or regulations by Persons experienced in such Work. The Contractor shall carry appropriate liability insurance and shall be responsible for any injuries to individuals or damage to property resulting from any blasting operation. The Contractor shall provide a copy of the policy of such insurance to the Engineer prior to bringing any explosives to the Project and to the Authorized Representative upon request. The Contractor shall take all necessary precautions to protect the Project, existing or adjacent property, water lines, and other underground Structures from blasting. Where there is danger to Structures or property from blasting, the charges shall be reduced and the material shall be covered with suitable timber, steel or rope mats. The Contractor shall notify all Owners of adjacent or utility property which may be affected of any intention to use explosives at least eight hours before blasting is commenced. Any inspection of use of explosives by the Engineer does not in any way reduce the responsibility of the Contractor or its Surety for damages that may be caused by such use.

107.37 Emergency. In the event of an emergency affecting the safety of the Project, other property, or individuals, the Contractor, without special instruction or authorization, shall act to prevent any threatened damage, injury, or loss. The Contractor shall give the Engineer and the Authorized Representative prompt written notice if the Contractor believes that any significant change in the Work or variation from the Contract Documents has been caused by any emergency or action taken in response to an emergency. If the Engineer recommends that a change in the Contract Documents be made because of any emergency or action taken in response to an emergency, and the Authorized

Representative approves, a Change Order will be processed, subject to final approval by the City Commission, if applicable.

107.38 Royalties and Patents. The Contractor shall pay all royalties and license fees and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents and if, to the knowledge of the Engineer, use of the specified item is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by the Engineer in the Contract Documents. If the Contractor has reason to believe that use of the specified item is subject to patent or copyright protection, the Contractor shall immediately notify the Authorized Representative.

ITEM 108 - SUBCONTRACTORS AND MATERIAL SUPPLIERS

108.01 Approval by City
108.02 Replacement
108.03 Contractor's Responsibility
108.04 Warranty and Guarantee
108.05 Prompt Payment
108.06 Prompt Payment Reduction and Interest
108.07 Affidavit of Claim
108.08 Claims Against Contract Bond
108.09 Assignment of Contract

108.01 Approval by City. Within ten Days of the Notice to Proceed, the Contractor shall list the Contractor's proposed Subcontractors and Material Suppliers on forms approved by the Authorized Representative and submit such forms to the Engineer for approval by the Authorized Representative. The City reserves the right to reject any Subcontractor or Material Supplier. Failure of the Engineer to notify the Contractor of rejection within ten Days of receipt of the forms shall constitute notice that the City has no objection. If the City rejects any Subcontractor or Material Supplier, the Contractor shall replace the Subcontractor or Material Supplier at no additional cost to the City.

108.02 Replacement. The Contractor shall not replace any Subcontractor or Material Supplier after execution of the Contract Form without written approval of the Authorized Representative. The Contractor shall submit to the Engineer amended approval forms and a written justification for the change of the Contractor's Subcontractors or Material Suppliers. The Contractor shall submit to the Engineer amended forms whenever any listed information changes for the Contractor's Subcontractors or Material Suppliers.

108.03 Contractor's Responsibility. The Contractor shall be fully responsible for all acts and omissions of the Contractor's Subcontractors and Material Suppliers and shall be responsible for scheduling and coordinating the Work of the Contractor's Subcontractors and Material Suppliers. Interference, disruption, hindrance, delay or impact attributable to the Contractor's Subcontractors or Material Suppliers shall be deemed to be interference, disruption, hindrance, delay or impact within the control and responsibility of the Contractor. The Contractor shall require that each of the Contractor's Subcontractors have a competent supervisor at the Project whenever Work is being performed by the Subcontractor. The Contractor agrees to bind the Contractor's Subcontractor and Material Supplier to the terms of the Contract Documents, so far as applicable to the Work of such Subcontractor or Material

Supplier, and shall not agree to any provisions which seek to bind the City to terms inconsistent with or at variance from the terms of the Contract Documents.

108.04 Warranty and Guarantee. The Contractor shall require each Subcontractor and Material Supplier to fully warrant and Guarantee, for the benefit of the City, the effectiveness, fitness for the purpose intended, quality and merchantability of any Work performed or item provided or installed by such Subcontractor or Material Supplier.

108.05 Prompt Payment. If a Subcontractor or Material Supplier requests payment in time to allow the Contractor to include the request in the Contractor's Contractor Payment Request, the Contractor shall pay within ten Days after receipt of payment from the City:

(a) To a Subcontractor an amount equal to percent of completion allowed by the City for the Subcontractor's Work;

(b) To a Material Supplier an amount equal to all or a portion of the Material Supplier's request for Materials furnished.

108.06 Prompt Payment Reduction and Interest. The Contractor may reduce the amount to be paid to a Subcontractor or Material Supplier pursuant to 108.05 by the amount of any retainage withheld from the Contractor and may withhold amounts necessary to resolve disputed liens or claims involving the Work of the Subcontractor or Material Supplier. If the Contractor fails to comply with the provisions of 108.05, the Contractor shall pay to the applicable Subcontractor or Material Supplier eighteen percent interest on any unpaid amount beginning on the eleventh Day after receipt of payment from the City.

108.07 Affidavit of Claim. In order to establish lien rights, Subcontractors and Material Suppliers not in privity of Contract with the Contractor must serve a notice of furnishing on the Contractor whose Contract is the Contract under which the Subcontractor or Material Supplier is performing. The notice of furnishing must be served upon the Contractor within twenty-one Days of performing the Work or furnishing the Materials. Subcontractors and Material Suppliers not in privity of Contract with the Contractor must, at the time of filing a Claim Affidavit with the Authorized Representative, provide a copy of the notice of furnishing and proof that it was received by the Contractor. In order to establish lien rights, a claimant must file a Claim Affidavit with the Authorized Representative, within one hundred twenty Days from the date of the last Work or furnishing of Materials. In order to receive priority over similar claims, the claimant must file a copy of the claim with the Montgomery County Recorder's

office within thirty Days of serving the Authorized Representative. All claimants who serve the Authorized Representative, and file with the Montgomery County Recorder within thirty Days, have no priority among themselves and share in the funds prorata. Claimants, who file with the Authorized Representative, but not with the Montgomery County Recorder, are paid only if there are sufficient funds left after paying those claimants who file with the Montgomery County Recorder. The Authorized Representative shall notify the Contractor of the receipt of the claim within five Days of receiving the Claim Affidavit. A copy of the Claim Affidavit and a statement advising the Contractor of the Contractor's right to dispute the claim will accompany the notice. The Contractor shall have twenty Days to dispute the claim. If the Contractor does not notify the Authorized Representative in writing of an intention to dispute the claim within twenty Days after receipt of the Claim Affidavit, the Contractor is deemed to have assented to its correctness. The City shall detain the amount stated in the Claim Affidavit from subsequent Contractor Payment Requests and deposit said amount in an escrow account in accordance with a general escrow agreement between the City and a bank. The escrow agent shall hold the deposit and any interest earned thereon until receipt of notice from the Authorized Representative specifying an amount to be released and the Person to whom the amount is to be released. The City reserves the right to pay a Claim Affidavit which is not timely disputed.

108.08 Claims Against Contract Bond. Laborers, Subcontractors or Material Suppliers who have furnished or delivered labor or Materials to the Project may, at any time after performing the labor or delivering the Materials, but not later than ninety Days after Final Acceptance of the Project, by the City, furnish the Surety a statement of the amount due. After furnishing the statement, laborers, Subcontractors or Material Suppliers must wait sixty Days to bring a suit for the amount due. If the Surety has not paid the claim at the expiration of sixty Days, laborers, Subcontractors or Material Suppliers may bring suit for amounts not paid, but must bring the suit within one year of Final Acceptance of the Project, by the City.

108.09 Assignment of Contract. The Contractor shall not sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of any right, title or interest therein, without written consent of the Authorized Representative. No sale, transfer, assignment or other disposition of the Contract shall in any case release the Contractor of liability under the Contract and the Contract Bond.

ITEM 109 CONSTRUCTION PHASE SCHEDULING

109.01 Compliance with Schedule
109.02 Responsibility of Contractor
109.03 Preceding Work
109.04 Coordination with City
109.05 Construction Schedule
109.06 Schedule Information
109.07 Construction Schedule Requirements
109.08 Use of Schedule and Float
109.09 Approval and Acceptance Schedule
109.10 Weekly Contractor Reports
109.11 Monthly Progress Reports
109.12 Time Recovery Plan
109.13 Project Meetings

109.01 Compliance with Schedule. The Contractor shall complete portions of the Work in such order and time as provided in the current Construction Schedule.

109.02 Responsibility of Contractor. The Contractor shall afford other Persons on the Project reasonable opportunity for the introduction and storage of Materials and Equipment and execution of Work and shall properly connect and coordinate the Contractor's Work with the Work of other Persons on the Project. The Contractor shall perform the Work so as not to interfere with, disturb, hinder, delay, or impact the Work of other Persons on the Project. If the Contractor, or any of the Contractor's Subcontractors or Material Suppliers, causes damage or injury to the property or Work of any other Person on the Project, or by failure to perform the Work with due diligence, delays, interferes with, hinders, disrupts or impacts any other Person on the Project, who suffers damage, injury or expense thereby, the Contractor shall be responsible to the other Person for such damage, injury or expense. Claims, disputes or actions between the Contractor and other Persons on the Project concerning such damages, injury or expense shall not delay completion of the Work which shall be continued by the parties to any such claim dispute or action. The Contractor shall coordinate the Work with the activities and responsibilities of other Persons on the Project, the Engineer and the City to complete the Project in accordance with the Contract Documents. In the event the Contractor fails to prosecute the Work in accordance with the Project Schedule, the Engineer may recommend that the provisions of 105.02 be invoked.

109.03 Preceding Work. If any part of the Contractor's Work is preceded by the Work of another Person, the Contractor shall inspect such

preceding Work before commencing any Work, and report in writing to the Engineer any defects which render the preceding work unsuitable as related to the Contractor's work. Failure of the Contractor to make such inspection and report in writing shall constitute an acceptance of the preceding work as fit and proper for the reception of the Contractor's work, except for latent defects which such an inspection would fail to disclose.

109.04 Coordination with City. The Contractor shall supervise and coordinate the Work in conformity with any coordination from the Engineer and the Authorized Representative, as provided in the Contract Documents. The Contractor shall give reasonable notice to the Engineer when the Engineer's presence is required for special consultations, decisions or recommendations, as required by the Contract Documents. The Contractor shall consult with the Engineer and the Authorized Representative to obtain full knowledge of all rules, regulations or requirements affecting the Project. The Contractor shall establish the regular working hours, subject to approval by the Engineer and the Authorized Representative. Night working hours and working hours on Sundays and holidays are not permitted without the prior written consent of the Engineer and the Authorized Representative. Such consent will not be provided unless the Contractor has given at least forty-eight hours notice in writing to the Engineer. The Contractor shall cooperate with the Engineer and the Authorized Representative so as not to interfere with, disturb, hinder or delay the responsibilities of the Engineer and the City.

109.05 Construction Schedule. The Contractor shall prepare the Construction Schedule for the Project and a schedule of submittals which is coordinated with the Construction Schedule within thirty Days of the date of the Notice to Proceed or such longer period as mutually agreed between the Engineer and the Contractor in writing upon timely written request by the Contractor. The Contractor shall, within seven Days of the date of the Notice to Proceed, furnish to the Engineer a preliminary Construction Schedule for the prosecution of Work on the Project. The Engineer shall, within seven Days of receipt of the Contractor's preliminary Construction Schedule, provide comments on the preliminary Construction Schedule to the Contractor. The Contractor shall, within five Days of receipt of the comments, prepare a revised Construction Schedule to incorporate those comments and submit the revised Construction Schedule to the Engineer together with all information requested and required by the Engineer. The Engineer shall submit 4 copies of the revised Construction Schedule, together with any recommendation thereon in writing, to the Authorized Representative within three Days of receipt. The Construction Schedule shall not exceed the time limits specified in the Contract Documents and the Notice to Proceed, shall provide for reasonable, efficient and economical execution of the Work and shall be coordinated with the Work of all other Persons or the entire Project to the extent required by the Contract Documents. The Construction Schedule shall be used to plan, organize, and execute the

Work, record and report actual performance and progress and show how the Contractor Plans to coordinate all Work to Contract Completion. In preparing the Construction Schedule the Contractor shall use critical path scheduling methods and shall provide without limitation, the information listed in 109.06, unless waived by the Authorized Representative in writing upon the written recommendation of the Engineer.

109.06 Schedule Information. In accordance with 109.05, the Contractor shall provide the following information:

(a) A graphic presentation of the sequence of the Work for the Project which includes, without limitation, the Contractor's resource loading curve in the media and format required by the Engineer;

(b) Identification of each phase of the Work and any milestone completion dates;

(c) Identification of activities and durations for all shop drawing and other submittal review and approval, fabrication and review of mock-up Work, product review and procurement, fabrication, shop inspection and delivery including, without limitation, lead time, coordination drawing delivery, Punch List, Punch List corrections, Project close-out requirements, Contract Completion, and occupancy or utilization requirements;

(d) Identification of disruptions and shutdowns due to other operations, facilities and functions, if any;

(e) Identification of the critical path of the Work;

(f) Identification of crew size and total resource hours for each activity in the Construction Schedule;

(g) The Contractor's signature and date thereof on the Construction Schedule.

109.07 Construction Schedule Requirements. The Engineer shall provide complete Specifications for the paper and electronic formats of the Construction Schedule. The Contractor shall develop the Construction Schedule using commercially available Personal computer software acceptable to the Engineer, in graphic and tabular form. Final copies shall be provided in color and in such size as is appropriate for the level of detail and shall clearly and legibly show all relevant information. The Contractor shall provide monthly updates of the Construction Schedule and shall update the Construction Schedule if a time recovery plan is approved in accordance with 109.12, in electronic and paper

formats, to the Engineer in graphic and tabular form. All base line and updated schedules shall be submitted electronically to the Engineer, in graphic and tabular form. The Contractor shall provide clear graphics, legends and other necessary data, including without limitation, milestones, constraints and items required by the Project and the Engineer. Unless waived by the Authorized Representative in writing upon written recommendation of the Engineer, each baseline and updated schedule shall show the Project name and Contract and contain lines for signatures and dates of signature for all Contractors involved in the Project. Each baseline and updated schedule shall provide activity identification and a description for each activity broken down to a maximum fifteen Day duration, responsibility of each applicable Contractor, the Contractor's resources and crew size for each activity, early start dates, early finish dates, late start dates, late finish dates, predecessor and successor activities for each activity, free float, total float and percentage completion. Each baseline and updated schedule shall identify the logic relationship between all activities and shall show all submittal dates, coordination drawing preparation, Working Drawing submittals and mark-up review and approval durations. Together with each updated schedule, the Contractor shall provide a list of all changes to the previously approved base line Construction Schedule or the previous updated Construction Schedule, including without limitation logic, float and actual start and finish dates of activities.

109.08 Use of Schedule and Float. The Construction Schedule and the Project Schedule, if applicable, shall be used as a tool for scheduling and reporting sequenced progress of the Work using early start dates and early finish dates. Free float and total float are resources of the Project and the use of float associated with an activity is not permitted without the concurrence of the Engineer, and other Contractors, if any.

109.09 Approval and Acceptance Schedule. The Contractor shall review and sign each updated Construction Schedule. The Contractor's signature or any base line or updated Construction Schedule shall serve as an affirmation of the Contractor's approval of and agreement to the Construction Schedule and a representation that the Contractor can meet the requirements of the Construction Schedule without additional compensation. Immediately after the Contractor has signed the Construction Schedule, the Engineer shall submit it and the schedule of submittals to the Authorized Representative or return them to the Contractor with recommendations for revision. In the absence of a Construction Schedule approved by the Contractor and accepted by the Authorized Representative, the City may withhold payment from the Contractor in accordance with 114.08 and 114.09. Alternatively, the City, in its sole discretion, may backcharge the Contractor in accordance with 105.02, reassign scheduling responsibility or suspend or terminate the Contract in accordance with 119.01 through 119.04.

109.10 Weekly Contractor Reports. Unless otherwise specified by the Contract Documents, the Contractor shall, on a bi-weekly basis, prepare and submit to the Engineer a written report describing activities begun or finished during the preceding week, work in progress, expected completion of the Work, a Projection of all activities to be started or finished in the upcoming two weeks including without limitation the Contractor's workforce crew size and total resource hours associated with such Work and any other information requested by the Engineer.

109.11 Monthly Progress Reports. Unless otherwise specified in the Contract Documents, the Engineer shall provide monthly progress reports to the Authorized Representative, which shall include recommendations for adjusting the Construction Schedule or the Project Schedule, as applicable, to meet milestone completion dates and Contract Completion dates.

109.12 Time Recovery Plan. When it is apparent to the Engineer that critical path activities, scheduled milestone completion dates, or Contract Completion dates will not be met, the Engineer shall submit to the Contractor a time recovery plan to avoid or minimize any delay. A time recovery plan may include, without limitation, increasing the Contractor's workforce in such quantities as will eliminate the backlog of Work, increasing the number of working hours per shift, shifts per workday, workdays per week, the amount of construction Equipment, or any combination thereof, rescheduling of activities to achieve maximum practical concurrency of work efforts and, if appropriate, time extensions. If the Contractor approves the time recovery plan within ten Days of receipt, a revised Construction Schedule shall be prepared by the Contractor and signed and accepted in accordance with 109.11 and, if applicable, a revised Project Schedule shall be prepared by the Engineer and approved and signed by the Contractors in accordance with 109.10. If the Contractor fails to approve a time recovery plan within ten Days of receipt, the Contractor shall immediately provide an Alternate time recovery plan to the Engineer in writing, for review and acceptance in accordance with 109.11 and, if applicable, 109.10.

109.13 Project Meetings. The Contractor and all appropriate Subcontractors shall attend Project meetings as requested by the Engineer. The purpose of the Project meetings may include, without limitation, review of progress in the Work, discussion of anticipated progress, and review of critical operations and existing and potential problems and safety matters. The Contractor shall be represented at every Project meeting by a Person authorized with signature authority to make decisions regarding possible modification of the Contract Documents. The Engineer shall notify the Contractor of the time and place of each Project meeting. The Contractor shall have any of the Contractor's Subcontractors and Material Suppliers attend a Project meeting as deemed advisable by the Contractor or as requested by the Engineer. The Engineer or

the Engineer's designated representative shall prepare a written report of each Project meeting and distribute such report to the Authorized Representative and the Contractor. The Engineer or the Engineer's designated representative, as applicable, shall not delegate the duty to prepare a written report of each Project meeting. If any Person objects to anything in a report of a Project meeting, the Person shall notify the Engineer, the Authorized Representative and any other affected Person in writing explaining the objection. The Engineer shall attach any objection made to a report of a Project meeting and any response thereto to the report.

ITEM 110 - WORKING DRAWINGS AND SAMPLES

110.01 Requirement to Provide
110.02 Samples, Tests, Cited Specifications
110.03 Source Sampling and Testing
110.04 Form of Submittals
110.05 Variation from Contract Documents
110.06 Contractor's Review
110.07 Engineer's Review
110.08 Risk of Nonpayment
110.09 Manufacturer's Statement

110.01 Requirement to Provide. Working Drawings, Samples and other submittals, including without limitation stress sheets, erection Plans, falsework Plans, cofferdam Plans, bending diagrams for reinforcing steel, formwork, Plans, and tunneling Plans, shall be provided by the Contractor for any item required by the Contract Documents but not fully described in the Drawings and Specifications, unless waived by the Engineer, and shall include, without limitation:

(a) Construction of the various parts, method of jointery, type of material, grade, quality and thickness of material, alloy of material, profiles of all sections, reinforcement, anchorage, type and grade of finish;

(b) Capacities, types of Materials and performance charts that are pertinent to the Materials and performance charts that are pertinent to the Work. Wiring diagrams, control diagrams, schematic diagrams, working and erection dimensions, arrangement and Specifications;

(c) Notwithstanding any measurements in Drawings or Specifications, where the Work involves repair, renovation, extension or alteration of, or addition to, an existing Structure, the Contractor shall make such measurements of the existing Structure as may be required to accurately attach the Work to the Structure.

110.02 Samples, Tests, Cited Specifications. Unless otherwise provided in the Contract Documents, the City shall test Samples of Materials in accordance with AASHTO, ASTM, AWWA or methods on file in the office of the Director at the expense of the City. Samples will be taken by a qualified representative of the City. References included in these Specifications to AASHTO, ASTM, AWWA, or federal Specifications shall be to the test method, sampling method or specification in effect upon the date of the notice to Bidders for the Contract. Copies of all test results will be furnished to the Contractor.

The Contractor shall cooperate fully in the sampling and inspection of Materials and shall notify the Engineer immediately upon the arrival of Materials to be used in the Work. The City reserves the right to retest all Materials and Equipment that have been stored prior to incorporation of those Materials into the Project and to reject all Materials and Equipment which, when retested, do not meet the requirements of the Contract Documents. The Contractor, in all cases, shall furnish the required Samples without charge. Transports and distributors hauling bituminous material shall be equipped with an approved submerged bituminous Materials sampling device.

110.03 Source Sampling and Testing. The Engineer may undertake the sampling and testing of Materials at the source of supply. If source sampling and testing is undertaken:

(a) The Contractor shall cooperate and assist the Engineer, including without limitation in compliance with applicable inspection, sampling and test requirements, and shall provide all necessary documentation;

(b) The Contractor shall provide full entry at all times to the parts of the source as may concern the manufacture or production of the Materials being sampled and tested;

(c) If required by the Engineer, the Contractor shall arrange for an approved building for the use of the inspection which building shall be located conveniently near the source and independent of any building used by the Materials producer;

(d) The Contractor shall provide and maintain adequate safety measures at the plant at all times;

(e) The City reserves the right to retest all Materials that were tested at the source prior to the incorporation of those Materials into the Project and to reject all Materials which, when retested, do not meet the requirements of the Contract Documents.

110.04 Form of Submittals. The Contractor shall provide a submittal letter and shall stamp and submit the working Drawings or other submittals to the Engineer in accordance with a schedule established by the Engineer and the Contractor. Unless otherwise specified in the Contract Documents, the Contractor shall submit 3 prints of all working Drawings and 4 copies of any other submittal. Only 1 print copy of all working Drawings will be returned to the Contractor by the Engineer. If the Contractor requires more than 1 copy, additional copies must be provided to the Engineer at the time of the original submission. The Engineer will not produce copies of the working Drawings. The data shown on the working Drawings shall be complete with respect to quantities,

dimensions, specified performance and design criteria, Materials and similar data to show the Engineer the Materials and Equipment which the Contractor proposes to provide. Each sample shall be identified clearly as to material, supplier, and pertinent data such as catalog numbers and the use for which intended and other uses as the Engineer may require to enable the Engineer to intelligently review the submittal. All working Drawings shall indicate the applicable plan sheet and Specifications.

110.05 Variation from Contract Documents. If the working Drawings or other submittals show variations from the requirements of the Contract Documents, the Contractor shall make specific mention of such variations in the Contractor's letter of submittal to the Engineer. If the variation is acceptable to the Engineer, the Engineer shall recommend acceptance of the variation to the Authorized Representative in writing. Upon written approval of the Authorized Representative, the variation shall be incorporated into the Contract Documents. The Contractor shall not be relieved of any responsibility for deviations from the requirements of the Contract Documents by the Engineer's review of working Drawings, Samples or other submittals.

110.06 Contractor's Review. All working Drawings, Samples and other submittals shall be reviewed and stamped by the Contractor prior to submittal to the Engineer. If it is apparent to the Engineer that the Contractor has not reviewed the submittals, or has conducted an incomplete review, the Engineer shall reject the submittals. The Contractor shall field verify conditions as necessary and make corrections of dimensions, location of various items, encroachments of Work or variations from the requirements of the Contract Documents. If required by the Contract Documents or applicable law, the Contractor shall have the working Drawings or other submittals prepared by Persons possessing expertise and experience in an appropriate trade or profession or by a licensed Engineer, landscape architect, or other design professional.

110.07 Engineer's Review. The Engineer shall review and approve or disapprove working Drawings, Samples or other submittals within fifteen Days of receipt or in accordance with the approved submittal schedule or such other period of time as is mutually agreed by the Engineer and the Contractor. The Contractor shall make any corrections required by the Engineer and shall resubmit the required number of corrected copies of working Drawings, Samples or other submittals until approved, which resubmission shall be acted upon by the Engineer with fifteen Days of receipt or such other period of time as is mutually agreed by the Engineer and the Contractor. When resubmitting submittals, the Contractor shall direct the Engineer's attention to any revisions made by noting such revisions on the resubmitted submittal. All costs incurred by the Engineer, the City or other Persons due to the failure of the initial submittal

to substantially meet the requirements of the Contract Documents, or due to excessive resubmittals, for attendant delay, interference, hindrance, disruption or impact of the Project, shall be paid by the Contractor. Resubmittals in excess of two may be deemed excessive by the City. The Engineer's review and approval of working Drawings, Samples and other submittals is to determine if the items covered by such submittals will, after installation and incorporation into the Work, conform to the Contract Documents and be compatible with the design concept of the Project as a functioning whole. The Engineer's review and approval shall not extend to means, methods, manners, techniques, sequences, procedure of construction or to safety precautions or programs incident thereto. The Engineer's review and approval of a separate item will not indicate approval of the assembly in which the item functions.

110.08 Risk of Nonpayment. No portion of the Work requiring a Working Drawing, sample or other submittal shall be commenced until the submittal, has been reviewed and approved by the Engineer. Any Work commenced by the Contractor prior to final approval of the Working Drawing, sample or other submittal by the Engineer shall be performed by the Contractor under risk that no payment will be approved or made by the City for such Work.

110.09 Manufacturer's Statement. Working Drawings on all Equipment shall include the following written statement from the manufacturer of the Equipment:

"This Equipment submitted for approval shall perform as specified when installed by the Contractor in the arrangement shown on this drawing and in the Contract Documents and in conjunction with all other accessories such as flues, breachings, piping, controls and Equipment not furnished by this manufacturer but required as an accessory or supplement to this Equipment, providing that the accessory or supplementary items perform as specified and are installed as shown in the Contract Documents."

ITEM 111 PREVAILING WAGE RATES

111.01 Prevailing Wages
111.02 Prevailing Wage Determination
111.03 Fines and Penalties
111.04 Wage Schedule
111.05 Payroll Reports

111.01 Prevailing Wages. The Contractor shall pay the prevailing wage rates of the Project locality, as determined by the Ohio Department of Commerce, Division of Labor and Worker Safety, Wage and Hour bureau, or the U.S. Department of Labor to laborers and mechanics performing Work on the Project, as applicable. The Contractor shall comply with the provisions, duties, obligations, and is subject to the remedies and penalties of Sections 4115.03 to 4115.22, ORC or the Davis-Bacon Act, as applicable.

111.02 Prevailing Wage Determination. The Contract Documents include pages setting forth the prevailing rates of wages as ascertained by the Ohio Department of Commerce, Division of Labor and Worker Safety, Wage and Hour Bureau, or the U.S. Department of Labor for the Project, as applicable. The City shall, within seven business Days after receipt of a notice of a change in the prevailing rates, notify the Contractor of the change. The Contractor shall make the necessary adjustment in the prevailing wage rate and shall pay any wage increase during the term of the Contract.

111.03 Fines and Penalties. Whoever violates Section 4115.08 or 4115.09, ORC, shall be fined not less than 25 dollars nor more than 500 dollars. Whoever violates division (C) of Section 4115.071, or Section 4115.10 or 4115.11, ORC is guilty of a misdemeanor of the second degree for a first offense. For each subsequent offense such Person is guilty of a misdemeanor of the first degree. Fines and penalties under the Davis-Bacon Act shall be as determined by the U.S. Department of Labor and in accordance with applicable law.

111.04 Wage Schedule. Within ten Days of the date of the Notice to Proceed, the Contractor shall provide the City's prevailing wage Coordinator a schedule of dates during the term of the Contract on which wages will be paid to employees for the Project.

111.05 Payroll Reports. The Contractor shall submit weekly payroll reports with each Contractor Payment Request, which reports shall be certified by the Contractor that the payroll is correct and complete and the wage rates

shown are not less than those required by the Contract. The Contractor shall be responsible for submitting all payroll reports of the Contractor's Subcontractors. The payroll report shall indicate the week covered and shall include a list containing the name, address and social security number of each employee of the Contractor and the Contractor's Subcontractors paid for the Work. The payroll report shall list the number of hours each employee worked each Day on the Project during the reporting period, the total hours each week on the Project, the employee's hourly rate of pay, job classification, fringe benefits and all deductions from wages and net pay. The payroll report shall also list each fringe benefit and state if it is paid as cash to the employee or to a named plan. The Contractor and the Contractor's Subcontractors shall also submit apprenticeship agreements for all apprentices utilized on the Project.

ITEM 112 INSURANCE

112.01 Contractor's Liability Insurance
112.02 Policy Limits
112.03 Explosion, Collapsed and Underground Insurance
112.04 Builder's Risk Insurance
112.05 Coverage Amount
112.06 Railroad Protective Insurance
112.07 Insurance Policy Requirements
112.08 Renewal Certificates
112.09 Waivers of Subrogation

112.01 Contractor's Liability Insurance. The Contractor shall purchase and maintain such liability and other insurance as will protect the Contractor from claims described below which may arise out of or result from the Contractor's performance or obligations under the Contract Documents, whether due to action or inaction by the Contractor or any Person for whom the Contractor is responsible:

(a) Claims under workers' compensation, occupational sickness or disease, disability benefit and other similar employee benefit acts;

(b) Claims for damages because of bodily injury, disease, illness, death or Personal injury, and other claims usually covered by bodily injury liability insurance;

(c) Claims for damages because of injury to or destruction of property and other claims usually covered by property damage liability insurance.

The Contractor shall comply with all provisions of the Ohio Workers Compensation Act and all rules of the Ohio Bureau of Workers' Compensation. In addition, if a portion of the Work is performed from a barge or a ship or requires unloading Materials from a barge or a ship on a navigable waterway of the United States, the Contractor shall arrange coverage for that portion of the Work under the Longshore and Harborworkers' Compensation Act, 33 U.S.C. Section 901, et seq., and the Jones Act, 5 U.S.C. Section 751, et seq. and shall provide proof of such coverage to the City. Comprehensive Automobile Liability Insurance shall cover owned, non-owned and hired vehicles.

112.02 Policy Limits. A Commercial General Liability policy and Business Automobile Liability policy shall be maintained to provide insurance as described below. An Umbrella or Excess Liability policy may be used in combination with the Commercial General Liability and business Automobile insurance to meet such limits:

(a)	**Policy Limits**	**Commercial General Liability**
	$2,000,000	General Aggregate
	$2,000,000	Products/Completed Operations Aggregate
	$1,000,000	Occurrence Limit
	$1,000,000	Personal and Advertising Injury Limit
	$100,000	Fire Legal Liability Limit
	$10,000	Medical Payments

(b)	**Policy Limits**	**Comprehensive Automobile Liability**
	$1,000,000	Bodily Injury & Property Damage Occurrence Limit

Contracts in the amount of one hundred thousand dollars or less shall require coverage in the amount of not less than two million dollars general aggregate and one million dollars per occurrence. Contracts in excess of one hundred thousand dollars, but not more than five million dollars shall require coverage in the amount of not less than three million dollars general aggregate and per occurrence. Contracts exceeding the amount of five million dollars shall require coverage in an amount to be determined by the Authorized Representative but in no case less than five million dollars general aggregate and per occurrence. Such policies shall be endorsed to provide that the General Aggregate Limit applies separately to each of the insured Contractor's Projects. Insurance coverage in the minimum amounts set forth above does not relieve the Contractor from liability in excess of such amounts.

112.03 Explosion, Collapsed and Underground Insurance. For any demolition, excavating, tunneling, shoring or similar operations, the Contractor shall purchase and maintain Explosion, Collapse and Underground (XCU) coverage with a limit of liability equal to such limit as specified in 112.02. In addition, if blasting is to be performed, the Contractor shall purchase and maintain XCU coverage providing a minimum Aggregate Limit of 5,000,000 dollars and Each Occurrence Limit of 1,000,000 dollars.

112.04 Builder's Risk Insurance. Unless otherwise specified in the Contract Documents, the Contractor shall provide and maintain, during the progress of the Work and until the execution of the Certificate of Contract Completion by the Authorized Representative, a builder's risk insurance policy to cover all Work in the course of construction including falsework, temporary

buildings and Structures and Materials used in the construction process, stored on or off site, or while in transit. The amount of coverage shall equal the total completed value of the Project (including the value of permanent fixtures and decorations). Such insurance shall be on a special cause of loss form, which provides coverage on an open perils basis insuring against the direct physical loss of or damage to covered property including flood and earthquake. It shall also include debris removal and demolition occasioned by enforcement of any applicable legal requirement, and shall cover reasonable compensation for the City's services and expenses required to limit further loss. Coverage must include provision to pay the reasonable extra costs of expediting temporary and permanent repairs to, or permanent replacement of, damaged property. This shall include overtime wages and the extra cost of "express" or other means for rapidly transporting Materials, Equipment and supplies necessary to such repair or replacement. The builder's risk policy shall protect both the Contractor and the City from loss and provide coverage for Materials in transit or stored off site and identified for the Project. Coverage for other perils may be required if specified in the Special Provisions.

112.05 Coverage Amount. Unless otherwise specified in the Contract Documents, the builder's risk policy shall be written in the amount equal to one hundred percent of the Contract price, including landscaping, paving and other sitework. The builder's risk policy shall specifically permit and allow for partial occupancy by the City prior to Final Acceptance of the Project by the City.

112.06 Railroad Protective Insurance. Where the Contract requires railroad Protective Insurance and no specific Bid item is provided in the Proposal for the payment of the premium therefore, the cost of such insurance shall be included in the various other Bid items in the Contract.

112.07 Insurance Policy Requirements. Each policy of insurance required to be purchased and maintained by the Contractor shall be obtained from an insurance company authorized by the Ohio Department of Insurance to do business in the State and shall name the City as an additional insured or loss payee, as applicable; provided, however, that such designation shall not cause any claim between the Contractor and the City to be waived except as set forth in 112.09. Each policy and the respective certificate of insurance shall expressly provide that no less than thirty Days prior written notice shall be given to the City in the event of cancellation, non-renewal, expiration or material alteration of the coverage contained in such policy or evidenced by such certificate of insurance. Each policy shall provide that the City shall be covered notwithstanding any action, omission or negligence of the Contractor. The Contractor shall furnish the City, when requested, a certified copy of any insurance or additional insured or loss payee endorsement required to be purchased or maintained by the Contract Documents. In no event shall any failure of the City to demand a certified copy of

any required insurance or endorsement be construed as a waiver of the obligation of the Contractor to obtain insurance required to be purchased or maintained by the Contract Documents. The Contractor shall maintain all insurance in the required amounts, without interruption, from the date of the execution of the Contract Form until the date of approval of the Certificate of Contract Completion by the Authorized Representative. Failure to maintain the required insurance during the time specified shall be cause for termination of the Contract. Insurance policies required to be purchased and maintained by the Contractor may include a reasonable loss deductible and exclusions, which shall be the responsibility of the Contractor to pay in the event of loss. The prompt repair or reconstruction of the Work as a result of an insured loss or damage shall be the Contractor's responsibility and shall be accomplished at no additional cost to the City.

112.08 Renewal Certificates. If the Contractor provides certificates of insurance showing expiration prior to the date of final completion, the Contractor shall provide new certificates to the City showing continuing coverage prior to expiration.

112.09 Waivers of Subrogation. The City and the Contractor waive all rights against each other for damages caused by fire or other perils to the extent of actual recovery of any insurance proceeds under any property insurance obtained pursuant to Item 112 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the City as fiduciary.

ITEM 113 INDEMNIFICATION

113.01 Indemnification for Injury or Damage
113.02 Indemnification for Patent or Copyright Use

113.01 Indemnification for Injury or Damage. To the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the City, the Engineer, any participating railroad or railway company, any property Owner or lessee of adjacent property, or utilities and any private Person providing financing for the Project, their respective members, officials, officers, consultants, agents, representatives and employees, in both individual and official capacities, from and against all claims, damages, losses, and expenses, direct, indirect or consequential arising out of or resulting from the Work. In the event of any such injury, including death, or loss or damage, or claims therefore, the Contractor shall give prompt notice thereof to the Engineer and the Authorized Representative. This provision is intended to be, and shall be construed, as consistent with, and not in conflict with, Section 2305.31 ORC, to the fullest extent permitted. The indemnification obligations of the Contractor under this 113.01 shall not extend to the liability of the Engineer, the Engineer's officials, consultants, agents, representatives or employees for negligent preparation or approval of Drawings, specification, Change Orders, opinions, and any other responsibility of the Engineer, except to the extent covered by the Contractor's insurance.

113.02 Indemnification for Patent or Copyright Use. To the fullest extent permitted by law, the Contractor shall indemnify, hold harmless and defend the City and the Engineer, their respective members, officials, officers, consultants, agents, representatives and employees, in both individual and official capacities from and against all claims, damages, losses and expenses arising out of the Contractor's infringement of patent rights or copyrights.

ITEM 114 CONTRACTOR PAYMENT

114.01 Contract Cost Breakdown
114.02 Contractor Payment Request
114.03 Payment Date
114.04 Labor Payments
114.05 Material Payments
114.06 Retainage
114.07 Retainage Reduction with Consent of Surety
114.08 Payments Withheld
114.09 Payments Detained
114.10 Measurement of Quantities
114.11 Final Payment Request
114.12 Final Payment Date
114.13 Waiver of City's Claims
114.14 Waiver of Contractor's Claims

114.01 Contract Cost Breakdown. The Contractor shall submit to the Engineer a full, accurate and detailed estimate (the Contract Cost Breakdown) of the various kinds of labor to be performed and material to be furnished, with separate amounts shown for labor and Materials for each branch of Work, following the preferred titles and sequences of sections in the format used by the Engineer in developing the Specifications. The grand total shown on the Contract Cost Breakdown must equal the total Contract price. The City reserves the right to use the approved Contract Cost Breakdown to determine the cost or credit resulting from any change in the Work. The first item should be actual aggregate cost of Contract Bond, insurance, permits and tests required for the Work. The amounts for labor and material shall accurately reflect the cost for each item. Separate items shall not be shown for overhead or profit, but shall be included in the totals for labor and Materials. Whenever the material allocation exceeds fifty-five percent of the Contract price, the Contractor shall provide, upon request, sufficient information to support such higher percentage. Subcontract Work shall show amounts for labor and Materials. Fringe benefits shall be shown as a part of labor costs. When more than one major Structure is included in the Contract, the Contract Cost Breakdown shall be subdivided accordingly if requested by the Engineer, with cost details for each Structure shown separately. A line item shall be included for commissioning, Punch List Work, Project record document submittals, delivery of inventory and specified training. The Contract Cost Breakdown will be returned to the Contractor for resubmittal if it does not meet the requirements set forth above or contains insufficient items or details of the Work. No payment will be made without an approved Contract Cost Breakdown.

114.02 Contractor Payment Request. The Contractor shall submit monthly to the Engineer an itemized Payment Request for Work performed based upon the Contract Cost Breakdown on a form satisfactory to the Authorized Representative. The Contractor Payment Request shall be supported by documentation substantiating the Contractor's right to payment. The Contractor shall supply any additional documentation the Engineer may request in connection with each payment to the Contractor. Certified payroll reports for the period of time indicated shall be attached to one copy of every Payment Request. The Contractor shall list on the Contractor Payment Request any approved Change Orders processed and performed during the time covered by the Payment Request.

114.03 Payment Date. Payment of an approved Payment Request shall be made within thirty Days from the date of approval by the Engineer. The City reserves the right to require proof of the renewal of required insurance as a condition precedent to payment. Payments due and not paid to the Contractor within such thirty Day period shall bear interest from the date payment is due under the Contract Documents at the rate paid by the STAR Account in accordance with 120.04. The amount of Liquidated Damages to which the City is apparently entitled under the Contract Documents may be deducted from any Payment Request by the Engineer and the Authorized Representative.

114.04 Labor Payments. Partial payments to the Contractor for labor performed under either a Unit Price or lump sum Contract shall be made at the rate of ninety percent of the amount invoiced through the Payment Request which shows the total Contract Completion at fifty percent or greater. After the Contract is fifty percent complete, as evidenced by payments in the amount of at least fifty percent of the Contract price to the Contractor, partial payments for labor performed under either a Unit Price or lump sum Contract shall be made at the rate of ninety-five percent of the amount involved.

114.05 Material Payments. Through the Payment Request which shows total Contract Completion at fifty percent or greater, the City shall pay to the Contractor a sum at the rate of ninety percent of the invoice cost, not to exceed the applicable Bid amount in a Unit Price or lump sum Contract, for material delivered on the site of the Project, or other point in the vicinity of the Project, or other storage site approved by the Engineer, provided the Contractor provides the following information with the Payment Request:

(a) A list of the fabricated Materials consigned to the Project, giving the place of storage, together with copies of invoices, in order to verify quantity and cost;

(b) A certification of Materials stored off site, prepared by the Contractor and signed by the Engineer to evidence that the Materials are in conformity with the Specifications and have been tagged with the Project name and number for delivery to the Project. All costs incurred by the Engineer to visit a storage site, other than the areas adjacent to the Project, shall be paid by the Contractor.

After the Contract is fifty percent complete, as evidenced by payments in the amount of at least fifty percent of the Contract price to the Contractor, partial payments for Materials furnished under either a Unit Price or lump sum Contract shall be made at the rate of ninety-five percent of the amount involved. When payment is allowed on account of material delivered on the site of the Project or in the vicinity thereof or under the possession and control of the Contractor but not yet incorporated therein, such material shall become the property of the City, but if such material is stolen, destroyed, or damaged by casualty before being used, the Contractor will be required to replace it at the Contractor's expense. Any such material not ultimately incorporated into the Project may, at the option of the City, be retained by the City or returned to the Contractor for credit to the City of a proportionate amount. Completed line items concealed, underground and buried and not subject to final Punch List may be paid for at the rate of one hundred percent. Such completed line items subject to a final Punch List requiring testing or start-up shall be paid at the rate of ninety-eight percent.

114.06 Retainage. The City will not deposit retainage in any escrow account and will not pay interest on retainage. Any contrary provisions of 153.12, 153.13, 153.14 and 153.63, ORC, do not apply to this Contract. Payment of retainage to the Contractor shall not be due until thirty Days after approval of a final Contractor Payment Request by the City and execution of the Certificate of Contract Completion by the City. Any reduction or release of retainage, or portion thereof, shall not be a waiver of the City's right to retainage in connection with other payments to the Contractor, or any other right or remedy the City has under the Contract Documents, at law or in equity.

114.07 Retainage Reduction with Consent of Surety. Upon consent by the Contractor's Surety, the City may reduce the amount of funds retained for the faithful performance of Work by fifty percent of the amount of funds required to be retained, provided the Contractor's Surety remains responsible for all damages that may be caused due to default by the Contractor, including without limitation, the following:

(a) Completion of the Work;

(b) All interference, disruption, hindrance, delay and impact claims;

(c) All Liquidated Damages; and

(d) All additional expenses incurred by the City.

114.08 Payments Withheld. The Engineer shall have the authority to recommend to the City that payments be withheld from, or Liquidated Damages be assessed against and withheld from, a Payment Request, stating the reasons for such recommendation. The City reserves the right to decline to approve any Contractor Payment Request or part thereof, or because of subsequent evidence or inspection, may nullify any previous Payment Request, in whole or in part, to such extent as may be necessary in the Authorized Representative's opinion to protect the City from loss because of:

(a) Defective Work not remedied;

(b) Damage caused by the Contractor;

(c) Failure to comply with the requirements of Sections 4115.03 to 4115.22, ORC or the Davis-Bacon Act as applicable; and/or

(d) Liquidated Damages.

If a basis for withholding payment is removed, payment shall be made for the amount withheld because of the basis.

114.09 Payments Detained. Whenever the City receives a Claim Affidavit, the Authorized Representative shall detain the stated amount from the Contractor's subsequent Payment Requests unless the Contractor provides a release and waiver of lien with a Payment Request. The release and waiver of lien shall be executed by the Person supplying labor, Materials or services on a Project, which has or may have a right of claim against the Contractor's proceeds. If the City detains an amount as set forth above, such action shall not be construed as conferring any right on such Subcontractor or Material Supplier, nor as enlarging or altering the application or effect of the existing lien law.

114.10 Measurement of Quantities. For all Contracts, except lump sum Contracts, after an item of the Work is completed and before final payment is made by the City, the Engineer will determine the quantities of various items of Work performed as the basis for final payment. The Contractor, in case of Unit Price items, will be paid as provided in 103.19. After issuance of a Certificate of Contract Completion in accordance with 115.05, the Engineer shall prepare a final estimate for payment based on the actual quantities of completed Work and deducting there from all previous payments made to the Contractor. Any prior estimate is subject to correction in the final estimate.

114.11 Final Payment Request. The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and to final payment, shall provide all documents required pursuant to 115.06 for approval by the Engineer with the Contractor's final Payment Request.

114.12 Final Payment Date. Payment of the final Payment Request shall be made within thirty Days from the date of approval by the Engineer. Payments due and not paid to the Contractor within such thirty Day period shall bear interest from the date payment is due under the Contract Documents at the rate paid by the STAR Account in accordance with 120.04.

114.13 Waiver of City's Claims. The making of final payment by the City shall constitute a waiver of all claims by the City except those relating to unresolved claims of the Contractor or the City and those arising after Contract Completion including, without limitation, the following:

(a) Defective or nonconforming Work resulting from latent defects, fraud or gross mistakes;

(b) Outstanding liens;

(c) Failure of the Contractor to comply with any warranties or Guarantees required by the Contract Documents.

114.14 Waiver of Contractor's Claims. The acceptance of final payment by the Contractor shall constitute a waiver of all claims against the City except those that the Contractor has previously made in writing in accordance with 118.01 through 118.11 and which remain unresolved at the time of final payment. This provision is intended to be, and shall be construed as, consistent with, and not in conflict with, Section 4113.62 ORC, to the fullest extent permitted.

ITEM 115 FINAL INSPECTION AND ACCEPTANCE

115.01 Contractor's Request
115.02 Engineer's Punch List
115.03 Completion and Correction of Punch List Items.
115.04 Deferred Items
115.05 Certificate of Contract Completion
115.06 Project Record Document Submittals
115.07 Record Drawings
115.08 Guarantee
115.09 Warranty
115.10 Exercise of Guarantee or Warranty
115.11 Final Cleaning
115.12 Final Cleaning Remedies
115.13 Work After Final Cleaning

115.01 Contractor's Request. When the Work or a designated portion thereof, is nearly complete, the Contractor shall submit a request for a Final Inspection of the Work ("the "Final Inspection") to the Engineer in writing.

115.02 Engineer's Punch List. The Engineer shall, within seven Days of receipt of the request for Final Inspection, notify the Contractor of acceptance or rejection of the request for Final Inspection, stating reasons for any rejection. Upon acceptance of the Contractor's request, the Engineer shall conduct the Final Inspection to determine whether the Work or the designated portion thereof, is in conformity with the Contract Documents. The Engineer shall notify the Contractor and the Authorized Representative of the scheduled time of the Final Inspection. Within three Days of the Final Inspection, the Engineer shall notify the Contractor of any items of Work remaining in a Defective, incomplete or unacceptable condition. The list of such items shall be known as the Engineer's Punch List.

115.03 Completion and Correction of Punch List Items. Within fourteen Days of receipt of the notice required by 115.02, the Contractor shall complete and correct all items on the Engineer's Punch List. If the Contractor does not complete the items on the Engineer's Punch List within fourteen Days of receipt of the notice, the provisions of 105.02 may be invoked. If the Work on the Engineer's Punch List cannot be completed within fourteen Days of receipt of the notice, the Contractor shall justify to the reasonable satisfaction of the Engineer the reasons the items cannot be so completed, and the Contractor shall propose, for approval of the Engineer, a time when such items will be completed. Failure of the Engineer to include any items on the Engineer's Punch List shall not alter the responsibility of the Contractor to complete all the Work in accordance with

the Contract Documents. If multiple inspections of items on the Engineer's Punch List are required due to the Contractor's failure to properly and timely complete them, the Contractor shall be responsible for any additional costs incurred by the Contractor, other Persons, the Engineer and the City resulting from any attendant delay.

115.04 Deferred Items. With the approval of the Engineer, when upon Final Inspection, items of Work cannot be completed because of seasonal conditions, such as bituminous paving or landscaping, or if the Authorized Representative agrees that a particular item need not be completed until a subsequent date, the Authorized Representative may release payment to the Contractor less twice the cost of completing the remaining Work as determined in the sole discretion of the Authorized Representative.

115.05 Certificate of Contract Completion. When all items on the Engineer's Punch List have been corrected to the satisfaction of the Engineer and the provisions of 115.06 through 115.14 have been fulfilled, the Engineer shall process a Certificate of Contract Completion for execution by the Authorized Representative. The City reserves the right of Final Acceptance of the Project.

115.06 Project Record Document Submittals. The Contractor, as a condition precedent to execution of the Certificate of Contract Completion, release of retainage and final payment, shall provide all Project record documents to the Engineer for approval, which may include, without limitation:

(a) Certificate of occupancy, if required;

(b) Any inspection certificates required such as pressure piping, elevator, boiler, electrical, plumbing or piping purification;

(c) Letter of Approval for fire suppression system, if required;

(d) Any operating and maintenance manuals, which shall be organized into suitable sets of manageable size. Indexed data shall be bound in individual binders, with pocket folders for folded sheet information and appropriate identification shall be marked on the front and the spine of each binder;

(e) Neatly and accurately marked sets of As-built Drawings and other Contract Documents reflecting the actual construction of the Project;

(f) Reproducible detailed Drawings reflecting the exact location of any concealed utilities, mechanical or electrical systems and components;

(g) Assignment to the City of all warranties and guaranties, including the most recent address and telephone number of any Subcontractors, Material Suppliers, or manufacturers;

(h) An affidavit from the Contractor to certify that all Subcontractors and Material Suppliers have been paid in full for all Work performed or Materials furnished for the Project and an affidavit from each Subcontractor and Material Supplier that the Subcontractor or Material Supplier has been paid in full for all Work performed or Materials furnished for the Project;

(i) Final certified payroll reports;

(j) Affidavit to certify that the Contractor and an affidavit from each Subcontractor to certify that the Subcontractor has complied with all requirements of Sections 4115.03 to 4115.22, ORC, or the Davis-Bacon Act, as applicable.

115.07 Record Drawings. Unless otherwise provided in the supplemental Specifications or Special Provisions, upon completion of the Work on Projects administered by the Water Engineering Manager of the City's Department of Water or administered by the Chief Engineer of the Department of Aviation, the Contractor shall organize the As-built Drawings into manageable sets, bind the sets with durable paper cover sheets, certify to the accuracy of the As-built Drawings by signature thereon, and deliver the As-built Drawings to the Engineer. The Engineer shall revise the original Contract drawing tracings or computer files with the information contained on the As-built Drawings provided by the Contractor. The City may thereafter use the As-built Drawings for any purpose relating to the Project including, without limitation, additions to or completion of the Project.

115.08 Guarantee. The Contractor shall provide a Guarantee to the City that all Work is in conformity with the Contract Documents and free from defects in workmanship, Materials and Equipment for a period of one year or such longer period as specified in the Contract Documents. The Contract Bond shall remain in effect until the expiration of the applicable period, unless the Contractor shall provide a Maintenance Bond in form and substance and from a Surety satisfactory to the City. The Guarantee time period shall commence on the date of approval of the Certificate of Contract Completion by the Authorized Representative, unless otherwise provided in writing. The Guarantee time period for any incomplete or uncorrected Work at the time of Partial Occupancy or Use, if any, shall commence with the date of approval of the Certificate of Contract Completion by the Authorized Representative, unless otherwise provided in writing. The Guarantee provided in this 115.08 shall be in addition to, and not in

limitation of, any other Guarantee, Warranty or remedy provided by law or by the Contract Documents.

115.09 Warranty. The Contractor shall, prior to installing material or Equipment which is subject to a Warranty, provide a copy of the Warranty to the Engineer for review and approval.

115.10 Exercise of Guarantee or Warranty. If defects in workmanship, material or Equipment become apparent within the applicable Guarantee or Warranty period, the Authorized Representative shall promptly notify the Contractor in writing and provide a copy of the notice to the Engineer. Within ten Days of receipt of the notice, the Contractor shall visit the Project in the company of a representative of the City to determine the extent of all defects and shall promptly repair or replace the defects, including all adjacent property damaged as a result of such defects or as a result of remedying the defects. If the repair or replacement is considered by the Authorized Representative to be an emergency, the Authorized Representative may require the Contractor to visit the Project within one Day of receipt of the notice. The Contractor shall be fully responsible for the cost of and all expenses associated with temporary Materials or Equipment required during the repair or replacement of the defects, including without limitation labor, permits and other incidentals. If the Contractor does not promptly repair or replace the defects, the City may repair or replace the defects and charge the cost thereof to the Contractor or the Contractor's Surety. Work which is repaired or replaced by the Contractor shall be inspected and accepted by a representative of the City and shall be Guaranteed by the Contractor for one year from the date of acceptance of the corrective Work by the City or for the remainder of the original Guarantee time period whichever is longer.

115.11 Final Cleaning. At the completion of the Work, the Contractor shall restore all property not designated for alteration by the Contract Documents to as near its original condition as practicable and clean the site of the Project and adjacent property of all dust, mud, waste Materials, and rubbish attributable to the Work and shall remove any temporary controls required pursuant to the storm water pollution prevention plan and permit.

115.12 Final Cleaning Remedies. Final cleaning shall be done to the satisfaction of the Engineer and the Authorized Representative. If the Contractor fails to clean up at completion of the Work, the provision of 105.02 may be invoked. If a dispute arises as to responsibility for final cleaning, the Engineer may employ City employees or engage a qualified cleaning company, to perform the clean up and deduct the cost from amounts due to the Contractor as the Engineer recommends and the Authorized Representative determines to be

appropriate. The decision of the Authorized Representative on the responsibility for such cost shall be final, subject to 118.01 through 118.11.

115.13 Work After Final Cleaning. If any Work is performed after a final cleaning by the Contractor, the Contractor shall clean any affected area again as provided in 115.11 and 115.12 so that upon Contract Completion, the Project shall be left ready for occupancy or utilization by the City.

ITEM 116 TIME

116.01 Time of Essence
116.02 Time Extensions
116.03 Critical Path
116.04 Extension Sole Remedy
116.05 Time for Contract Completion
116.06 Liquidated Damages

116.01 Time of Essence. Time is of the essence to the Contract Documents and all obligations thereunder. By executing the Contract Form, the Contractor acknowledges that the time for Contract Completion is, and by signing the Construction Schedule and Project Schedule, if applicable, that any specified milestone completion dates are, reasonable taking into consideration the usual weather and other conditions prevailing in the locality of the Project. The Contractor agrees that the Notice to Proceed shall establish the date for commencement of the Work. The Contractor agrees that the City has entered into, or may enter into, agreements or representations for use of all or part of the Project based upon the Contractor achieving Final Acceptance within the time for Contract Completion. The Contractor agrees that the Work will be prosecuted in a reasonable, efficient and economical sequence, in cooperation with the Engineer and in the order and time as provided in the current Construction Schedule and Project Schedule, if applicable. The Contractor shall perform the Work so as not to interfere with, disrupt, hinder, delay or impact the Work of other Persons on the Project and of such other Persons' Subcontractors and Material Suppliers. The Contractor agrees that the possibility that the Contractor may be subject to interference, disruption, hindrance, delay or impact in the progress of the Work from any and all causes is within the contemplation of the Contractor and the City and that the sole remedy for such interference, disruption, hindrance, delay or impact shall be an extension of time granted pursuant to 116.02, except if otherwise required by Section 4113.62 ORC.

116.02 Time Extensions. If the Contractor is interfered with, disrupted, hindered, delayed or impacted at any time in the progress of the Work by any of the following causes, the time for Contract Completion shall be extended for such reasonable time which the Authorized Representative determines, in consultation with the Engineer, has been caused by the interference, disruption, hindrance, delay, or impact in the Work:

(a) Due to suspension of the Work for which the Contractor is not responsible; unusually severe weather conditions not normally prevailing in the particular season; labor dispute, excluding informational pickets; fire; or flood; or

(b) Due to any unforeseeable cause beyond the control and without fault or negligence of the Contractor;

(c) The Contractor shall request any extension of time pursuant to 117.01 through 117.11.

116.03 Critical Path. Notwithstanding any other provision of the Contract Documents, time extensions will depend upon the extent to which the Work on the critical path of the Construction Schedule is affected, or if the Project involves multiple Contractors the extent to which Work on the critical path of the Project Schedule is affected. A Change Order granting a time extension may provide that the time for Contract Completion will be extended for only those specific elements so interfered with, disrupted, hindered or delayed and that remaining milestone completion dates will not be altered and may further provide for adjustment of Liquidated Damages.

116.04 Extension Sole Remedy. Except when the cause for a delay is the proximate result of the City's act or failure to act as required by Section 4113.62 ORC, any extension of time granted pursuant to 116.02 shall be the sole remedy which may be provided by the City. The Contractor shall not be entitled to additional compensation from the City or mitigation of Liquidated Damages for any delay, interference, hindrance, or disruption, including, without limitation, costs of acceleration, consequential damages, loss of efficiency, loss of productivity, lost opportunity costs, impact damages, lost profits or other similar remuneration. It is within the contemplation of the Contractor and the City that the Contractor may accelerate its performance to meet the Construction Schedule and that such acceleration is solely within the discretion of the Contractor. This provision is intended to be, and shall be construed as, consistent with, and not in conflict with Section 4113.62 ORC to the fullest extent permitted by law.

116.05 Time for Contract Completion. The Contractor shall diligently prosecute the Work and shall complete all Work so that Final Acceptance occurs on or before the number of consecutive Days set forth in the Contract Documents following the date set forth in the Notice to Proceed, unless the Contractor timely requests and the City grants an extension of time in accordance with the Contract Documents. The period of time established by the preceding sentence is referred to herein as the time for Contract Completion. Each applicable portion of the Work shall be completed upon the respective milestone completion date unless the Contractor timely requests and the City grants an extension of time in accordance with the Contract Documents.

116.06 Liquidated Damages. Upon failure to complete all Work within the time for Contract Completion, the City shall be entitled to retain or recover from the Contractor, as Liquidated Damages, and not as a penalty, the applicable amount set forth in the following table for each and every Day thereafter until Contract Completion, unless the Contractor timely requests and the City grants an extension of time in accordance with the Contract Documents.

LIQUIDATED DAMAGES Contract Amount	Contract Completion
$0 to $50,000	$150
more than $50,000 to $150,000	$250
more than $150,000 to $500,000	$500
more than $500,000 to $2,000,000	$1,000
more than $2,000,000 to $5,000,000	$2,000
more than $5,000,000 to $10,000,000	$2,500
more than $10,000,000	$3,000

The amount of Liquidated Damages is agreed upon by and between the Contractor and the City because of the impracticability and extreme difficulty of ascertaining the actual amount of damage the City, its taxpayers and the public would sustain. Liquidated Damages only replace the City's actual damages for delays, are not the City's exclusive remedy for breach by the Contractor and are not to be construed in any way as a limitation of any other rights or remedies available to the City under the Contract Documents or otherwise. If a delay of the critical path in completion of the Project occurs which is caused by the City and the Contractor concurrently, the applicable Liquidated Damages shall be apportioned, and the specific number of Days for which the City is solely responsible for shall be deducted from the total number of Days of the concurrent delay used in calculating the Liquidated Damages and the Contractor shall pay Liquidated Damages for the remaining number of Days of delay. In addition to the amounts specified above, the City may charge the Contractor for all inspection regardless of any time extension.

ITEM 117 - CHANGES IN THE WORK

117.01 Change Order
117.02 Payment of Change Order
117.03 Requirement to Perform Changed Work
117.04 Change Order Price Determination
117.05 Change Order Procedures
117.06 Change Order Process
117.07 Paperwork Consolidation
117.08 Change Order Numbering System
117.09 Project Contingency Funds
117.10 Change Order Pricing Guidelines
117.11 Differing Site Conditions
117.12 Time Extension

117.01 Change Order. The City Commission or the Authorized Representative, without invalidating the Contract, may order changes in the Work consisting of additions, deletions or other revisions, including without limitation revisions resulting from an extension granted in accordance with 116.04. To the extent the time for Contract Completion or the Contract price is affected, the Contract may be adjusted by Change Order in accordance with 117.01 through 117.12. The Contractor shall proportionately increase the amount of the Contract Bond whenever the Contract price is increased. If notice of any change affecting the Contract is required by the provision of any Contract Bond, the giving of any such notice shall be the Contractor's responsibility, and the amount of each applicable Contract Bond shall be adjusted accordingly.

117.02 Payment of Change Order. The Contractor shall not proceed with any change in the Work without the required written Change Order. If the Contractor believes that any item is not Work required by the Contract Documents or reasonably inferred therefrom to produce the intended results, the Contractor shall obtain a Change Order before proceeding with such item. Except as provided in 118.01 through 118.11, failure to obtain such a Change Order shall constitute a waiver by the Contractor of any claim for additional compensation for such item. The Contractor understands and agrees that agreement to a Change Order is final and without reservation of any rights.

117.03 Requirement to Perform Changed Work. If the Contractor does not agree to, or fails or refuses to sign, a Change Order, the Contractor shall perform any Work related to the Change Order as required by the Authorized Representative in accordance with 117.04; provided, however, the Contractor may seek compensation and time extension in accordance with 117.04 and 117.10 through 117.12, as applicable, and 118.01 through 118.11 for

any such Work performed. The City reserves the right to cancel or modify any Change Order authorization.

117.04 Change Order Price Determination. The maximum cost or credit resulting from a change in the Work shall be determined as provided in 117.04 through 117.10. Proposals which do not set forth all information required by 117.05 and 117.10 will not be considered or accepted under any circumstances. A Unit Price Proposal shall only be valid when incorporated into the Contract by Change Order; provided, however, that Unit Price Work set forth on the Bid Form, included in the Contract price and which does not exceed the scheduled quantities on the Bid Form may be performed and paid for without a Change Order. The amounts allowed for overhead and profit are all-inclusive, include all Contractor Project costs relating to field and home office operations, and no additional or other amounts for overhead or profit shall be allowed. The maximum cost or credit as determined by 117.10 includes all compensation for impact costs and no additional or other amounts for impact costs shall be allowed. The Contractor shall not assign any portion of the Work to another whereby the Contractor would benefit directly or indirectly from the double application of charges for overhead or profit. If no agreement can be reached between the Contractor and the City as to the cost or credit resulting from a change in the Work or the Contractor fails or refuses to sign a Change Order, the cost or credit shall be determined by the Authorized Representative, upon the recommendation of the Engineer. The Contractor shall proceed with the Change Order Work when so required by the Authorized Representative in writing. The Contractor may dispute the Authorized Representative's determination of the cost or credit by filing a claim in accordance with 118.01 through 118.11. The City reserves the right to require certified payrolls for labor costs and certified invoices for material costs and reserves the right to audit the records of the Contractor and the Contractor's Subcontractors and Material Suppliers.

117.05 Change Order Procedures. The Contractor must be certain to comply with the applicable procedures or payment may be delayed or denied. The Engineer has responsibility for:

(a) Preparing, reviewing, recommending, coordinating, monitoring and processing a Change Order and related documents;

(b) Reviewing the Contractor's pricing within the stated time period, verifying the pricing complies with the pricing guidelines set forth in 117.10 and negotiating pricing, if necessary, to an amount acceptable to the City;

(c) If the change is to have a not-to-exceed price based on performing the Work on a time and material basis or other cost-plus basis, monitoring the Contractor's progress toward completing the revised

portion of the Work and requiring that the Contractor prepare daily records of additional labor, Materials and Equipment required along with a certification from the Contractor that the records are accurate and appropriate for the revised Work. The Engineer shall review these daily records and sign them, but solely for the purposes of signifying that the records are an accurate accounting of the items described therein, and provide a signed copy of the daily records to the Authorized Representative. The signed daily records are also to be attached to the Change Order. If the changed Work should cost less than the maximum amount noted on the Change Order, the Engineer is also responsible for preparing a deduct Change Order for the cost difference;

(d) Reviewing and resolving the Contractor's request for an extension of time related to a Change Order in accordance with 116.01 through 116.06 and 117.12;

(e) Confirming that the City concurs with the change and has available funds or a written commitment for funding the Change Order;

(f) Monitoring the overall Change Order process for timeliness and follow up.

The Contractor has responsibility for:

(a) Responding to requests for pricing within the stated time period;

(b) Preparing all necessary Proposals in sufficient detail for intelligent review with pricing and schedule impact, including those of all affected Subcontractors and Material Suppliers according to the pricing guidelines set forth in 117.10 or Unit Prices, as applicable, and negotiating pricing, if necessary;

(c) If the change is proposed to have a not-to-exceed price based on performing the Work on a time and material basis or other cost plus basis, furnishing and certifying detailed records of all labor, Materials and Equipment provided. If the changed Work should cost less than the maximum amount noted on the Change Order, the Contractor is also responsible for executing a deduct Change Order prepared for the cost difference;

(d) Proceeding with the Work upon receipt of a fully signed Change Order;

(e) If the Contractor performs Work without the appropriate, required Change Order, the Contractor does so at the Contractor's own risk that payment for such Work may not be approved or made, unless the City

has required the Contractor to perform the Work in accordance with 117.03 and 117.04; and

(f) Providing the changed Work in a timely manner and as authorized by the Change Order, all in accordance with the requirements of the Contract Documents.

117.06 Change Order Process. When a change to the Work is ordered, the Engineer shall:

(a) Prepare an estimate of the cost of the changed Work and verify with the Authorized Representative that the change is ordered and that funds are available in the amount of the estimate for the Work;

(b) Prepare a detailed scope of Work in Bulletin form, including any necessary Drawings;

(c) Submit the Bulletin to the Authorized Representative for approval, along with a justification letter indicating the reason for the change in the Work;

(d) Upon receipt of approval by the Authorized Representative, release the Bulletin to the Contractor with a date specified for the Contractor to return a Proposal. If the Contractor fails to respond to the Engineer within the time specified, or as otherwise agreed to in writing by the Contractor and the Engineer, the Contractor shall be responsible for any additional costs incurred by the Contractor, the Engineer and the City resulting from any attendant delay;

(e) Review the Contractor's Proposal, verifying that pricing complies with the pricing guidelines set forth in 117.10 or Unit Prices, as applicable, and negotiate the price if required to obtain a price less than the maximum established by the pricing guidelines or different from the amount calculated using Unit Prices where appropriate. Within seven Days of receipt of the Contractor's Proposal, the Engineer shall notify the Contractor whether the Proposal is acceptable in form or advise the Contractor in writing of the reasons for disapproval. If negotiation of the price is necessary, any failure of the Contractor to respond appropriately and within the time specified, or as otherwise agreed to in writing by the Contractor and the Engineer shall cause the Contractor to be responsible for any additional costs incurred by the Contractor, the Engineer and the City resulting from any attendant delay;

(f) Determine the basis for pricing the Work and confirm whether the Work is for a fixed price, or for a not-to-exceed price based on performing the Work on a time and material basis, or other cost-plus

basis. Verify that any Subcontractor and Material Supplier pricing is included and complies with the pricing guidelines set forth in 117.10 or Unit Prices, as applicable. Review any requested time extension with the Authorized Representative to be determined according to 116.01 through 116.06 and 117.12 and obtain written recommendation of approval of the Change Order from the Engineer and the applicable Director if other than the Engineer. Sign and obtain the Contractor's signature on the Change Order;

(g) Submit the Proposal to the Authorized Representative or the City Commission, as applicable, for approval along with the written recommendation of approval or disapproval of the Proposal of the City Engineer and other City Department head, if applicable;

(h) Deliver multiple copies of the signed Change Order package to the Authorized Representative for signing and any necessary fund certification. Upon signing by the Authorized Representative, the Authorized Representative shall return copies of the executed Change Order to the Contractor and the Engineer. The Contractor may bill for Work covered by the Change Order only after this final step.

117.07 Paperwork Consolidation. Related transactions occurring at or about the same time shall, whenever possible, be consolidated into the same Bulletin or Change Order, or both. Add and deduct items may be included on the same Change Order, as well as items with different reasons for changed Work so long as the reason and pricing for each item is separately stated.

117.08 Change Order Numbering System. Unless otherwise provided in the Contract Documents, the Engineer shall assign a number to each change which shall be stated on the Bulletin, starting with number 001. All Contractors affected by the change will be recorded under the same number. The Engineer will establish and maintain a Change Order log to track all activities related to Change Order processing and taking care not to duplicate or reuse any Change Order number throughout the Project.

117.09 Project Contingency Funds. Project Contingency Funds shall be reserved to pay costs resulting from Change Orders, unanticipated job conditions, to comply with rulings regarding building and other codes, to pay costs related to errors and omissions in Contract Documents, and to pay the cost of settlements and judgments related to the Project. Change Orders for which there are sufficient moneys in the Contract price including the Project Contingency Funds must be approved by the Engineer and the Authorized Representative. Change Orders which would increase the Contract price must be approved by the City Commission.

117.10 Change Order Pricing Guidelines. For each change, the Contractor shall furnish a detailed, written Proposal itemized according to these pricing guidelines. Any Subcontractor or Material Supplier pricing shall also be itemized according to these pricing guidelines. Where Unit Prices were included in the Bid Form and the Contract price, the Engineer may also require incorporation of such Unit Prices or preparation of an Alternate Proposal incorporating such Unit Prices. These pricing guidelines are intended to establish the maximum amount which the City will pay for any Change Order, including without limitation all amounts for interference with, delay, hindrance, disruption or impact of the Work. A Change Order may provide that the City may pay less than the amount established by these pricing guidelines if such amount is negotiated by the Engineer in accordance with 117.06 or is determined in accordance with 118.01 through 118.11. As provided in 114.01 the Contract Cost Breakdown may be used by the City to determine any cost or credit. In order to expedite the review and approval process, all Proposals shall be prepared in the categories and in the order listed below. This provision is intended to be, and shall be construed as, consistent with, and not in conflict with, Section 4113.62, ORC to the fullest extent permitted. The pricing guidelines are:

(a) LABOR - All field labor shall be priced at the current base rate, excluding fringe benefits, of the prevailing wage in the Project locality. The Proposal and documentation is to include number of hours and rate of pay for each classification of worker. If the Contractor pays an employee a base rate exceeding prevailing wage, the Contractor shall submit certified payroll records that substantiate that rate. Any Contractor performing Work on a time and material basis or the cost-plus basis Work shall submit certified payroll records for all employees performing that Work;

(b) FRINGES - All established payroll taxes, assessments and fringe benefits on the labor. This may include, without limitation, FICA, Federal and State Unemployment, Health and Welfare, pension Funds, Workers' Compensation and Apprentice Fund. Each of the fringes is to be a separate line item. The Contractor shall submit documentation supporting the calculation of the amounts for each fringe for each worker classification;

(c) EQUIPMENT RENTALS - All charges for certain non-owned heavy or specialized Equipment at up to one hundred percent of the documented rental cost. No rental charges will be allowed for hand tools, minor Equipment, simple scaffolds, etc. Downtime due to repairs, maintenance and weather delays will not be allowed. The Contractor shall submit copies of actual paid invoices to substantiate rental costs;

(d) OWNED EQUIPMENT - All charges for certain owned, heavy or specialized Equipment at up to one hundred percent of the cost listed by the Associated Equipment Dealers Green book rental rates and Specifications for construction Equipment. No recovery will be allowed for hand tools, minor Equipment, simple scaffolds, etc. The longest period of time that the Equipment is to be required for the Work will be the basis for the pricing. Downtime due to repairs, maintenance and weather delays will not be allowed;

(e) TRUCKING - A reasonable delivery charge or per-mile trucking charge for delivery of required Materials or Equipment. Charges for use of a pick-up truck will not be allowed;

(f) OVERHEAD - Overhead on items in 117.10 (a)-(d) up to ten percent, which shall include all costs required to schedule and coordinate the Work. Overhead includes, without limitation, telephone, telephone charges, facsimile, electronic mail, telegrams, postage, photos, photocopying, hand tools, simple scaffolds (1 level high), tool breakage, tool repairs, tool replacement, tool blades, tool bits, home office estimating and expediting, home office clerical and accounting support, home office labor (management, supervision, engineering), all other home office expense, legal services, travel and parking expenses; provided, however, shop or engineering labor, which shall not be subject to prevailing wage rates, for steel Fabricators, sheet metal Fabricators and sprinkler system Fabricators will be allowed under 117.10 (a)-(d);

(g) MATERIALS - All Materials purchased by the Contractor and incorporated into the changed Work, showing costs, quantities, or Unit Prices of all items, as appropriate. Reimbursement of material costs shall only be allowed in the amount of the Contractor's actual cost, including any and all discounts, rebates or related credits. One-third of the cost of reusable Materials for each use, such as formwork lumber, shoring or temporary enclosures;

(h) PROFIT - Profit on items in 117.10 (a)-(g) up to ten percent;

(i) SUBCONTRACTOR - The reasonable cost of all labor and material provided by a Subcontractor whose pricing is included and which complies with these pricing guidelines;

(j) CONTRACTOR MARK-UP ON SUBCONTRACTOR - Mark-up on items in 117.10 (i) up to five percent or 2,500 dollars, whichever is less;

(k) MISCELLANEOUS - The following items are allowable at the cost of the Work, with no overhead or profit:

.1 The cost of extending the bond and the cost of extending liability, property damage, builder's risk or specialty coverage insurance;

.2 Fees for permits, licenses, inspections, test, etc.; and

(l) Costs which will not be reimbursed for Change Order Work include the following:

.1 Overnight lodging, travel and food;

.2 Employee Profit Sharing Plans - regardless of how defined or described, the Contractor will pay these charges from Contractor profit and will not be reimbursed; and

.3 Voluntary Employee Deductions - examples are United Way and U.S. Savings Bonds.

(m) State sales tax shall be allowed on items as described in 104.18.

117.11 Differing Site Conditions. During the progress of the Work, if subsurface or concealed conditions are encountered at the site differing materially from those indicated in the Contract Documents or if subsurface or concealed physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract Documents, are encountered at the site, the Contractor shall notify the Engineer in writing of the specific differing conditions before they are disturbed or the affected Work is performed. Upon notification, the Engineer will investigate the conditions and if it is determined that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, a Change Order may be issued in accordance with the 117.01 through 117.12, as applicable. The City may decline to issue a Change Order if the notice required by this 117.11 is not timely provided by the Contractor. If the Contractor fails to timely provide the notice required by this 117.11, the Contractor shall be deemed to have waived any and all claims for additional compensation or time extensions for the related subsurface or concealed physical condition.

117.12 Time Extension. Notwithstanding any other provision of the Contract Documents, time extensions for changes in the Work will depend upon the extent to which the change causes delay in Work on the critical path of the Construction Schedule or if the Project involves multiple Contractors of the

Project Schedule as determined pursuant to 109.06 and 109.05, respectively. If extending the time for Contract Completion is not possible, the Contractor shall price, and separately state, all costs of accelerated performance in the Contractor's Proposal. A Change Order granting a time extension may provide that the time for Contract Completion will be extended for only those specific elements actually delayed and that remaining milestone completion dates will not be altered and may further provide for adjustment of Liquidated Damages, to the fullest extent permitted by law.

ITEM 118 DISPUTE RESOLUTION PROCEDURE

118.01 Notice and Claim Requirements
118.02 Filing of Notice
118.03 Filing of Claim
118.04 Claim Response
118.05 Claim Review and Decision
118.06 Appeal to Board of Review
118.07 Alternate Dispute Resolution
118.08 Delegation
118.09 Auditing of Claims
118.10 False Certification of Claims
118.11 Performance and Payment

118.01 Notice and Claim Requirements. Whenever the Contractor intends to seek additional time or compensation or mitigation of Liquidated Damages, whether due to delay, extra Work, additional time or Work, breach of Contract, or other causes arising out of or related to the Contract or the Project, the Contractor shall follow the procedures set forth in 118.01 through 118.11. To the fullest extent permitted by law, failure by the Contractor to follow the procedures in 118.01 through 118.11 is a waiver of any claim for additional time or compensation or for mitigation of Liquidated Damages. Compliance with all applicable procedures in 118.01 through 118.11 is a condition precedent to the filing by the Contractor of any litigation related to the Contract or the Project.

118.02 Filing of Notice. The Contractor shall file notice of any claim with the Engineer, in writing, no more than ten Days after the initial occurrence of the facts, which are the basis of the claim. To the fullest extent permitted by law, failure of the Contractor to timely and completely provide such notice shall constitute a waiver by the Contractor of any claim for additional time or compensation or for mitigation of Liquidated Damages. Every such written notice shall provide the following information to permit timely and appropriate evaluation of the claim, determination of responsibility and opportunity for mitigation:

(a) Nature of claim and estimated amount of the claim, including all costs for interference, disruption, hindrance, delay and any impact, which amount shall be calculated in accordance with the pricing guidelines set forth in 117.10, shall be based upon the Contractor's experience and shall be a fair and reasonably accurate assessment of the damages suffered or anticipated by the Contractor, as applicable;

(b) Specific number of Days of extension requested and specific number of Days for remobilization requested;

(c) Identification of Persons and events responsible for causing the claim, including without limitation the date or anticipated date, as applicable of the commencement of any interference, disruption, hindrance, delay or impact;

(d) Identification of activities on the Construction Schedule and the Project Schedule, if applicable, which will or may be affected by the claim or new activities which will or may be created and the relationship with existing activities;

(e) Anticipated impacts and anticipated duration of any interference, disruption, hindrance, delay or impact and any remobilization period; and

(f) Recommended action to avoid or minimize any interference, disruption, hindrance, delay or impact.

118.03 Filing of Claim. With respect to every claim submitted, the Contractor shall file three copies of its claim with the Engineer not more than thirty Days after the notice required by 118.02 and, in all events prior to Contract Completion. The Contractor's claim shall detail the amounts claimed and provide the following information to permit timely and appropriate evaluation of the claim, determination of responsibility and any remaining opportunity for mitigation. If the Contractor is unable to calculate any amount claimed in detail, the Contractor shall use its best efforts to provide a reasonable estimate of such amount:

(a) A narrative of the event, or combination of events, claimed as resulting in interference, disruption, hindrance, delay or impact to the Contractor, including the start date of the event or events and the actual, or anticipated, finish date;

(b) A quantification of the planned Work items and the changed scope of Work items claimed as having been impacted;

(c) A time impact analysis, consistent with standard critical path methodology for scheduling, demonstrating the impact to the Contractor's scheduled activities;

(d) Copies of the Contractor's daily log for each Day of impact;

(e) Copies of relevant correspondence and other information regarding or supporting Contractor entitlement;

(f) Copies of Contractor payroll records for labor impacts claimed by Contractor and any Subcontractor affected by the event or events;

(g) Copies of invoices for material impacts claimed by the Contractor and any Subcontractor affected by the event or events;

(h) Copies of Equipment records, or rental invoices, for any Equipment impacts claimed by the Contractor or any Subcontractor affected by the event or events;

(i) Copies of the most recent Contractor's income statement, including segregated general and administrative expenses for the most recent reporting period, and for the period of the Contract, if available, and similar information for any Subcontractor claim included;

(j) A statement, signed by an authorized representative of the Contractor, certifying that the claims are made in good faith, the supporting data is accurate and complete to the best of the Contractor's knowledge and belief and the amount requested accurately reflects the Contract adjustment for which the Contractor believes the City is liable in accordance with the Contract Documents, in particular the pricing guidelines set forth 117.10.

118.04 Claim Response. Immediately upon receipt of any claim submitted by the Contractor in accordance with 118.03, the Engineer shall deliver 2 copies to the Authorized Representative. Upon submission of the claim by the Contractor, the Engineer shall convene a meeting with the Contractor and any applicable Subcontractors and Material Suppliers to review and discuss the claim. The Engineer shall review the Contractor's claims with all attendees and discuss any questions regarding the nature or content of the required items. Any items deemed deficient shall be corrected by the Contractor before the Engineer will commence review in accordance with 118.05. The Engineer shall document the timeliness of notice provided under paragraph 118.02 and the actual date of corrected submission of the claim.

118.05 Claim Review and Decision. Upon corrected submission of the claim by the Contractor, the Engineer shall review the claim and prepare a written analysis of its content. The analysis may include a narrative of the examination of the facts giving rise to the claim, relevant Contract Documents and language therein, an analysis of claimed additional labor, Materials and Equipment for the scope of the Work items described and an analysis of any time extension for any interference, disruption, hindrance, impact or delay claimed (including the calculation of any concurrent delays affecting entitlement) and shall include confirmation of the calculation of claimed labor, Materials and Equipment as conforming to the pricing guidelines set forth in 117.10 and a concluding recommendation regarding Contractor entitlement to, and the appropriateness and reasonableness of, all or any part of, the claimed costs and time extension. The Engineer may include copies of contemporaneous documentation supporting

any recommendation regarding the sufficiency or inadequacy of the Contractor's claim, the Contractor's performance or the rebuttal of the claim. The Engineer shall prepare and submit the claim analysis to the Authorized Representative within thirty Days of the corrected submission of the claim. The Authorized Representative shall examine the Contractor's claim, and the analysis of the claim submitted by the Engineer. The Authorized Representative shall approve or deny all or any part of, the Contractor's claim and forward a written decision to the Contractor and the Engineer within thirty Days after receipt of the Engineer's claim analysis. The decision of the Authorized Representative shall be final and conclusive, unless the Contractor appeals the decision to the Board of Review in accordance with 118.06.

118.06 Appeal to Board of Review. The Contractor may appeal the decision of the Authorized Representative to the Board of Review by written notice to the Authorized Representative within ten Days of receipt of the Authorized Representative's decision. The Board of Review shall meet within thirty Days of receipt of the notice by the Authorized Representative. The Contractor shall be given an opportunity to present the claim at the meeting. The purpose of the meeting shall be to settle the issues in dispute. The Board of Review shall render a decision on the claim within thirty Days of the meeting unless a mutual agreement is made between the Contractor and the Board of Review to extend the time for decision. The decision of the Board of Review shall be final and conclusive, unless the Contractor provides written notice to the Authorized Representative of the Contractor's intention to file litigation within ten Days of receipt of the decision. The filing of an appeal and the provision of notice of intention to file litigation are each a condition precedent to the filing of any litigation related to the Project or the Contract by the Contractor and any failure by the Contractor to timely fulfill them will preclude the Contractor from filing any such litigation.

118.07 Alternate Dispute Resolution. If, upon consideration of a claim, the Contractor and the City mutually agree in writing, the dispute resolution procedure may be waived, or the claim may be referred to a form of Alternative Dispute Resolution, including a procedure to equitably share the costs of the Alternative Dispute Resolution.

118.08 Delegation. No provision shall prevent the Board of Review or the Authorized Representative from delegating the duties or authorities of the Board of Review or the Authorized Representative to any third Person selected at the discretion of the Board of Review or Authorized Representative, as applicable.

118.09 Auditing of Claims. All claims by the Contractor shall be subject to audit at any time following the filing of such claim, whether or not such claim is part of litigation pending in the courts of this State. The audit may be performed by employees of the City or by a consultant engaged by the City. The audit may begin on ten Days' notice to the Contractor, Subcontractor or Material Supplier, as applicable. The Contractor, Subcontractor or Material Supplier shall use its best efforts to cooperate with the audit. Failure of the Contractor, Subcontractor or Material Supplier to maintain and retain sufficient records to allow the City to verify the claim shall constitute a waiver of any portion of such claim that cannot be verified. Without limiting the foregoing, and as a minimum, the Contractor, Subcontractor or Material Supplier shall make available to the City the following documents:

(a) Daily time sheets and foreperson's daily reports;

(b) Union agreements, if any and employer agreements;

(c) Insurance, welfare, fringes and benefits records;

(d) Payroll register;

(e) Earnings records;

(f) Payroll tax returns;

(g) Material invoices, purchase orders, Subcontractor Contracts and all material and supply acquisition Contracts;

(h) Material cost distribution worksheets;

(i) Equipment records (list of Contractor Equipment, rates, etc.);

(j) Vendor rental agreements, and Subcontractor invoices;

(k) Subcontractor payment certificates;

(l) Canceled checks (payroll and vendors);

(m) Job cost reports;

(n) Job payroll ledger;

(o) General ledger, general journal, (if used) and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals;

(p) Cash disbursements journal;

(q) Financial statements for all years reflecting operations on the Project;

(r) Income tax returns for all years reflecting operations on the Project;

(s) Depreciation records on all Equipment utilized whether such records are maintained by the Contractor involved, its accountant, or others;

(t) If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating Equipment, all such other source documents;

(u) All documents which reflect the Contractor's actual profit and overhead, or the calculation of overhead multipliers, during the years the Project was being performed and for each of the five years prior to the commencement of this Project;

(v) All documents related to the preparation of the Contractor's Bid, including the final calculations on which the Bid was based;

(w) All documents which relate to each and every claim together with all documents which support or negate the amount of damages as to each claim;

(x) Worksheets used to prepare the claim establishing the cost components for items of the claim including, but not limited to, labor, fringes, benefits and insurance, Materials, Equipment, Subcontractors, and all documents which establish the time periods, individuals involved, the hours and rate of pay for the individuals; and

(y) All other documents required by the City to intelligently review the claim.

118.10 False Certification of Claims. If any Contractor falsely certifies all or any part of a claim, the portion of the claim so certified shall be denied. If any Contractor is found to have falsely certified all or any part of any claim, that fact may be used to support a finding of non-responsibility in future Bids for the award of any City Contract.

118.11 Performance and Payment. The Contractor shall proceed with performance of the Work during any dispute resolution process, unless otherwise agreed by the Contractor and the Authorized Representative in writing. The City shall continue to make payment of any undisputed amounts in accordance with the Contract Documents pending final resolution of a claim,

unless otherwise agreed by the Contractor and the Authorized Representative in writing. If the Contractor accepts the decision of the Authorized Representative or the City Commission and foregoes litigation of the claim, any payment to be made, credit to be provided or extension of time to be granted pursuant to the decision shall be evidenced by a Change Order package consisting of a completed Change Order form signed by the Contractor, the Engineer and the Authorized Representative, a copy of the approval of the City Commission and any necessary supporting documentation and any payment shall be made pursuant to a Payment Request in accordance with 114.02 and 114.03 or 114.10 through 114.13, as applicable.

ITEM 119 CONTRACT TERMINATION

119.01 Notice to Surety
119.02 Suspension of Work
119.03 Termination for Convenience
119.04 Termination for Cause
119.05 Contractor Bankruptcy

119.01 Notice to Surety. The Authorized Representative shall provide notice to the Contractor's Surety of any Suspension or Termination pursuant to 119.01 through 119.05; provided, however, the failure to provide such notice shall not release the Surety from any of its obligations.

119.02 Suspension of Work. If, in the judgment of the Authorized Representative, the Contractor is causing undue risk of damage to any part of the Project or adjacent area, the Authorized Representative may suspend the Work temporarily, either wholly or in part, for such period until, in the judgment of the Authorized Representative, the safe and proper prosecution of the Work may be resumed. The Authorized Representative may also suspend the Work either in whole or in part for a specified number of Days on account of public necessity, adverse weather conditions, or other similar reasons which are beyond the control of the Contractor. In case of such a suspension, an extension of time, if appropriate, may be allowed as provided in the Contract Documents but no payment will be made to the Contractor for any expense or damages resulting therefrom. This provision is intended to be, and shall be construed as, consistent with, Section 4113.62 ORC, to the fullest extent permitted. Any failure of the Authorized Representative to suspend the Work shall not relieve the Contractor of the Contractor's responsibility to perform the Work safely and in accordance with the Contract Documents. The Contractor shall, upon receipt of notice of suspension, cease Work on the suspended activities and take all necessary or appropriate steps to limit disbursements and minimize costs with respect thereto. The Contractor shall furnish a report to the Authorized Representative, within five Days of receipt of the notice of suspension, describing the status of the Work, including without limitation, results accomplished, conclusions resulting therefrom, and such other information as the Authorized Representative may require. In the event of suspension, the Contractor shall be entitled to payment of compensation due under the Contract Documents, upon submission of a proper invoice, for the Work performed prior to receipt of notice of suspension, which shall be payable based upon the Contract Cost Breakdown.

119.03 Termination for Convenience. The City may, at any time upon twenty Days written notice to the Contractor, terminate the Contract in whole or in part for the City's convenience and without cause. Upon receipt of

the notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Authorized Representative, proceed with performance of the following duties:

(a) Cease operation as specified in the notice;

(b) Place no further orders and enter into no further subcontracts for Materials, labor, services or facilities except as necessary to complete continued portions of the Project;

(c) Terminate all subcontracts and orders to the extent they relate to the Work terminated;

(d) Proceed to complete the performance of any Work not terminated; and

(e) Take actions that may be necessary, or that the Authorized Representative may require, for the protection and preservation of the terminated Work.

Upon termination for convenience, the Contractor shall be paid in accordance with the Contract Cost Breakdown for Work completed, including any amount retained, and the value of Materials ordered and delivered, less any salvage credit the Contractor may receive for them. All Materials, Equipment, facilities and supplies at the Project site, or stored off site, for which the Contractor has been compensated, shall become property of the City. The Contractor may submit evidence of any reasonable expenses directly attributable to the termination of the Work for consideration by the City. The Contractor shall not be entitled to any profit or overhead for Work not performed and in no event shall the Contractor's compensation exceed the total Contract price. Any dispute as to the sum then payable to the Contractor shall be resolved in accordance with the provisions of 118.01 through 118.11.

119.04 Termination for Cause. If the City determines that the Contractor has failed to prosecute the Work with the necessary force or in a timely manner, or has refused to remedy any Defective Work, the Authorized Representative shall notify the Contractor and the Contractor's Surety of such failure or refusal. The Contractor shall begin to cure such failure or refusal within five Days of receipt of the notice. If the Contractor fails to cure such failure or refusal within twenty Days of receipt of the notice, the City may terminate the Contract and employ upon the Work the additional force, or supply the Materials or such part of either as is appropriate, and may remove Defective Work. If the Contractor is so terminated, the Contractor's Surety shall have the option to engage another Contractor to perform the Contract, with the approval of the Authorized Representative. If the Contractor's Surety does not commence performance of the Contract within ten Days of the date on which the Contract

was terminated, the City may complete the Work by such means as the Authorized Representative deems appropriate. The City may take possession of and use all Materials, facilities, and Equipment at the Project site or stored off site for which the City has paid. If the Contract is so terminated, the Contractor shall not be entitled to any further payment. If the City completes the Work and if the cost of completing the Work exceeds the balance of the Contract price, including compensation for all direct and consequential damages incurred by the Engineer and/or the City as a result of the termination, such excess shall be paid by the Contractor or the Contractor's Surety. If the Contractor's Surety performs the Work, the provisions of the Contract Documents shall govern the Surety's performance, with the Surety being substituted for the Contractor in all such provisions including, without limitation, provisions for payment for the Work and provisions about the right of the City to complete the Work. Upon a final determination, by a court of competent jurisdiction, that the termination pursuant to 119.04 was improper, the termination shall be deemed a termination for convenience pursuant to 119.03.

119.05 Contractor Bankruptcy. If the Contractor files a voluntary petition in bankruptcy or has an involuntary petition in bankruptcy filed against the Contractor, or if the Contractor makes a general assignment for the benefit of creditors, or if a receiver is appointed for all or a substantial part of the Contractor's business or property, the Authorized Representative shall serve written notice on the Contractor and the Contractor's Surety stating that any failure of the Contractor to provide adequate assurances of continued performance will be considered a rejection of the Contract, which shall result in termination of the Contract for cause. Such termination of the Contract need not be evidenced by an order of any court rejecting the Contract. Upon a final determination, by a court having jurisdiction, that the termination was improper, the termination will be deemed to be a termination for convenience pursuant to 119.03.

ITEM 120 - AUDITS AND RECORDS

120.01 Examination
120.02 Termination and Disputes
120.03 Non-Disclosure by Contractor
120.04 Interest

120.01 Examination. The City shall have the right to examine all books, records, documents and other data of the Contractor and of the Contractor's Subcontractors and Material Suppliers related to the Bidding, pricing, or performance of the Work, including without limitation for the purpose of evaluating any Proposal or claim. Such Materials shall be made available at the office of the Contractor, Subcontractor, or Material Supplier, as applicable, at all reasonable times for inspection, audit and reproduction until the expiration of seven years after the date of Final Acceptance of the Project by the City. To the extent that the Contractor, Subcontractor, or Material Supplier, as applicable, informs the City in writing that any documents copied by the City are trade secrets, the City shall treat such documents as trade secrets of the Contractor, Subcontractor, or Material Supplier, as applicable. In the event, any dispute arises with any other Person about whether such other Person should be given access to the documents, the Contractor, Subcontractor, or Material Supplier, as applicable, agrees to indemnify the City against all costs, expenses and damages, including without limitation attorneys' fees, incurred or paid by reason of such dispute. The right of inspection, audit, and reproduction shall extend to all documents necessary to permit adequate evaluation of the cost of pricing data submitted along with the computations and Projections used therein.

120.02 Termination and Disputes. If the Contract has been terminated, in whole or in part, the records relating to the Work terminated shall be made available to the City for a period of seven years from the date of any applicable final settlement or payment, as applicable. Records which relate to disputes, litigation, or settlement of claims arising out of the performance of the Work shall be made available until such dispute, litigation or settlement has been finally decided or settled.

120.03 Non-Disclosure by Contractor. The Contractor shall not disclose, at any time during or after the Work, either directly or indirectly, any confidential records, knowledge or information which the Contractor may acquire about the Project or the City, except as may be required by law or order of a court of competent jurisdiction.

120.04 Interest. Moneys owed to the Contractor by the City pursuant to the terms of the Contract Documents, which are not paid when due shall accrue straight interest at the rate paid by the STAR Account, from the date the moneys become due until the moneys are paid.

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 construction area, except such objects designated to remain or are specified for removal according to other items of Work.

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 or to remain. This Work shall also include the preservation from injury or defacement of all vegetation and objects designated 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.

Trees less than 6 inches in diameter and stumps less than 24 inches above the ground, clearing, grubbing and scalping as defined in these Specifications shall be included as incidental Work to be included in the Bid price for the appropriate items of Item 203 or Item 810.

201.03 Clearing and Grubbing. All surface objects, 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, except for special treatment as follows:

(a) In locations within the construction limits, all stumps shall be completely removed including roots extending within 1 foot of finished grade or pavement Subgrade.

(b) In locations which will be a minimum of 3 feet below the slope of embankment, the Contractor may leave undisturbed stumps or roots provided they do not extend more than 6 inches above the original 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.

201.04 Scalping. The Contractor shall scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust and decayed vegetable matter from the surface of the ground.

201.05 Method of Measurement. For Clearing and Grubbing specified in the Contract, measurement of the area cleared and grubbed will not be made. For Item 201 Tree Removed and Item 201 Stump Removed, measurement will be the individual unit basis. The diameter of trees and stumps will be measured at a height of 54 inches above the ground. Trees and stumps less than 6 in diameter will be classed as brush. Stump measurement will be made by taking the average diameter at the cutoff. Trees and/or stumps will be designated and measured in accordance with the following schedule of sizes:

Diameter	**Pay Item Designation**
6 inch to 18 inch	6 inch to 18 inch
Over 18 inch to 30 inch	18 inch to 30 inch
Over 30 inch	Over 30 inch

201.06 Basis of Payment. The accepted quantities will be paid for at the Contract Unit Price as follows:

Item	**Unit**	**Description**
201	Each	Tree removed __ size
201	Each	Stump removed __ size
201	Lump Sum	Clearing and grubbing

ITEM 202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202.01 Description
202.02 Grinding Existing Pavement
202.03 Removal of Old Pavement
202.04 Removal of Structures
202.041 Buildings Removed
202.042 Underground Storage Tanks Removed
202.05 Pipe Removed
202.06 Sidewalks, Curbs, etc. Removed
202.07 Guardrail and Fence Removed
202.08 Manhole, Catch Basin, and Inlet Removed
202.09 Sawing Existing Concrete or Existing Asphaltic Concrete
202.10 Method of Measurement
202.11 Basis of Payment

202.01 Description. This Work shall consist of removal wholly or in part, and satisfactory disposal of all Structures, old pavements, curb, Sidewalk 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 include backfilling the resulting trenches, holes, pits, and salvaging designated Materials.

Where sawing existing concrete or existing asphalt concrete is a separate pay item shown on the Plans, in the Proposal, or where ordered by the Engineer, payment shall be made under Item 202, Sawing Existing Concrete or Existing Asphalt Concrete.

The Contractor shall raze, remove, and dispose of all buildings and foundations, Structures, fences, guardrails, old pavements, abandoned pipe lines, storage tanks, and other obstructions any portion of which are in the Right-of-Way, except utilities and those items for which other provisions have been made for removal. All designated salvageable Materials 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. 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 Item 203.

Any item in use by traffic shall not be removed until arrangements are made to accommodate traffic.

When existing Sewers are encountered in removal operations and are determined by the Engineer to be inactive or are to be abandoned, they shall be

plugged or sealed at the ends where broken into before backfilling operations proceed. Plugging and sealing shall be accomplished by furnishing and placing approved precast stoppers or masonry bulkheads.

202.02 Grinding Existing Pavement. This item shall cover the removal of existing pavement by planing, including disposal of cuttings, at a thickness designated on the Plans or established by the Engineer.

Planing Equipment shall be self-propelled with sufficient power and stability to consistently and efficiently produce the required results. The cutting element may be of the grinding, sawing, or milling type. Planing cutters shall be mounted rigidly to the carrier and shall be adjustable and controllable as to the depth of cut and cross-slope. Longitudinal planing action may be capable of producing either a variable or a constant cross-slope as required. Planing cutters shall be designed, maintained and operated so as to produce a surface free from groves, ridges, gouges or other irregularities detrimental to the safe operation of vehicles in traffic routed onto the planed surface, temporarily or permanently. Suitable supplemental Equipment or methods, approved by the Engineer, may be used in small or confined areas.

One or more planing passes shall be made over the designed area as necessary to remove such irregularities as bumps, corrugations, and wheel ruts, and, when required, to establish a new pavement surface elevation or cross-slope. Cuttings shall be free of all loose material that would create a hazard, a nuisance in the surface texture. Cuttings shall be disposed of in accordance with 203.05. Effective measures shall be taken to control dust, contamination of the pavement, and the scattering of loose particles during planing and cleaning operations. Where sound pavement has been damaged by planing operations, the damaged area shall be repaired at the Contractor's expense in a manner satisfactory to the Engineer. The repaired area shall conform to the adjacent pavement in smoothness and durability.

The surface shall be planed to a smoothness of 1/4 inch in 10 feet, and the surfaces at the edges of adjacent passes shall be matched within 1/4 inch. The cross-slope of the planed surface shall conform to the specified cross-slope within 3/8 inch in 10 feet.

202.03 Removal of Old Pavement. This item shall cover the excavation and disposal of any type of old pavement required to be removed for the incorporation of the new Work or in order to match the grades and alignment of the new Work with the existing pavement.

The type of old pavement to be excavated, such as concrete and brick, will be shown on the Plans or stated in the Proposal.

When no item of excavation under Item 203 is shown for the areas in which the existing pavement is to be removed, this item shall include the necessary preparation of the Subgrade to the proper alignment and grade in accordance with the applicable provisions of Item 203.

The use of an iron weight commonly known as a "pear drop" or "headache ball" is prohibited unless authorized by the Engineer.

Wherever the old pavement to be excavated consists of that made necessary to be removed in order to match the grade and alignment of the new Work, care shall be taken in so removing the old pavement that the remaining pavement will not be damaged. In excavating such areas, the pavement shall be cut to straight lines by the use of pneumatic tools or other methods equally satisfactory and trimmed neatly about 2 inches down from the surface.

Where required, brick pavement or base shall be carefully removed, cleaned, and delivered as specified.

202.04 Removal of Structures. This Work shall consist of removal of all or part of a Structure such as steps, walls, headers, foundations or other miscellaneous obstructions. Partial removal of a Structure shall be performed with sufficient care as to leave the remaining portion of the Structure undamaged and the removal line shall be a straight line. In case of damage or an irregular removal line to the existing Structure, repair or replacement shall be made at the Contractor's expense and to the approval of the Engineer.

202.041 Buildings Removed. Buildings and appurtenances designated for removal shall not be disturbed by the Contractor until the Contractor has been furnished with 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, under the direction of the Engineer, in a manner that will accommodate utility rearrangements and clearance of Structures. Buildings designated for removal which are located partially or totally on temporary Right-of-Way shall be removed in their entirety as directed by the Engineer, and the backfill and related Work shall be done the same as if they were in the permanent Right-of-Way.

If the Contractor desires to use buildings located partially on and partially off permanent Right-of-Way 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 Right-of-Way 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, floor slabs, and basement, pit, well and cistern walls shall be removed in their entirety.

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 and all drains that are not removed shall be sealed with masonry or with precast clay or concrete stoppers.

All material 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 disconnecting all utilities in compliance with local requirements.

As soon as removal Work has been otherwise completed and approved by the Engineer, filling shall be performed as described in 202.01. 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.

202.042 Underground Storage Tanks Removed. Underground storage tanks located within the proposed Right-of-Way limits shall be emptied and the removed contents disposed of in accordance with 202.01 in a manner that will comply with requirements of the National, State and Local regulations 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 the Contractor. Filling shall be in accordance with 202.01

All required testing and permit fees shall be the responsibility of the Contractor.

202.05 Pipe Removed. The Work shall include excavating all material necessary to permit removing the pipe, disposing of excavated material, including broken pipe, removing and disposing of pipe headwalls, and installation of plugs as specified in 202.01.

The pipe becomes the property of the Contractor and shall be disposed of.

Where caving occurs, the caved material shall be excavated before the trench is backfilled.

All excavated material shall be used or disposed of in accordance with the provisions of Item 203.

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

202.06 Sidewalks, Curbs, etc. Removed. When designated for removal, concrete Sidewalks, concrete gutters, stone or concrete curbs, concrete alley mouths, concrete driveways, concrete islands, and concrete traffic dividers shall be removed and disposed of as follows:

(a) Materials to be salvaged shall be carefully removed and stored in the Right-of-Way at locations determined by the Engineer.

(b) Materials that are not to be salvaged or that are not suitable for re-use shall be disposed of as indicated in 203.05.

All removals shall be made to a clean, straight line and to the nearest construction joint. Any damage to the remaining walks, curbs, gutters, etc., shall be repaired at the Contractor's expense. If no item for sawing concrete is specifically shown on the Plans, the cost of cutting the clean, straight line is included in the appropriate removal item.

202.07 Guardrail and Fence Removed. Where so required by the Plans and Proposal, existing guardrail including anchor assemblies and terminal assemblies, and any attached posts, signs, delineators, and fence shall be carefully dismantled and stored for re-use as specified or for salvage by the City. Unless otherwise specified, wood posts and other Materials not considered salvageable shall be disposed of as directed.

For Projects where fence is to be removed and replaced, no fence shall be removed until replacement material is on site. New installation shall start within seven working Days of the removal process.

202.08 Manhole, Catch Basin, and Inlet Removed. Unless otherwise provided, all existing drainage Structures of these types, which are not to remain as an integral part of a drainage system, shall be removed.

Castings shall be carefully removed and stored for re-use as specified or for salvage by the City.

When directed, existing pipes shall be connected with new pipe of a type and in a manner acceptable to the Engineer without additional cost to the City.

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.

After connecting across or sealing the existing pipes, remaining cavities shall be backfilled as required. When connecting pipes are used, suit able backfill shall be carefully tamped solidly under and around the pipe.

202.09 Sawing Existing Concrete or Existing Asphalt Concrete. Care shall be taken in making the cut in concrete or asphaltic concrete so as to follow along the line and to the depth as shown on the Plans. Concrete or asphalt damaged by the sawing operation shall be repaired by the Contractor to the satisfaction of the Engineer without cost to the City.

Saw cuts shall not be permitted in brick wearing course.

202.10 Method of Measurement. Payment will be made for the removal of specific items or for sawing on a "linear foot", "square foot", "square yard", "cubic foot", "cubic yard", or "each" basis, measurement will be made by the unit stipulated in the Contract.

202.11 Basis of Payment. The accepted quantities of Structures and obstructions removed and stored or disposed of, as directed, for pavement planed, and for sawing, will be paid for 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 in the Right-of-Way and disposal as provided herein.

Payments will be made at the Contract prices bid under:

Item	Unit	Description
202	Square yard	Grinding existing pavement
202	Square yard	Pavement removed
202	Square yard	Base removed
202	Lump sum, cubic yard, linear foot, or square foot	Structure removed
202	Linear foot	Pipe removed
202	Square foot	Sidewalk removed
202	Linear foot	Curb or curb and gutter removed
202	Square yard or linear foot	Gutter removed
202	Linear foot	Header removed
202	Each	Precast traffic dividers removed for re-use or storage
202	Linear foot	Guardrail removed for re-use or storage
202	Linear foot	Fence removed for re-use or storage
202	Each	Manholes removed
202	Each	Catch basins and/or inlets removed
202	Linear foot	Sawing existing concrete or existing asphalt concrete
202	Each	Underground storage tank removed
202	Square yard	Brick removed for salvage
202	Linear foot	Stone curb removed for salvage

203 ROADWAY EXCAVATION AND EMBANKMENT

203.01 Description
203.02 Definitions
203.04 General
203.05 Disposal of Excavated Material
203.06 Tolerances
203.07 Embankment Construction
203.08 Requirements for Suitable Material
203.09 Construction
203.10 Construction of Embankment and Subgrade with Moisture and 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; finishing Shoulder, slopes and ditches; all in accordance with these Specifications and in reasonable close conformity with the lines, grades, thicknesses and cross sections shown on the Plans. All excavation shall be considered as unclassified excavation.

When the Proposal does not contain an estimated quantity for Item 201 Tree Removed, or an estimated quantity for 201 Stump Removal or an estimated quantity for Item 202 Removal of Structures, this Work shall be performed but will not be paid for directly, and shall be considered as a subsidiary obligation of the Contractor under Item 203.

203.02 Definitions. Embankment. A Structure consisting of soil, granular material, shale, rock or random material, obtained from an approved source outside the Project area, constructed in compacted layers to a predetermined elevation and cross section.

Excavation Including Embankment. Excavated material planned for future use in the Project area.

Excavation not Including Embankment. Excavated material disposed of by the Contractor.

Base. Selected material of planned thickness placed on the Subgrade as a foundation for another bases or a surface course. The base 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 thirty-five percent by weight of the grains or particles will pass a No. 200 sieve.

Granular Material. Natural or synthetic mineral aggregate such as broken or crushed rock, gravel, sand or cinders which can be readily incorporated in an 8 inch layer, and in which at least sixty-five percent by weight of the grains or particles are retained on a No. 200 sieve.

Shale. Laminated material, formed by the consolidation in nature of soil, having a finely stratified structure.

Rock. Sandstone, limestone, 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 (AASHTO Designation: T99). Appropriate typical moisture-density curves may be used to establish optimum moisture.

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 T99, Method A. Appropriate typical moisture-density curves may be used to establish maximum Laboratory dry weight.

Excavation. The excavation and disposal of all Materials of whatever character encountered in the Work.

203.04 General. Excavation and embankments shall be finished to conform to the plan cross sections within the tolerances set forth in 203.06. The Contractor shall be satisfied 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.

Where excavation to the finished graded section results in a Subgrade of unstable soil, the Engineer may require the Contractor to remove the unstable Materials and backfill to the finish graded section with approved material in accordance with 203.12. The Contractor shall conduct 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 Roadway area shall be maintained in such condition that it will be well drained at all times. The Contractor shall use suitable dewatering methods for any necessary removal of deleterious water during excavation.

(b) Rock and Shale Excavation. Where granular subbase is not a part of the pavement design, and where rock or shale 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 excavation 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 or shale below plan Subgrade elevation is not required. The Contractor shall be paid for the thickness of granular subbase material shown on the typical sections in rock excavation areas. Any pockets in the rock below the plan Subgrade elevation shall drain either longitudinally or laterally and all irregularities in the rock below this elevation shall be filled with granular subbase material at no additional cost to the City.

(c) Drilling and Blasting in Rock Cuts. 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. Where necessary, the method of blasting shall be modified by such procedures as drilling of blast holes at the inclination of the slope along the line of the proposed finished slope and adjacent areas, use of delayed blasting techniques or reducing the quantity of explosive.

The spacing of the blast holes and the method of blasting required will be dependent upon the quality and structure of the rock encountered

and the method of blasting used in approaching the slope. The Contractor shall adjust operations to obtain the required slope conditions as called for on the Plans.

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

(d) Slides 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 the Contractor's 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 in accordance with Item 117.

(e) Shoulders, Slopes and Ditches. 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.

Earth or other Materials shall not be dumped or stockpiled on the new or existing pavement. Such material shall be kept clear of the pavement at all times.

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:

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

(b) Disposed of by the Contractor at the Contractor's own responsibility and expense outside the limits of the Right-of-Way.

Prior to the disposal of waste Materials, the Contractor shall submit an executed copy of its Contract or permission statement from the property Owner to the Engineer. The Contract or permission statement must recite that the waste Materials are not the property of the City. Further, it must expressly state that the City is not a party to that Contract or permission statement and that the Contractor and property Owner will hold the City harmless from any claim that may arise from their Contract or permission statement.

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 Subgrade, the surface shall at no place vary more than 1/2 inch from a 10 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 the Plans.

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; the placing and compacting of approved material within Roadway areas where unsuitable material has been removed; 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 material, shale, rock and random material as defined in 203.02 are suitable for use in embankment.

Soil is suitable for use in embankment provided it has the following characteristics:

(a) 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.

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

(c) Soil 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 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, unless the width of the excavation required exceeds 6 feet, in which case the excavated material in excess of 6 feet will be measured and paid for as Roadway excavation.

Soil, granular material, shale and random material 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.

The Contractor shall replace all sections of embankment which have been damaged or displaced, due to carelessness or neglect on the part of the Contractor or due to natural causes, such as storms, and not attributable to the unavoidable movements, of the natural ground upon which the embankment is made.

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 to the extent 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 tests. The moisture content shall be as determined by the Engineer to obtain the desired compaction.

(c) Shale. Shale which consists predominately 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 ordered by the Engineer, water shall be used to aid in breaking down the shale. Watering of the shale shall be performed and paid for 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 six 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 three percent and optimum plus two percent. Each layer shall be rolled with at least six 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 eight 8 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 six 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 substantially 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 embankment 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 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 the Contractor's 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) Random Material. For random material the moisture content and compaction shall be as required by the Engineer. When random material is of such size that it cannot be readily incorporated into an 8 inch layer it shall be reduced in size until it can be so incorporated.

(f) 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 203.09 except that it may be deposited in water without compaction to a height not exceeding normal water level. Compaction of granular material with water above normal water level is permitted if satisfactory drainage is provided.

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.

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 203.11 shall be sprinkled with water as directed by the Engineer. 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 three percentage points above optimum, except that for material which displays pronounced elasticity or deformation under the action of loaded rubber tire 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 ordered by the Engineer.

203.12 Embankment Compaction. Soil 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 T99 or other approved method.

EMBANKMENT SOIL COMPACTION REQUIREMENTS

Condition I		Condition II	
Fills ten feet or less in height and not closer than 60 feet to Bridge abutment.		Fills exceeding ten feet in height or less than ten feet in height, but within 60 feet of a Bridge abutment.	
Max. Lab. Dry Wt. Pounds per cubic foot Max.	Min. Comp.* Requirements % Lab. Max.	Max. Lab. Dry. Wt. Pounds per cubic foot	Min. Comp.* Requirements % Lab.
90-104.9	100	90-104.9	102
105-119.9	98	105-119.9	100
120 and more	96	120 and more	98

*All soil Subgrade shall be compacted to a minimum depth of 1 foot to one hundred percent of maximum dry density.

203.13 Subgrade. All soil Subgrade shall be prepared in accordance with 203.13. Soils with a maximum 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 suitable soil or granular material.

(a) Compaction Requirements. All soil Subgrade shall be compacted to not less than one hundred of maximum dry density as determined by AASHTO T99 or other approved methods.

Subgrade under new pavement and paved Shoulders shall be compacted to a depth of 12 inches below the surface of the Subgrade and to a width of 12 inches beyond the edge of the pavement and shall be included in the Unit Price Bid for Item 203.

Subgrade under pavement widening, driveways and stabilized Shoulders, shall be compacted to a depth of 6 inches below the surface of the Subgrade and to the width of the pavement or base or to the back

of adjacent curb and gutter and shall not be paid for as a separate item. The cost of compacting Subgrade to a depth of 6 inches shall be included in the Unit Price Bid for Item 203.

(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 surface 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. The excavation thus required shall be measured and paid for at the Contract Unit Price Bid for Item 203. Material thus excavated shall be disposed of in accordance with 203.05.

Where embankment is a separate pay item, the excavation thus made shall be filled with suitable material placed in accordance with the compaction and moisture requirements of this Item and shall be paid for at the Contract Unit Price for Item 203.

Where embankment is not a separate pay item, the excavation thus made shall be filled with suitable material from Item 203 other than that excavated from the soft Subgrade area, if available from grading operations within 1/2 mile of the soft Subgrade area. If such suitable material is not available, the excavation thus made shall be filled with suitable material from Item 203. A-4b silt from excavation or borrow shall not be used to replace soft Subgrade material removed.

Where soft Subgrade in cuts is due to the failure of the Contractor to maintain adequate surface drainage as required in 203.04 (a) Drainage, or is due to any other fault or neglect of the Contractor, the unstable condition 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 or base material is placed thereon, the Subgrade and a portion of the berm for a distance of at least 12 inches outside the limits 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 pneumatic tire 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 25 to 50 tons.

The tires shall be capable of operating at inflation pressures ranging from 90 to 150 pounds per square inch. From ninety to ninety-five percent of the volume of the tires 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 unit 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 tire 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 operate 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 5 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 tire 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 of 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. Any irregularities of the surface caused by operation of the heavy pneumatic tire 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, and 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 over breakage 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 impractical to measure material by the cross section method due to the erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

(c) Measurement on a Linear Basis. When an item of excavation is to be measured and paid for on a linear basis, the actual length will be measured in the units specified in the Contract.

(d) Measurement of Embankments. Where the Contract does not specifically provide for payment for embankment, 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.

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 embankment 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 embankment.

(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 Shoulders, and curb and gutter supported Subgrade. Rock and shale Subgrade in cuts shall not be included in quantities measured for payment.

(f) 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 under:

Item	Unit	Description
203	Cubic yard	Excavation including embankment construction
203	Cubic yard	Excavation not including embankment construction
203	Cubic yard	Embankment
203	Station or mile	Linear grading
203	Square yard	Subgrade compaction
203	Hour	Proof rolling

ITEM 207 TEMPORARY SOIL EROSION AND SEDIMENT CONTROL

207.01 Description
207.02 General
207.03 Construction
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 rock construction entrances, conveyance channels, stream crossings, check dams, slope protection, sediment basins and traps, slope drains, coarse aggregate, mulches, grasses, filter fabrics, 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 practical 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.

All grading and erosion control measures shall comply with “Rainwater and Land Development, Ohio’s Standard for Stormwater Management, Land Development, and Urban Stream Protection”, (latest edition).

207.02 General. Commercial fertilizer shall be (12-12-12) and shall conform to 659.03.

Temporary seeding and mulching shall consist of annual ryegrass (Lolium multifolium). Seed and mulching material shall be applied in accordance with Item 659.

Temporary ditch checks shall consist of coarse aggregate.

Temporary inlet filters shall consist of filter fabric fence. Filter fabric for sediment fences shall meet the requirements of 712.09, Type 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. Sediment pits and traps may be included as part of slope drain construction.

Temporary sediment basins and temporary sediment traps shall be constructed by methods described in 203.07 or 601.08, Type C without filter. Sand or filter fabric may be required.

207.03 Construction. The 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, lakes, ponds, or other areas of water impoundment. Such Work will involve the construction of temporary check dams filters, conveyance channels, sediment basins, sediment traps, slope drains, and use of temporary mulches, mats, 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 can be made available. This will require the establishing of final grades and application of Item 659. 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 12 feet (vertical) of embankment or cut, unless otherwise directed by the Engineer. Should seasonal limitations or embankment make such coordination unrealistic, temporary erosion control measures including seeding 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 750,000 square feet without prior approval by the Engineer.

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 potential for erosion 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, 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 Item 659.

All areas of temporary seeding shall be seeded with annual ryegrass sown at the rate of two pounds per 1,000 square feet and mulched in accordance with Item 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 Item 659, these requirements may be waived except that temporary seed shall not be placed on frozen ground.

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

Temporary erosion control features shall be acceptably maintained, including watering, 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 proper control of soil erosion and sedimentation is not being provided by the Contractor, the Engineer may withhold progress estimates until proper control is achieved.

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

(a) All fertilizing will be measured and paid for as Item 659.

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

(c) Temporary slope drains and filter fabric fence will be measured by the linear foot complete in place.

(d) Rock required will be paid for under Item 601, Type C without filter.

(e) Temporary benches, dikes, dams, sediment traps, 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.

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 the Contractor's 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 under:

Item	Unit	Description
207	Square yard	Temporary seeding and mulching
207	Linear foot	Temporary slope drains
207	Cubic yard	Temporary benches, dikes, dams, sediment traps, and basins
207	Each	Inlet filter
207	Linear foot	Filter fabric fence

Where other directed Work falls within the Specifications for a Work item that has a Contract price, the units of Work shall be measured and paid for at the proper Contract price, as provided in Item 117. Should the Work not be

comparable to the Project Work under the applicable Contract items, the Contractor will be ordered to perform the Work on a force account basis, or by agreed Unit Prices, as provided in Item 117.

300 BASES

ITEM 301 BITUMINOUS AGGREGATE BASE

301.01 Description
301.02 Composition
301.03 Materials
301.031 Use of Reclaimed Pavements
301.04 Mixing Plants
301.13 Spreading and Finishing
301.16 Spreading and Surface Tolerances
301.18 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 requirements of Item 401 apply, except as modified by this specification.

301.02 Composition. The gradation of the aggregate portion of the mix shall be within the limits in the following table.

Sieve Size	**Total Passing, percent 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

Bitumen content shall be as directed by the Engineer within the following limits.

Bitumen (Percent of total mix) 3-5

301.03 Materials. Materials shall be:

Aggregate ----------	703.04
Bituminous material,	
Asphalt cement ----------	702.01

301.031 Use of Reclaimed Pavement. In addition to the requirements of 401.031, the Contractor may use thirty percent of reclaimed asphalt concrete pavement or reclaimed bituminous aggregate base pavement in Item 301 by submitting the viscosity of the recovered bitumen from the reclaimed pavement to the Engineer. The Engineer will establish the job-mix formula in accordance with 401.02.

301.04 Mixing Plants. Screens shall have openings of such sizes that will result in a reasonably balanced separation of the dried and heated aggregate into a minimum of two bins.

301.13 Spreading and Finishing. The maximum compacted depth of any one layer shall be 6 inches. Following the completion of bituminous aggregate base, adjacent earth construction shall be placed and compacted a minimum of 18 inches in width.

301.16 Spreading and Surface Tolerances. The variation of the surface from the testing edge of the 10 foot straightedge shall not exceed 3/8 inch.

Variations in excess of slope or surface tolerances shall be corrected by adding or removing material in a manner satisfactory to the Engineer. Asphalt concrete Item 403 or Item 404 specified in the Contract may be used for this purpose.

301.18 Basis of Payment. Payment for accepted quantities, complete in place, will be made at Contract price for:

Item	Unit	Description
301	Cubic yard	Bituminous aggregate base

ITEM 304 AGGREGATE BASE

304.01 Description
304.02 Aggregate
304.03 Placing
304.04 Compaction
304.05 Method of Measurement
304.06 Basis of Payment

304.01 Description. This Work shall consist of furnishing, placing and compacting one or more courses of aggregate, including furnishing and incorporating water required for compaction, on a prepared surface in accordance with these Specifications, in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the Plans or established by the Engineer.

304.02 Aggregate. The aggregate shall be the following size and shall meet the requirements of 703.04.

Sieve Size	**Total Percent Passing**
2 inch	100
1 inch	70-100
3/4 inch	50-90
No. 4	30-60
No. 30	7-30
No. 200	0-13

Screenings shall be crushed screenings meeting the requirements of 703.10.

Aggregate acceptance shall be determined prior to incorporation into the Work based on Samples taken from stockpiles.

Prior to placing, aggregate shall have reasonably uniform moisture content at or near optimum for compaction.

304.03 Placing. The maximum compacted thickness of any one layer shall not exceed 4 inches; except when vibratory Equipment is used in conjunction with other methods of compaction, the compacted depth of a single layer may be increased to 6 inches. When the required compacted depth of the base course exceeds 6 inches, the base shall be constructed in two or more layers of approximate 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 when the total area of base course is 2,000 square yards or less, or 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 ninety-eight 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 straight-edges, 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. The aggregate base course may be determined by slips, provided a slip for each load is signed by the Contractor's foreperson and turned into the Engineer each Day. If the quantity shown on the slips is measured by weight, 4,000 pounds of aggregate base shall be equal to 1 cubic yard.

304.06 Basis of Payment. Payment for accepted quantities, complete in place, will be made at Contract prices for:

Item	Unit	Description
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 Item 451 except that:

(a) Fabricated steel reinforcement is not required. Load transfer devices are required at all transverse joints.

(b) Transverse Contraction joints shall be constructed at 20-foot intervals by sawing to a minimum depth of 1/6 of specified base thickness and width of approximately 1/8 inch.

Standard longitudinal joints shall be constructed between lanes by sawing or forming. If sawed, the minimum depth shall be 1/4 of the specified base thickness. The width shall be approximately 1/8 inch. Sealing will be required for expansion joints only and shall be as specified in 705.04. If the base is opened to traffic, all sawed joints shall be cleaned and sealed.

(c) Final surface texture as specified in 451.09 is not required.

(d) Smoothness shall be as specified in 451.12 except that the specified tolerance shall be 1/4 inch.

305.02 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 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 the Roadway. The plan quantities as adjusted for changes, errors and deviations in excess of allowable tolerances 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 451.16 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 under:

Item	**Unit**	**Description**
305	Square yard	Concrete base

400 FLEXIBLE PAVEMENT

401 PLANT MIX PAVEMENTS - GENERAL

401.01 Description
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401.01 Description. These Specifications include general requirements applicable to all types of plant mix bituminous pavements irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use. Deviations from these general requirements will be covered in the specific requirements for each type, according to the appropriate Contract item or items.

This Work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these Specifications and the specific requirements of the type under Contract, and in reasonably close conformity with the lines, grades and typical cross sections shown on the Plans or established by the Engineer.

Bituminous plant mix pavement thickness shown on the Plans or stated in the Proposal is for exclusive use in calculating the weight required to be placed per unit of surface area.

401.02 Composition. The bituminous plant mix shall be composed of a mixture of uniformly graded aggregate and specified type and grade of bituminous material.

The composition table for the type under Contract specifies the limits within which the job-mix formula will be set by the Engineer, after examination of the Materials the Contractor proposes to use. If the Contractor proposes to change the source of the Materials, sufficient notice shall be given the Engineer that Samples may be taken and the job-mix formula checked prior to making the change.

The Engineer will establish a job-mix formula which will produce a satisfactory mix and may make changes as required; no change, however, shall be made unless authorized by the Engineer. During production, variation from the job-mix formula, as shown by the plant Inspector's analysis, of plus or minus four percent passing the No. 4 sieve or plus or minus 0.3 percent bitumen shall be investigated and corrected by the Contractor.

Acceptance for gradation and bitumen content will be based upon the mean of the results of all tests performed by the plant Inspector during a Day's production.

Production will be considered acceptable if the following tolerances are not exceeded and the remaining sieves do not exceed the limits of the applicable specification:

Mix Characteristics	Deviation of the Mean from the Design		Range
Bitumen content	±	0.5 percent	1.0
No. 4 sieve	±	6.0 percent	12.0

A variation from the job-mix formula exceeding these tolerances shall be sufficient cause for the Engineer to order production discontinued until the cause of the variation is corrected.

401.03 Materials. Materials shall be:

Aggregates	---	703.05
Bituminous material (301,403,404)	---	702.01
Bituminous material (401.12)	---	702.01, 702.02, 702.03 or 702.04

Aggregate and bituminous material shall be sampled in accordance with 110.03.

401.031 Use of Reclaimed Pavement. The Contractor may use a blend of new Materials in combination with reclaimed asphalt concrete pavement or reclaimed bituminous aggregate base pavement. A maximum of twenty percent of reclaimed pavement may be used. This percentage is based on the dry weight of all the Materials used. The addition of the reclaimed pavement can be made without adjusting the job mix formula. The combined mixture shall fall within the limits of the item specified.

The Contractor shall identify the reclaimed pavement as to type, source, gradation and bitumen content. The stockpile shall be free of contamination and uniform in composition. Prior to stockpiling, the proposed sites for storing the reclaimed pavement shall be cleaned, graded, and compacted to produce a firm level base. Stockpiles shall be subject to approval of the Engineer prior to use. Additional reclaimed pavement shall not be added to an approved stockpile, except when the reclaimed pavement proposed for use is being reclaimed concurrently with the production of the recycled mixture.

The reclaimed pavement shall be of proper size to allow for complete breakdown of material in the plant. Incomplete mixing shall be reason to require a 2 inch screen to be placed on the cold feed or the material shall be crushed to minus 2 inches. Due to variations in the reclaimed pavement gradation, a maximum of five percent oversize material will be tolerated in the completed mix, provided it can be incorporated into the Work with satisfactory results.

401.04 Mixing Plants. Plants shall be approved by the Engineer prior to preparation of the mixtures. General requirements for bituminous concrete mixing plants are on file in the office of the Engineer.

401.05 Weather Limitations. Bituminous plant mixtures shall only be placed when the surface is dry and when weather conditions are such that proper handling, finishing and compaction can be accomplished. In no case, however,

shall bituminous plant mixtures be placed when the air temperature is below 40°F.

For all surface courses placed after October 15 and before April 15, the bitumen content of the job-mix formula shall be increased by 0.2 percent.

401.06 Bituminous Material Preparation. The bituminous material shall be heated and delivered to the mixer within the temperature range specified in 702.00. Bituminous material shall not be used while foaming.

401.07 Aggregate Preparation. Aggregates shall be fed to the cold elevator in their proper proportions and at a rate to permit correct and uniform control of heating and drying. All aggregates in the hot bins that will produce a mix outside the temperature limits or that contain sufficient moisture or expanding gases to cause foaming in the mixture shall be removed and returned to the proper stockpiles.

401.08 Mixing. When batch mixing is used, the order or sequence in which the several aggregates are drawn or weighed shall be determined by the Engineer. After all of the aggregate is in the mixer, the bituminous material shall be added in an evenly spread sheet over the full length of the mixer. The mixing time shall be the interval between the start of application of the bituminous material and the opening of the mixer gate. All bituminous material required for one batch shall be discharged in not more than thirty seconds. The Engineer will establish a minimum mixing time of not less than thirty seconds.

When continuous mixing is used the bituminous material shall be added in an evenly spread sheet over the full width of the mixer at the charging end. The Engineer shall establish mixing time of not less than thirty seconds. The mixing time is a ratio of pounds of dead load of the mixer to the pounds per second delivered. The dead load shall be determined by weighing a mixer full of material. The pounds per second delivered shall be determined by timing and weighing a load of mixed material.

Temperatures of the several mixtures at the plant shall be maintained within the ranges set by the Engineer for the mix design. The temperature of the mixture on arrival at the Project site shall be as determined by the Engineer in keeping with the temperature range set for the mix design and heat losses in transit.

401.09 Hauling. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds from which the entire quantity of mixture is discharged smoothly into the spreading Equipment.

Prior to loading a thin coating of material shall be applied to the inside surfaces of the truck bed to prevent adhesion of mixture to the bed surfaces. The use of fuel oils for this purpose is prohibited. Only material which will not contaminate and alter the characteristics of the mixture will be permitted. Truck beds shall be drained prior to loading.

Each truck shall have a securely fastened, waterproof cover of suitable material to adequately protect the mixture from the weather. At the request of the Engineer, covers shall be removed prior to dumping into the paver.

When hot mixtures are being transported at prevailing air temperatures below 50°F or when the length of haul exceeds 20 miles, all truck beds shall be insulated to maintain workable temperature of the mixture, and all covers shall be so fastened as to exclude all wind. The maximum distance mixtures may be transported from mixing plant to paving site shall not exceed 50 miles except by specific permission of the Engineer.

401.10 Spreading Equipment. Spreading Equipment shall be self - contained and of sufficient size, power and stability to receive, distribute and strike-off the bituminous mixture at rates and widths commensurate with the typical sections and other details shown on the Plans. Approval of spreading Equipment by the Engineer will be based on the demonstrated capability of the Equipment to place the mixture to the refinished condition ready for compaction.

Specialized Equipment or hand methods approved by the Engineer may be employed to spread the bituminous mixture where the use of standard full scale spreading Equipment is impractical due to the size or irregularity of the area to be paved.

401.11 Rollers. Rollers shall be of the steel wheel and pneumatic tire types meeting the minimum requirements of the following tables. All ballasting shall conform to manufacturer's Specifications.

The maximum capacities of the rollers, in square yards per hour, shall be: 700 for three-wheel and tandem; 15 per inch width for trench; Vibratory-15 per inch width for vibrating roll, 3 per inch width with static roll (no vibrations); 1,000 for Type I pneumatic tire; and 700 for Type II pneumatic tire.

STEEL WHEEL ROLLERS

Roller Type	Three Wheel	Tandem	Vibratory Static	Trench
Total weight, tons	10	8-12	8-12	
Compression rolls, pounds per square inch width, min.	300	200	120	300

PNEUMATIC TIRE ROLLERS

Type I
Tire size, minimum ----------9.00 x 20 inches
Wheel load, minimum ----------5000 pounds
Average tire contact pressure, min ----------85 pounds per square inch

Type II
Tire size, minimum ----------7.50 x 15 inches
Wheel load, minimum ----------2000 pounds
Average tire contact pressure, min ----------55 pounds per square inch

Pneumatic tire rollers shall be self-propelled, reversible units with vertical oscillation on all wheels on at least one axle. Tire inflation pressure shall be determined by the Contractor to meet the specified minimum contact area and contact pressure requirements. The Contractor shall furnish tire manufacturer's charts or tabulations for verification of the required inflation pressure by the Engineer. Tire inflation pressure shall be checked by the Contractor as directed by the Engineer and shall be maintained within 5 pounds per square inch of the required pressure.

Rolls and wheels shall be provided with the necessary accessories to prevent adhesion of the mixture and shall be kept properly moistened with water or water containing a detergent or other approved additive. The use of excess liquid will not be permitted.

401.12 Conditioning Existing Surface. The surface on which the bituminous plant mix is to be placed shall be cleaned and maintained 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, the deficiency shall be corrected in accordance with the requirements for the item or items involved prior to the spreading of bituminous plant mix for a subsequent pavement course.

When a quantity of bituminous plant mix is specified for use in spot leveling or patching an existing pavement surface, the material needed to effect the corrections shall be spread and compacted as directed by the Engineer.

Contact surfaces of curbing, gutters, manholes, and other Structures shall be painted with a thin, uniform coating of bituminous material prior to the bituminous mixture being placed against them.

Where mixture is to be placed against the vertical face of an existing pavement Structure, the vertical face shall be cleaned of foreign material and given an application of bituminous material in a manner which results in a coating of approximately 0.25 gallon per square yard.

When the surface course is not placed within ten Days after completion of the intermediate course, the Contractor shall provide a tack coat, Item 407, at the Contractors own expense, as directed by the Engineer.

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.

401.13 Spreading and Finishing. The mixture shall be spread at a rate determined by calculations using the specified thickness and the compacted width of the pavement course being placed, and the weight to volume conversion factors given in 401.17. The actual rate of spreading the mixture shall be maintained equal to the required calculated rate within the tolerance specified in 401.16 except for pavement courses specified for the purpose of leveling an existing pavement surface in which the actual rate of spreading the mixture may vary from the required calculated rate as approved by the Engineer to accomplish the intended purpose.

Approved Equipment or methods in use shall result in the mixture being spread and finished in such condition that compaction can follow immediately. The mixture shall be contained laterally during the spreading operation by means of sufficient side plates. When paving in excess of the nominal paver width, only a permanent extension or an adjustable extension with full auger extensions shall be used when matching a previously placed pavement course. Such extension shall have the ability to heat. Strike-off plates may be used on adjacent berm areas. Supplemental hand forming and tamping shall be performed where irregularities develop and where the mixture is placed by hand methods.

The mixture as spread and finished shall be uniform in composition and surface texture. Conditions causing objectionable segregation of the mixture components or irregularities in surface texture shall be corrected and any portion of the pavement course found to be defective in surface texture or composition,

before or after compaction, shall be removed and replaced or otherwise corrected in a manner satisfactory to the Engineer.

The spreading operation shall be coordinated with the rate of production and delivery of the mixture to attain uniform, continuous progress. Erratic spreader operation due to irregular contact with the hauling vehicle, surging in the feed and distribution of the mixture, or other cause shall be avoided. Sufficient control of the spreading Equipment with regard to line and grade references shall be maintained that the pavement course, when compacted as specified, will be in reasonable conformance with the lines, grades and typical sections shown on the Plans or established by the Engineer.

The spreading operations on Bridge deck waterproofing membranes shall not displace or damage the membrane.

401.14 Compaction. Immediately after the bituminous mixture has been spread and any surface irregularities adjusted, the mixture shall be compacted uniformly using rollers meeting the requirements of 401.11. The rate at which the mixture is spread shall not exceed the total of the specified capacities of the rollers in use, except that the rate of spreading shall not exceed twice the total capacity of the rollers in use for the compaction of mixture spread as an intermediate or pre-leveling course less than 1 inch thickness.

The Contractor shall coordinate the spreading of the mixture with the application of the required roller coverage, giving consideration to the rate of cooling of the mixture as affected by lift thickness and environmental conditions. The required roller coverage shall be completed 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.

Base mixtures shall be compacted using a combination of both steel and Type I pneumatic tire rollers except in small areas where these mixtures may be compacted as approved by the Engineer using any one of the specified rollers.

Intermediate and surface mixtures shall be compacted using rollers which shall include either a three-wheel or a pneumatic-tire type except in small areas where these mixtures may be compacted as approved by the Engineer using any one of the specified roller types.

Variable depth courses shall be compacted using a combination of both steel and pneumatic tire rollers, except in small areas where these mixtures may be compacted as approved by the Engineer using any one of the specified rollers.

Vibrator rollers shall not be used on courses with a thickness under 1-1/2 inches.

When vibratory rollers are used, they shall be supplemented by three-wheel or pneumatic tire rollers.

In alleys, parks and driveways paved with bituminous concrete, rollers weighing 5 to 8 tons may be used.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the centerline at a slow, uniform speed. After each coverage or complete round trip, the roller shall progress toward the crown of the road by overlapping the previous pass by at least one half the width of the compression roll. On superelevated curves, the rolling shall begin at the low side and progress toward the high side. In all cases where a longitudinal joint is being made, it shall be rolled first and then followed by the applicable rolling procedure.

Rolling shall be continued until full coverage of the course has been completed and all roller marks are eliminated. Care shall be taken to prevent displacement of the edge line and grade. Where displacement occurs, the area shall be corrected immediately in a manner satisfactory to the Engineer.

Along curbs, headers, walls and in other areas not accessible to rollers, the mixture shall be thoroughly compacted with hot, hand tampers or with mechanical tampers. On depressed areas, trench rollers or rollers fitted with compression strips may be used.

Mixture that becomes loose, broken, contaminated or otherwise defective shall be replaced with fresh, hot mixture compacted to conform to the surrounding area.

401.15 Joints. Placing of the bituminous paving shall be as continuous as possible. Longitudinal and transverse joints shall be made in a careful manner. Joints shall be "set up" 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, it shall be trimmed to a vertical face prior to placing the adjacent pavement. On Projects where traffic is permitted to cross the edge of the new pavement lane, the longitudinal joint of the adjacent lane or berm shall be completed within twenty-four hours. A well bond and sealed joint is required.

Hot longitudinal joints shall be formed using bituminous pavers operating in contiguous lanes, one just ahead of the other. The distance between pavers in adjacent lanes shall not exceed the distance that a normal size load of mixture will cover. The loads of mixture as they arrive shall be alternated between the pavers. Rollers performing the initial rolling operation in

one lane shall in no case be allowed closer than 12 inches to the longitudinal joint until the adjacent lane is placed.

In lieu of hot joint construction using multiple pavers, full-width construction with a single unit paver may be used.

Compact all cold longitudinal joints on intermediate and surface courses using a three-wheel roller.

For surface courses, form or cut all transverse joints to a vertical.

All cold joints on surface courses, and any bituminous concrete course that is open to traffic for more than thirty Days, shall be sealed by coating the vertical face of the cold joint with bituminous material 702.01, 702.02, or 702.04, applied at a rate of 0.25 gallon per square yard.

The bituminous material used will be measured by the gallon and payment for accepted quantities complete in place will be made at the Unit Price Bid for Item 407. If there is no pay item provided for Item 407, the cost of sealing joints as described above shall be included in the Unit Price Bid for the asphalt concrete courses.

401.16 Spreading and Surface Tolerances. When a uniform course is specified, the Contractor shall make checks and adjustments as indicated to maintain the rate of spreading within a tolerance of plus or minus five percent of the required calculated weight per unit of area.

When variable depth courses are specified, the Contractor shall place the mixture at rates established by the Engineer, in accordance with the intent of the Plans.

When 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. Prior to placing the surface course, the Contractor shall check the profile of the preceding course at 50 foot intervals along the outside edge of each traffic lane and along any additional line described in superelevation tables and shall submit a tabulation of the results to the Engineer for approval. Corrective Work necessary for compliance with the profile tolerance shall be performed prior to placing the surface course. This requirement shall not apply to small incidental areas of pavement less than 500 feet in length.

The transverse slope of the surface of the completed course shall not vary from the specified slope by more than 3/8 inch in 10 feet.

The surface of each completed course shall not vary from the testing edge of a 10-foot straightedge by more than a 1/4 inch or by more than the tolerance specified for the type under Contract. The Contractor shall furnish straightedges and straightedges equipped with levels or other devices satisfactory to the Engineer and shall check the surface for conformance with requirements.

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.

401.17 Method of Measurement. The number of tons to be paid for under this item shall be the actual number of tons of mixture finished to the crown and grade set by the Engineer. Plant weight tickets shall be provided by the Contractor.

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 factor for gravel and stone at 4,000 pounds per cubic yard.

401.18 Basis of Payment. All Work performed and measured as prescribed above will be paid for as provided in the respective items for each type.

ITEM 403 ASPHALT CONCRETE

403.01 Description
403.02 Composition
403.12 Conditioning Existing Surface
403.13 Spreading and Finishing
403.16 Spreading and Surface Tolerances
403.18 Basis of Payment

403.01 Description. This Work shall consist of constructing a surface course or 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, Item 401, shall apply; deviations from these are as follows.

403.02 Composition. Coarse aggregate (No. 8) and fine aggregate shall be as directed by the Engineer but within the following limits:

Sieve Size	**Total Passing, percent by weight**
1/2 inch	100
3/8 inch	90-100
No. 4	45-75
No. 16	15-45
No. 50	3-22
No. 200	0-8

Bitumen content shall be as directed by the Engineer within the following limits:

Bitumen (Percent of total mix)....4.5-12.0

403.12 Conditioning Existing Surface. In areas where the surface is required to be feathered to meet an adjoining surface, the existing surface uniformly shall be coated uniformly with a thin coat of asphalt binder.

403.13 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. The surface course shall be placed within two Days after completion of the intermediate course unless otherwise authorized by the Engineer.

On Projects where traffic is maintained, longitudinal joints shall be made within twenty-four hours. Traffic shall not be permitted on the compacted mixture until it has cooled sufficiently to prevent glazing as determined by the Engineer.

After completion of the surface course, cold joints shall be sealed with asphalt cement as directed by the Engineer. The material shall be applied at a uniform width of approximately 4 inches and at a rate just sufficient to fill surface voids.

403.16 Spreading and Surface Tolerances. The completed surface course will be checked with straightedges and/or rolling straightedges by the Engineer. The variation of the surface course 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 removal of mixture to neat lines and replacement or by surface grinding in a manner satisfactory to the Engineer.

403.18 Basis of Payment. Payment for accepted quantities, complete in place, will be made at the Contract price for:

Item	Unit	Description
403	Ton	Asphalt concrete

ITEM 404 ASPHALT CONCRETE, MODIFIED

404.01 Description
404.02 Composition
404.12 Conditioning Existing Surface
404.13 Spreading and Finishing
404.15 Joints
404.16 Spreading and Surface Tolerances
404.18 Basis of Payment

404.01 Description. This Work shall consist of constructing a surface course or 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, Item 401, shall apply; deviations from these are as follows.

404.02 Composition. Coarse aggregate (No. 8) 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 Size	Total Passing, percent by weight
1/2 inch	100
3/8 inch	90-100
No. 4	45-75
No. 16	15-45
No. 50	3-22
No. 200	0-8

Bitumen content shall be as directed by the Engineer within the following limits:

Bitumen (Percent of total mix)....4.5-12.0

Course aggregate, in addition to meeting all requirements of 703.05, shall have at least ninety percent by weight with at least two fractured faces and at least ninety-eight percent by weight with at least one fractured face.

The job mix shall be designed to produce a high stability mixture to resist displacement under heavy traffic.

404.12 Conditioning Existing Surface. 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.

404.13 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. The surface course shall be placed within two Days after completion of the intermediate course unless otherwise authorized by the Engineer.

On Projects where traffic is maintained, longitudinal joints shall be made within twenty-four hours. Traffic shall not be permitted on the compacted mixture until it has cooled sufficiently to prevent glazing as determined by the Engineer.

After completion of the surface course, cold joints shall be sealed with asphalt cement as directed by the Engineer. The material shall be applied at a uniform width of approximately 4 inches and at a rate just sufficient to fill surface voids.

404.15 Joints. Transverse construction joints shall be made against a full depth face which has been formed or cut in the previously placed mixture and coated with asphalt cement.

Longitudinal joints between mainline and speed change lanes, turning lanes or intersections that are not made hot shall be made against a face which has been coated uniformly with asphalt cement.

404.16 Spreading and Surface Tolerances. The completed surface course will be checked with straightedges and/or rolling straightedges by the Engineer. The variation of the surface course 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 removal of mixture to neat lines and replacement or by surface grinding in a manner satisfactory to the Engineer.

404.18 Basis of Payment. Payment for accepted quantities, complete in place, will be made at the Contract price for:

Item	Unit	Description
404	Ton	Asphalt concrete, modified

ITEM 406 ASPHALT SLURRY SEAL

406.01 Description
406.02 Aggregate Materials
406.03 Emulsified Asphalt
406.04 Tack Coat
406.05 Water
406.06 Weather Limitations
406.07 Equipment
406.08 Preparation of Surface
406.09 Testing and Design
406.10 Control of Composition and Rate of Application of the Slurry Mix
406.11 Application of Bituminous Tack Coat
406.12 Application of Slurry Seal Coat
406.13 Qualification of Bidders
406.14 Method of Measurement
406.15 Basis of Payment

406.01 Description. This item shall consist of a mixture of emulsified asphalt, mineral aggregate, water and/or mineral fillers and other additives, properly proportioned, mixed and spread evenly on a prepared underlying course or on an existing surface course in accordance with these Specifications and shall conform to the dimensions shown on the Plans or as directed by the Engineer.

406.02 Aggregate Materials. The aggregate shall consist of one hundred percent crushed aggregate or gravel. The aggregate shall be clean and free from vegetation, dirt, dust and other deleterious substances. The aggregate blend shall have a sand equivalent of not less than forty-five percent when tested in accordance with AASHTO T176. The aggregate shall show a Los Angeles Rattler loss of not more than 35 when tested in accordance with AASHTO T104.

When a mineral filler such as portland cement or limestone dust is added, in addition to that naturally present in the aggregate, it shall meet the requirements of ASTM D242 and shall be used in the minimum amounts required. Mineral filler shall only be used if needed to improve the workability of the mix or to improve the gradation of the aggregate. The filler shall be considered as part of the blended aggregate.

The aggregate shall have a proven durability record for the conditions and traffic expected. Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

The combined mineral aggregate shall conform to the following dry gradation:

GRADATION OF AGGREGATES

Percentage by Weight Passing Sieves

SIEVE SIZE	TYPE I	TYPE II	TYPE III
3/8	100	100	100
No. 4	100	90-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-60	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	0-20	5-15	5-15
Residual Asphalt Content Percent Dry Aggregate	10-16	7.5-13.5	6.5-12
Application Rate, Pounds/SY, Dry	8 + 2	15 + 2	20 + 2

The aggregate gradation band applicable to a Project shall be as directed by the Engineer. Type I gradation is to be used for maximum crack penetration and in low density traffic areas where the primary objective is sealing. Type II gradation is to be used to seal and improve skid resistance. Type III gradation is to be used to correct surface conditions and provide skid resistance.

406.03 Emulsified Asphalt. The emulsified asphalt shall conform to AASHTO Specifications for dense mixing grade SS-1h except that it shall be of the Quick Set Slurry Seal Emulsion Type, and in conformance with International Slurry Seal Association Technical Bulletin No. 106. The Contractor shall provide suitable storage facilities for the asphalt emulsion. The container shall be equipped to prevent water from entering the emulsion. Suitable heat shall be provided if necessary to prevent freezing.

406.04 Tack Coat. The tack coat shall be a diluted asphalt emulsion of the same type specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1:3.

406.05 Water. All water used in making slurry shall be potable and free from harmful soluble salts.

406.06 Weather Limitations. The slurry seal shall not be applied if either the pavement or air temperature is 50°F or below and falling. The mixture shall not be applied if rain is imminent or if high relative humidity prolongs the curing beyond a reasonable time.

406.07 Equipment. All Equipment, tools and machines used in the performance of this Work shall be maintained in satisfactory working order at all times. Descriptive information on the slurry mixing and applying Equipment to be used shall be submitted to the Engineer for approval not less than ten Days before Work starts.

(a) Pressure Distributors. Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gallons per square yard of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gages, and volume-measuring devices.

(b) Slurry Mixing Equipment. The slurry mixing machine shall be a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and of discharging the thoroughly mixed product on a continuous basis. The aggregate shall be prewetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No excessive or violent mixing shall be permitted. The mixing machine shall be equipped with an approved lines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer. The fines feeder shall be used whenever added mineral filler is a part of the aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog-type spray bar adequate for complete fogging of the surface with an application of 0.05 to 0.10 gallons per square yard preceding the spreading Equipment.

Calibrated liquid level gauges shall be mounted externally so that they may be easily read from the ground.

Sufficient machine storage capacity to mix properly and apply a minimum of five tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

(c) Slurry Spreading Equipment. Attached to the mixing machine shall be a mechanical spreader box equipped with flexible material in contact

with the surface to prevent loss of slurry from the spreader. The spreader shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. Provision for mix agitation shall be made when required.

There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean and true. Buildup of asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

(d) Cleaning Equipment. Power brooms, power brushes, power blowers, air compressors, water flushing Equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

(e) Auxiliary Equipment. Other tools or Equipment such as brushes, hand squeegees, hose Equipment, tank trucks, water distributors and flushers, barricades, etc., shall be provided as required.

406.08 Preparation of Surface. Immediately prior to applying the tack coat and slurry seal coat, the surface shall be cleaned of all dust, dirt, loose Materials, silt spots, vegetation and other objectionable material. Any standard cleaning method used to clean pavements will be acceptable, except water flushing will not be permitted in areas where considerable cracks are present in the pavement surface. High pressure water (10 gallon per minute at 7,000 pounds per square inch) shall be the only approved method for removal of mud and adhesive clays. The Engineer shall give final approval of the prepared surface.

406.09 Testing and Design. The Bidder shall submit to the Engineer a complete Laboratory design made in a qualified Laboratory before the Work commences. A complete analysis of the Materials and Job Mix Formula proposed for use in the performance of the Work shall be made in accordance with procedures outlined in the current issue of ISSA Technical Bulletin No. 111 as indicated by the Engineer. The Engineer shall select from the data presented by the Bidder the optimum design for the Materials selected by the Contractor.

The Engineer may waive the design submittals provided the Bidder has previously applied slurry with substantially the same Materials proposed for this Work. In any case, untried Materials may not be substituted without a new analysis and design.

406.10 Control of Composition and Rate of Application of the Slurry Mix. The optimum Job Mix Formula shall be translated into job control

quantities by the Contractor in accordance with ISSA Technical Bulletin No. 107. The rate of spread shall be determined by the Contractor in accordance with ISSA Technical Bulletin No. 112.

At the completion of each load, a record shall be made of all material quantities used, distance and width covered and operating conditions. The load record shall include:

QUANTITIES USED

1. Fines or portland cement
2. Aggregate (percent moisture)
3. Asphalt emulsion
4. Water
5. Liquid additive
6. Other Materials

OTHER DATA

7 Distance and width traversed
8. Mixer speed
9. Location of speed
10. Weather conditions

The load record shall be made available at all times to the Engineer or his authorized representative. Final payment will not be made until all load tickets and inventories are verified to assure that Job Mix Formula quantities have been applied. In case of disputes, the Engineer's judgment shall be final.

406.11 Application of Bituminous Tack Coat. When the slurry is being placed over a polished, slick or highly absorbent surface a one part emulsion, three parts water, tack coat of the same asphalt emulsion type and grade as specified for slurry may be required. This mixture may be applied with the slurry machine spreader box or may be spray applied. The normal application rate shall be 0.05 to 0.10 gallons of the diluted emulsion per square yard of surface. The tack coat shall be applied at least two hours before the slurry seal, but within the same Day. The Engineer shall give final approval.

406.12 Application of Slurry Seal Coat. The slurry seal coat shall be applied as follows:

(a) General. The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface. Total time of mixing shall not exceed two minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that the complete coverage is obtained. No lumping, balling or unmixed aggregate shall be permitted. No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

(b) Joints. No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints.

(c) Hand Work. Approved squeegees shall be used to spread slurry in inaccessible areas. Care shall be exercised in leaving no unsightly appearance from hand Work.

(d) Curing. A fresh slurry seal application shall be protected by barricades, flagmen and markers and permitted to dry for a period of four to twenty-four hours depending on the weather or as directed by the Engineer. Any damage to the uncured slurry will be repaired at the Contractor's expense.

(e) Structures. All Structures which may become marred by the slurry such as open grates, catch basins, manholes and valve boxes, shall be masked prior to the Work with 0.006 inch plastic Or Equal and attached so as not to be displaced by the operations. Care shall be taken at intersections to achieve a clean straight line as directed by the Engineer by use of 15 pound roofing felt Or Equal.

(f) Clean-up. Provisions shall be made for the orderly storage and disposal of waste Materials. All masking Materials shall be removed at the completion of the Work.

406.13 Qualification of Bidders. Bidders who have not previously completed satisfactory slurry seal Projects should provide evidence of adequate experience with the Materials and design proposed for this Work and shall submit the following:

(a) All public Work of this class undertaken by the Bidder in the past two years.

(b) A list of Equipment available for completion of this Work.

406.14 Method of Measurement. The bituminous material for emulsified asphalt shall be measured by the gallon. The aggregate shall be measured by the ton.

406.15 Basis of Payment. The accepted quantities will be paid at the Contract price. These prices shall be full compensation for furnishing all labor, Materials, Equipment, tools, design, cleaning street surfaces, providing traffic control, applying these Materials, and incidentals necessary for the completion of the items. Payment will be made under:

Item	Unit	Description
406	Gallon	Emulsified asphalt for tack coat
406	Gallon	Emulsified asphalt for slurry coat
406	Ton	Aggregate

ITEM 407 TACK COAT

407.01 Description
407.02 Material
407.03 Equipment
407.04 Preparation of Surface
407.05 Application of Bituminous Material
407.06 Application of Cover Aggregate
407.07 Method of Measurement
407.08 Basis of Payment

407.01 Description. This Work shall consist of preparing and treating a paved surface with bituminous material and cover aggregate if required in accordance with these Specifications and in reasonably close conformity with the lines shown on the Plans or established by the Engineer.

407.02 Material. The bituminous material shall meet the applicable requirements of Item 702 and shall be one of the following: 702.02 RC-70 or RC-250; or 702.04 RS-1, SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h. Cut-back asphalt 702.02 may only be used after September 15 and before May 15.

Cover aggregate shall conform to 703.06.

407.03 Equipment. Equipment shall consist of adequate cleaning Equipment, spreader boxes, and bituminous distributors.

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 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 ten percent of the required rate and the material is applied uniformly with no visible evidence of streaking or ridging.

407.04 Preparation of Surface. The surface shall be thoroughly clean and dry when the bituminous material is applied. Material cleaned from the surface shall be removed and disposed of as directed by the Engineer.

407.05 Application of Bituminous Material. The bituminous material shall be uniformly applied with a bituminous distributor. For irregular areas such as driveways and intersections, the method of application shall be approved by the Engineer.

The tack coat shall be applied in a manner that offers the least inconvenience to traffic and permits one-way traffic without pickup or tracking.

The bituminous material shall not be applied when the surface temperature is below the minimum placement temperature for the pavement course to be placed, as specified in 401.05.

The quantity, rate of application, temperature, and areas to be treated, shall be approved prior to application. The tack coat application shall be limited to areas that will be covered by a pavement course during the same Day.

407.06 Application of Cover Aggregate. Immediately following the application of the bituminous material in areas which will be exposed to traffic, sufficiently dry cover aggregate shall be applied uniformly to form a bonded layer which, after curing, will not be picked up by traffic. Excessive application resulting in an unbonded layer of cover aggregate will not be accepted. The cover aggregate shall be included in the Bid price for the tack coat.

407.07 Method of Measurement. Bituminous material will be measured by the gallon in accordance with Items 114 and 115.

407.08 Basis of Payment. Payment for accepted quantities complete in place will be made at the Contract price for:

Item	Unit	Description
407	Gallon	Tack coat

ITEM 408 PRIME COAT

408.01 Description
408.02 Bituminous Material
408.03 Cover Aggregate
408.04 Weather Limitations
408.05 Equipment
408.06 Preparation of Surface
408.07 Application of Bituminous Material
408.08 Application of Cover Aggregate
408.09 Method of Measurement
408.10 Basis of Payment

408.01 Description. This Work shall consist of preparing and treating an existing surface with bituminous material, and cover aggregate if required, in accordance with these Specifications and in reasonably close conformity with the lines shown on the Plans or established by the Engineer.

408.02 Bituminous Material. Bituminous material of the type and grade specified shall conform to Item 702.

When two or more grades of one type of bituminous material are specified, the grade to be used shall be determined by the Engineer.

408.03 Cover Aggregate. Cover aggregate shall conform to size or gradation requirements of 703.05 or 703.06.

408.04 Weather Limitations. Bituminous material shall not be applied on a wet surface. Prime coats for road mix or surface treatment Work shall not be applied when the atmospheric temperature is below 50°F or when the air temperature within the preceding twenty-four hours has been 40°F or lower. Prime coats on new macadam, stabilized and granular base courses may be applied when the atmospheric temperature is 40°F or higher.

408.05 Equipment. Equipment shall conform to 407.03.

408.06 Preparation of Surface. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be smooth and uniformly compacted at the time of application of the bituminous material.

The cleaning shall be done in such manner as to thoroughly remove all mud, earth and other foreign material. The sweeping on a waterbound surface shall be just sufficient to expose the pattern of the course aggregate. Special care shall be taken to clean the edges of road to be primed in order to insure uniform application of the bituminous material directly on the existing base or pavement surface. Material cleaned from the surface shall be removed and disposed of as directed by the Engineer.

408.07 Application of Bituminous Material. Bituminous material shall be applied in a uniform continuous spread to the width of the section to be primed by means of a pressure distributor conforming to 407.03. When traffic is maintained, not more than 1/2 of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junction of spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.

When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the road bed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed. The quantity, rate of application, temperatures and areas to be treated shall be approved before application of the prime coat.

408.08 Application of Cover Aggregate. If, after the application of the prime coat, the bituminous material fails to penetrate within the required time and the Roadway must be used by traffic, cover aggregate shall be spread in the amounts required to absorb any excess bituminous material. The cover aggregate shall be included in the Bid price for the bituminous prime coat.

408.09 Method of Measurement. Bituminous material shall be measured by the gallon in accordance with Items 114 and 115.

408.10 Basis of Payment. Payment for accepted quantities complete in place will be made at the Contract price for:

Item	Unit	Description
408	Gallon	Prime coat

ITEM 409 SEAL COAT

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 reasonable close conformity with the lines shown on the Plans or established by the Engineer.

409.02 Bituminous Material. The bituminous material shall meet the application requirements of Item 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 the Contractor desires to use treated material, the agent shall be approved by the Engineer.

409.04 Weather Limitations. No bituminous material shall be applied unless the atmospheric temperature is 50°F and rising nor when the temperature has been below 40°F in the preceding twenty-four hours, except as provided for seal coat application on Shoulders. No bituminous material shall be applied while the surface is wet nor when impending weather conditions are such that proper curing may not be obtained.

For seal coat application on Shoulders, cut back asphalt or cutback asphalt emulsion may be applied when the air temperature is between 40°F and 50°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°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 Type II pneumatic tire conforming to 401.11 except the maximum capacity shall not apply.

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 imbedment and retention of the cover aggregate.

At the beginning and at the end of a 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 a 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 soon after the bituminous material has cured sufficiently to prevent dislodging of the imbedded aggregate particles.

409.09 Method of Measurement. The quantities will 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 Items 114 and 115.

Aggregate shall be measured by weight in accordance with Items 114 and 115 and converted to cubic yards in accordance with the following for 703.05 aggregate:

Aggregate	**Pounds Per Cubic Yard**
Crushed gravel	2,600
Stone	2,400

409.10 Basis of Payment. The quantities measured as above provided will be paid for at the Contract price for:

Item	**Unit**	**Description**
409	Gallon	Seal coat bituminous material
409	Cubic yard	Seal coat cover aggregate, No ____

450 RIGID PAVEMENT

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 Placing Reinforcement
451.08 Joints
451.09 Consolidating and Finishing
451.091 Hand Finishing
451.10 Curing
451.11 Removing Forms
451.12 Surface Smoothness
451.13 Sealing Joints
451.14 Opening to Traffic
451.15 Concrete Pavement-Slipform Method
451.151 Reinforced Concrete Alley Pavement and Reinforced Concrete Alley Mouths
451.16 Pavement Thickness
451.17 Method of Measurement
451.18 Basis of Payment

451.01 Description. This Work 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, thicknesses and typical cross sections shown on the Plans or established by the Engineer.

451.02 Materials. Materials shall be:

Concrete	------	499 Class D
Joint sealer	------	705.04
Preformed elastomeric joint sealer	------	705.11
Preformed filler	------	705.03
Curing Materials	------	705.05, 705.06, 705.07 (Type 2)
Reinforcing steel	------	709.09, 709.10, 709.12
Dowel bars	------	709.13
Expansion shield anchors	------	712.01

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.

Written permission of the Engineer must be obtained if the use of any finishing Equipment not meeting these Specifications is contemplated. Permission to use an alternate type of finishing machine will be granted only upon evidence that previous satisfactory results have been obtained with this Equipment.

(b) Vibrators. For full width vibration of concrete paving slabs, vibrators 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 2,000 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 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 a Subgrader or Subgrade planer. This finegrading operation should involve a slight removal of the subbase material and bring the subbase 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 pre-set 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.

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 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. A separate internal vibrator shall be used to consolidate concrete around dowel basket assemblies.

Provided the curing compound damage caused by sawing is repaired according to 451.10 and to the Engineer's satisfaction, the Contractor may operate the sawing Equipment necessary to saw joints on the newly constructed pavement. Mechanical Equipment shall not be operated upon existing lane of pavement until that lane has been in place for at least seven Days or until specimen beams have attained a modulus of rupture of 600 pounds per square inch. If only finishing Equipment is carried on the existing lane, paving may be permitted after that lane has been in place for at least three Days or after specimen beams have attained a modulus of rupture of 500 pounds per square inch. The material and labor for preparing and testing the beams shall be furnished by the Contractor at his expense. The number of beams and the locations where beams shall be taken shall be as determined by the Engineer.

An approved spreader will be required when the width of pavement being placed in one operation is 12 or more feet and the total square yardage of any given width on the Project exceeds 10,000. When a slipform paver is equipped with a dowel bar inserter the separate spreader requirement may be waived provided the slipform paver is capable of spreading, consolidating, screeding, and float finishing the freshly placed concrete. The Engineer shall be provided documentation that the slipform paver will meet this specification.

No concrete shall be mixed, placed or finished after dark, unless an adequate and approved artificial lighting system is operated.

For concrete placed when the temperature of the air is 35°F or below, the concrete immediately after placing in the forms shall have a temperature of between 50°F and 80°F.

The Subgrade or subbase upon which concrete is to be placed shall be entirely free from frost, when concrete is deposited.

Concrete test cylinders shall be made at frequent intervals and tested in accordance with 499.031. The compressive strength shall meet the requirements for Class D concrete as specified in 499.031.

When constructing concrete pavement, a circle 2 feet greater in diameter than the diameter of the top of manhole castings shall be bulkheaded around the casting and a circle 3 feet in diameter shall be bulkheaded around lampholes, gas, water and other utility valve castings. For large square or rectangular castings the perimeter of the bulkheaded area shall be 1 foot outside of the perimeter of the casting. Diagonal steel bars and hook bolts shall be placed in the concrete pavement outside the bulkheaded area as shown on the standard Drawings.

451.07 Placing Reinforcement. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to 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. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of 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 free from dirt, oil, paint and grease.

Steel reinforcement shall conform to the size and spacing shown on the standard Drawings unless indicated otherwise on the Contract Plans.

451.08 Joints. Joints shall be constructed of the type, dimensions, and at locations specified and shall be in accordance with the details shown on the standard Drawings unless indicated otherwise on the Contract Plans.

(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 1/3 of the specified pavement thickness within three Days after the pavement is placed. 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 depth of 1/2 inch. The width shall be approximately 1/4 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 center line of the slab by an approved metal device that is left in the pavement. Deformed steel tie bars, 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 according to the standard drawingf 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 2 inches in depth shall be sawed for installation of 705.11 joint sealer or an opening 1 inch in width by 1 inch in depth shall be formed for installation of 705.04 joint sealer.

(d) Contraction Joint. Contraction joints shall be sawed as specified to a minimum depth of 2 inches and a width of 1/4 inch ($\pm$ 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 may be done wet or dry but the joint must be cleaned by a jet of water or air under pressure after having been sawed. 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 built as specified at the end of each Day's Work and whenever necessary to suspend the Work for a period of more than thirty minutes. In no case shall an emergency construction joint be placed closer than 10 feet to a parallel joint.

451.09 Consolidating and Finishing. Internal vibration or an approved mechanical mesh installer 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.

The pavement shall be finished by an approved finishing machine operated over each section of pavement 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 10 foot straightedges. If the pavement surface is dragged with a diagonal pipe float machine, only occasional straightedge surface checks, while the concrete is plastic, will be required.

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 toolmarks 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 use of a broom or artificial turf drag in the longitudinal direction so as to produce a uniform, gritty, longitudinal texture. In addition to and immediately following the above specified longitudinal drag texture, the pavement shall be textured in the transverse direction by an approved device that will produce a relatively uniform pattern of grooves. The grooves shall be spaced at 3/8 to 1 3/4 inches and shall be approximately 0.05 inches to 0.08 inches deep and 0.10 inches wide. A width of 18 inches along each curb shall not be textured but left smooth to facilitate drainage. Variation

from the texturing requirements will be permitted only with permission of the Engineer.

On pavement grades of five percent and over, a broomed finish shall be used. Immediately after the joints have been edged, the surface checked with a straightedge and before the concrete has had its initial set, the pavement shall be given a broom finish in a careful and workmanlike manner without tearing or raveling the concrete. The strokes shall be from center to edge of the slab, one stroke per width of broom with adjacent strokes slightly overlapped and so as to produce regular corrugations not over 1/8 inch in depth. A width of 18 inches along each curb shall not be broomed but left smooth to facilitate drainage. The broom shall be of an approved type, not less than 15 inches in width, of bass or bassine fiber not more than 5 inches in length. The entire operation of brooming shall be executed to the satisfaction of the Engineer.

451.091 Hand Finishing. When hand finishing is permitted, the screed used for striking-off the concrete shall be substantially constructed with trussed top and lateral stiffeners of either steel or steel-shod wood construction. After adjustment of the screed for proper crown and pavement section has been completed, the height of the middle ordinate shall not be increased more than ten percent when supported at the center than when supported at its ends. The striking template shall be operated forward with a combined longitudinal and transverse motion. All other applicable details of screeding, finishing and checking shall conform to the provisions of 451.09.

On Roadways or alleys with inverted crowns and in alleys where space is lacking along the sides, the above described method of finishing cannot usually be adhered to. In such cases hand floating shall be resorted to, working from suitable Bridges spanning the soft concrete in order to obtain compaction and finishing comparable to that obtained by the ordinary methods described above.

451.10 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 in a manner subject to the approval of the Engineer.

Wind protection to the spray fog shall be provided by an adequate shield. A minimum of 1 gallon of material shall be used for each 150 square feet of surface treated. Curing material shall be thoroughly agitated immediately prior to use.

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.

Concrete to be placed after October 31 which will be opened to traffic during the following winter shall be cured by use of cotton or burlap mats, waterproof paper, polyethylene sheeting, or waterproof curing blankets. Curing shall be applied as soon after the finishing operations as possible without marring the surface of the concrete. The entire surface of the top and sides of the newly placed concrete shall be covered and maintained covered for seven Days, unless specimen beams have attained a modulus of rupture of 600 pounds per square inch.

The Contractor shall be responsible for protecting the concrete from freezing until beam strength of 600 pounds per square inch or cylinder strength of 3,000 pounds per square inch has been attained.

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.

451.11 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 451.10.

451.12 Surface Smoothness. After the final curing of the concrete, the surface shall be cleaned and 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, more than 1/4 inch in a 10 foot length of pavement, shall be ground off to within the specified tolerance in a manner satisfactory to the Engineer. Bush hammering will not be permitted.

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.

451.13 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.

Transverse contraction joints shall be sealed with preformed polychloroprene compression seals meeting the requirements of 705.11. Expansion joints shall be sealed with material conforming to 705.04 or 705.11. The seals shall be installed by suitable tools using an approved lubricant-adhesive which shall cover both sides of the sealer. The seals shall be installed in a substantially fully compressed condition and shall at all times be below the level of the pavement surface by approximately 1/4 inch. The seals shall be in one piece without field or factory splice between longitudinal joint and edge of pavement or between longitudinal joints of multilane pavement. The elongation of the seals during installation shall not exceed five percent as determined by length measurement marks.

Formed joints shall be sealed with joint filler conforming to 705.04. Sawed joints shall be sealed with joint filler conforming to 705.04 or 705.11. The joint sealer shall be placed with proper Equipment to obtain a neat workmanlike joint free from excess and unsightly filler.

451.14 Opening to Traffic. The completed pavement may be used for traffic, including construction traffic, when seven Days have elapsed. Provided that a modulus of rupture of 600 pounds per square inch has been attained, the pavement may be opened to traffic when five Days have elapsed. In the event it is necessary to open a portion of the pavement in less than five Days, high early strength concrete in accordance with 499.03 shall be used. The portion of pavement may be opened after three Days provided test beams attain a modulus of rupture of 600 pounds per square inch.

451.15 Concrete Pavement-Slipform Method. If the Contractor elects, 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 additional compaction before concrete is placed. The grade should 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 particles at no increase in cost.

(b) Placing Concrete. The concrete shall be placed with an approved slipform paver or combination of pavers designed to spread, con-

solidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finish 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. Slipform 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 451.09 and 451.12. The edges of the pavements adjacent the Shoulder area shall not vary more than 1/2 inch below the typical section. In areas where adjoining pavement is to be constructed, the edge of the pavement on either side of the longitudinal joint shall not vary more than 1/4 inch below the typical section.

(d) Curing. Curing shall be done in accordance with 451.10. The curing compound 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 451.08. In the area of construction joints placed at the end of the Days run, a reduction of approximately 2 inches in overall width will be permitted.

451.151 Reinforced Concrete Alley Pavement and Reinforced Concrete Alley Mouths. These items shall conform to the previously described Specifications except that:

(a) Finishing shall be in accordance with the requirements of 451.091.

(b) Pavement thickness shall be 7 inches unless otherwise shown on the Contract Plans.

(c) All joints shall be of the type, dimensions and spacing shown on the standard Drawings.

(d) Longitudinal expansion joints 1/2 inch thick shall be constructed along buildings and at concrete ramps into garages.

(e) Additional construction details shall be as shown on the standard Drawings.

451.16 Pavement Thickness. Thickness of concrete at any point, determined by the measurement of cores cut as hereinafter specified, shall not be more than 1/5 inch less than the specified thickness, nor shall the average thickness of the concrete, determined as hereinafter specified, be more than 1/10 inch less than the specified thickness. The length of the cores will be determined in accordance with AASHTO T148.

The entire pavement shall be considered a unit for the purpose of coring.

One core shall be taken at random for every 2,000 square yards of pavement or major fraction thereof; however, a minimum of three cores shall be taken from any pavement cored. Additional cores may be requested at locations specified by the Engineer. Should any core show a deficiency in thickness of more than 1/2 inch, 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 50 feet and 100 feet, measured longitudinally from the location of the first core found to be deficient in thickness, and thence at 100 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 boundaries of the zone of deficiency, but in no case shall additional cores be cut 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.

When any core shows a deficiency of more than 1/2 inch, the length of the adjacent pavement for which payment shall be withheld, shall be the sum of the distance measured parallel to the center line, from the location at which the core originally found to be deficient in thickness was cut, to the nearest boring in each direction longitudinally which produced a core within the 1/2 inch tolerance. Deductions shall be only for the separately poured lane from which the cores were cut to determine thickness.

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 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.

Price Adjustments. Where the average thickness of pavement is deficient in thickness by more than 1/10 inch, but not more than 1/2 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency

Deficiency in Thickness as Determined by Cores	Proportional Part of Contract Price
0.0 to 0.2	100 percent
0.2 to 0.5	Ratio $\frac{(\text{Average Thickness})^2}{(\text{Specified Thickness})^2}$
Greater than 0.5	None

When the thickness of pavement is deficient by more than 1/2 inch and the judgment of the Engineer is that the area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

451.17 Method of Measurement. The yardage under this item will be the number of square yards of concrete pavement completed and accepted in place. Areas blocked out for manholes, catch basin aprons, etc., which have a surface area exceeding 9 square feet shall be deducted from the gross pavement area. Areas blocked out which have a surface area less than 9 square feet shall not be deducted. The width for measurements will be the width of the pavement shown on the typical cross section of the Plans. Where integral curb is called for on the Plans, the width for measurements will be the width of the pavement between back-to-back of the integral curb shown on the typical cross section of the Plans. The length will be measured horizontally along the center line of the pavement.

451.18 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, joint Materials, blocking out for manholes,

catch basin aprons, etc., and integral curb when it is called for on the Plans or in the Proposal; provided, however, that for pavement found deficient in thickness only the reduced price stipulated in 451.16 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 will be made under:

Item	**Unit**	**Description**
451	Square yard	Reinforced concrete pavement
451	Square yard	Reinforced concrete pavement with integral barrier curb
451	Square yard	Reinforced concrete pavement with integral mountable curb
451	Square yard	Reinforced concrete alley pavement
451	Square yard	Reinforced concrete alley mouths

ITEM 452 PLAIN PORTLAND CEMENT CONCRETE PAVEMENT

452.01 Description
452.02 Method of Measurement
452.03 Basis of Payment

452.01 Description. This Work shall consist of constructing a portland cement concrete pavement 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 item shall conform to the same Specifications and requirements as prescribed in Item 451, except that:

(a) Fabricated steel reinforcement is not required.

(b) Load transfer devices (dowel bars) are required for all transverse contraction joints, expansion joints and construction joints in thoroughfare street pavement. Load transfer devices (dowel bars) are required only at transverse expansion and construction joints in residential street pavement and alley pavement unless indicated otherwise on the Contract Plans.

(c) Transverse contraction joints shall be constructed according to the Plans or standard Drawings. Longitudinal joints shall be constructed where shown on the Contract Plans.

(d) All joint details shall be as shown on the standard Drawings unless indicated otherwise on the Contract Plans.

(e) If the Contractor elects to use sawed contraction joints or if sawed contraction joints are specified on the contract Plans, control joints of premolded ribbon material shall be installed at 100 foot spacing unless directed otherwise by the Engineer.

452.02 Method of Measurement. The yardage under this item will be the number of square yards of concrete pavement completed and accepted in place. Areas blocked out for manholes, catch basin aprons, etc., which have a surface area exceeding 9 square feet shall be deducted from the gross pavement area. Areas blocked out which have a surface area less than 9 square feet shall not be deducted. The width for measurements will be the width of the pavement shown on the typical cross section of the Plans. Where integral curb is called for on the Plans, the width for measurements will be the width of the pavement between back-to-back of the integral curb shown on the typical cross section of

the Plans. The length will be measured horizontally along the center line of the pavement.

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 reinforcing steel, dowels, joint Materials, blocking out for manholes, catch basin aprons, etc., and integral curb when it is called for on the Plans or in the Proposal; provided, however, that for pavement found deficient in thickness only the reduced price stipulated in 451.16 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 will be made under:

Item	Unit	Description
452	Square yard	Plain concrete pavement
452	Square yard	Plain concrete pavement with integral barrier curb
452	Square yard	Plain concrete pavement with integral mountable curb
452	Square yard	Plain concrete alley pavement
452	Square yard	Plain concrete alley mouth

ITEM 453 CONCRETE DRIVEWAYS

453.01 Description
453.02 Materials
453.03 Construction
453.04 Method of Measurement
453.05 Basis of Payment

453.01 Description. This Work shall consist of constructing concrete driveways placed upon the prepared and approved Subgrade at the locations shown on the Contract Plans or where directed by the Engineer. Unless otherwise shown on the Contract Plans, the concrete wearing surface shall be 6 inches in depth for residential driveways and 7 inches in depth for all other driveways.

453.02 Materials. Materials shall be:

Concrete	----------	499 Class D
Expansion joint material	----------	705.03

453.03 Construction.

(a) Excavation shall be made to the required depth and to a width that will permit the installation and bracing of forms. The Subgrade shall be shaped and compacted to a firm surface conforming to the Plans or as ordered by the Engineer.

(b) Forms shall be of wood or metal and shall extend for the full depth of the concrete. They shall be of sufficient strength to resist the pressure of the concrete without springing.

(c) Concrete shall be placed in accordance with the provisions of 451.06.

(d) Concrete shall be finished in accordance with the provisions of 451.091.

(e) Concrete shall be cured in accordance with the provisions of 451.10.

(f) Joint details and additional construction details shall be as shown on the standard Drawings.

(g) When curb "turns" are used they shall be constructed monolithic with the driveway pavement. The radii will vary from a minimum of 3 feet to a maximum to be determined by the Engineer according to the distance and elevation between the walk and the curb.

453.04 Method of Measurement. The area to be paid for under this item shall be the actual number of square feet of concrete driveways completed and accepted in place. The area of the curb "turns" shall be included in the measurements.

453.05 Basis of Payment. The accepted quantities of concrete driveways will be paid for at the Contract Unit Price per square foot, which price and payment shall be full compensation for excavating furnishing and placing all Materials, including concrete, expansion joints and other material necessary for completion of the item.

Payment will be made under:

Item	**Unit**	**Description**
453	Square foot	Concrete driveway

ITEM 455 EXCESS COST OF HIGH-EARLY STRENGTH CEMENT

455.01 Description
455.02 Materials
455.03 Basis of Payment

455.01 Description. This item shall consist of furnishing high-early-strength cement instead of the cement required for the specified class of concrete in the item involved. It shall be used only when specified on the Contract Plans or where directed by the Engineer.

455.02 Materials. Materials shall be:

High-early-strength cement ---------- 701.05

455.03 Basis of Payment. Payment for this item will be made at the price bid per sack (94 pounds), which shall cover only the cost of the high-early-strength cement over and above the cost of the cement required for the specified class of concrete in the item involved.

Payment will be made under:

Item	Unit	Description
455	Sack	Excess cost of high-early-strength cement

ITEM 499 CONCRETE GENERAL

499.01 Description
499.02 Materials
499.03 Proportioning
499.031 Strength
499.04 Equipment
499.05 Handling, Measuring and Batching Materials
499.06 Mixing Concrete
499.07 Plant Inspection

499.01 Description. This Work shall consist of proportioning and mixing concrete.

499.02 Materials. Materials shall be:

Fine aggregate*	---------	703.02
Coarse aggregate	---------	703.02
Portland cement	---------	701.01, 701.04, 701.05
Air entraining admixture	---------	705.10

*703.02 natural sand is required in Item 451 and Item 452.

Water used in concrete shall be free from sewage, oil, acid, strong alkalies 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 net water-content shall not exceed the maximum specified. Below this limit the quantity of water shall be adjusted to meet the slump requirements.

Concrete shall contain four to seven percent of entrained air. Specific air content within these limits shall be subject to the approval of the Engineer.

Slump, when tested in accordance with ASTM C143, shall be maintained within the range of 3/4 inch to 4 inches, unless otherwise specified.

When used in paving, tests shall be made on plastic concrete after it is placed on the subbase. 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 and the quantity of water shall be determined by the Engineer from the weights given in the Concrete Table, using not to exceed the net amount of water shown and the range in slump stated.

If high-early-strength concrete is desired by the Contractor, the Contractor may use, at the Contractor's own expense, cement conforming to 701.05, water-reducing agents, set-retarding agents, or a combination of these as approved by the Engineer.

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 and limestone 2.65. 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).

CONCRETE TABLE

Quantities Per Cubic Yard

Type of Coarse Aggregate	Dry Aggregates Fine Aggregate (lbs)	Coarse Aggregate (lbs)	Total (lb)	Cement Content (lb)	Max. Water Content (gal)
CLASS D					
Gravel	1040	2110	3150	611	36
Limestone	1170	1950	3120	611	36
CLASS E					
Gravel	1100	2090	3190	517	37
Limestone	1235	1925	3160	517	37
CLASS F					
Gravel	1170	2050	3220	470	35
Limestone	1310	1880	3190	470	35

At any time during the construction period, the relative weights of fine and coarse aggregates as determined from the above table may be varied by the Engineer in order to insure the use of the least amount of fine aggregate which will produce workable concrete within the specified slump range. Coarse aggregate may be furnished in two separate sizes or in one size of coarse aggregate. If two separate sizes are used, they shall be No. 4 and No. 6. The single size shall be No. 57. The ratio of the No. 6 size of coarse aggregate to total coarse aggregate may be varied within the range of forty to sixty percent by

weight, to secure the most desirable and uniform gradation of the combined material. 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 net water content specified, the total weight of aggregate shall be reduced until concrete of the proper consistency is obtained without exceeding the maximum net water content specified. However, the Contractor shall not be compensated for any 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) Yield tests shall be made for the purpose of determining the cement content per cubic yard of concrete. Based on these yield tests the batch weights may be adjusted provided that the specified cement factor is maintained and the maximum net water content is not 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.

499.031 Strength. Test cylinders 6 inches in diameter and 12 inches high shall be made at frequent intervals from the concrete which is being incorporated in the Work. When and wherever required by the Engineer test cylinders will be made from concrete incorporated in the Work and test cores will be cut from the completed Work. These cylinders shall be made and tested in accordance with ASTM C31M-a and ASTM C39M, and the following minimum compressive strength per square inch shall be obtained.

Class of Concrete	Average for any 3 Consecutive Cylinders		Any One Cylinder	
	7 Days	28 Days	7 Days	28 Days
D	2800	4000	2500	3500
E	2400	3400	2100	3000
F	2100	3000	1800	2600

If the average compressive strength of three consecutive cylinders falls below that shown in the table above for "average for any three consecutive cylinders" it shall be sufficient reason for increasing the cement content of the concrete mix without additional cost to the City.

If the compressive strength of any one cylinder falls below that shown in the above table for "any one cylinder" it shall be sufficient reason for rejection of the Work involved.

499.04 Equipment. Equipment shall be as follows:

(a) Batch plant. The plant shall be so constructed that there will be no intermingling of the Materials stored prior to batching. The weighing of the separate Materials shall be accomplished to an accuracy of one percent. Dials or other devices shall be connected to the weighing mechanism that will provide either a visible means of checking the weight or a printed record.

Ten 50 pound standard test weights that conform to the regulations of the Ohio Department of Agriculture shall be provided at the batch plant for testing weighting Equipment. Scales shall be tested as often as the Engineer may deem necessary to assure this continued accuracy.

All weighing devices shall be checked and approved by the Sealer of Weights before their use will be permitted. In lieu of approval by the Sealer of Weights, the weighing devices may be checked by a servicing company.

(b) Mixers. 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.

Site mixers shall be approved types capable of producing thoroughly mixed and uniform concrete within the specified mixing period, and of discharging and distributing the mixture without segregation on the prepared grade. 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 and which records the number of batches mixed.

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 M157.

Bodies of non-agitating hauling Equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when required by the Engineer. Trucks having dump bodies with rounded corners and no internal ribs or projections will be permitted for nonagitating hauling.

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 uniform moisture.

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.

When mixing is at the site of the Work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. The Contractor shall use a suitable method of handling the bulk cement from weighing device to transporting container or into the batch itself for transportation to the mixer, with chute, boot or other approved device to prevent loss of cement and arrange to provide positive assurance of the actual presence in each batch of the entire cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch, between the fine and coarse aggregates, or in case of a onestop plant it may be blended directly with the aggregates provided that the introduction of the cement to the blend is delayed until the bed of the truck is covered with aggregate and in no case shall any cement be discharged after the last of the aggregate. When the cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1 1/2 hours of such contact.

Batches shall be delivered to the mixer separately and intact. Each batch shall be dumped into the mixer without appreciable loss of cement and

without spilling of material from one batch compartment into another. Batching shall be so conducted as to result in the weights of each material required within a tolerance of one percent for cement and two percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one percent. Unless the water is to be weighed, the water measuring Equipment shall include an auxiliary tank from which the measuring tank shall be filled. Means shall be provided for readily and accurately determining the amount of water in the measuring tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

Methods and Equipment for adding air-entraining agent or other admixtures into the batch, when required, shall be approved by the Engineer. All admixtures shall be measured into the mixer with an accuracy of one percent.

499.06 Mixing Concrete. The concrete may be mixed at the site of the Work, in a central mix plant or in truck mixers. The mixer shall be of an approved type.

When mixed in a site mixer, the mixing time shall be not less than fifty seconds. Mixing time for central mixers shall be not less than sixty seconds. Mixing time begins when all Materials are in the drum and ends when the discharge begins. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

Ready-mixed concrete shall be mixed and delivered in accordance with 499.04(b). The concrete shall be delivered to the site of the Work and discharge shall be completed within one hour after the addition of the cement to the aggregates.

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, except that an overload may be permitted for site mixers. A ten overload is permitted when operating site mixers on grades in excess of six percent, and an overload of twenty percent if the grade is six percent or less, provided all parts of the site mixers including skip and bucket will hold the overcharge without spillage.

Mixed concrete from the central mixers shall be transported in truck mixers, truck agitators or trucks having nonagitating bodies. The time elapsing from the time water is added to the mix until the concrete is incorporated in the Work shall not exceed sixty minutes.

Re-tempering concrete by adding water or by other means will not be permitted. When concrete is delivered in transit mixers or agitators, additional water within the limits specified may be added and sufficient mixing performed to adjust the slump and to regenerate the specified air content throughout the batch, provided all these operations are performed prior to discharging any of the batch and within the above time limitations.

Admixtures for increasing the workability or for accelerating the set will be permitted only when specifically provided for in the Contract, or upon written permission of the Engineer.

When the maximum daily air temperature exceeds 70°F and with the specific approval of the Engineer or at any time upon the direct order of the Engineer, the Contractor may/shall use a modified concrete mix having a minimum cement content of 6 sacks per cubic yard and an approved water-reducing, set-retarding admixture meeting the requirements of ASTM C494, Type D. The admixture submitted for approval for use in the concrete shall be produced by a firm which has had a minimum of five years of actual experience in the field usage of the basic product. The producer of the admixture shall submit written test data from a recognized Laboratory showing that the admixture meets the requirements specified. The admixture shall be added to the concrete in the quantity and manner necessary to produce the physical requirements specified in Table I of ASTM C49 and shall be used in compliance with the Specifications of the manufacturer.

499.07 Plant Inspection. The City shall reserve the right to inspect and check the operations of the concrete plant, including the Materials to be incorporated into the concrete, when the plant is not owned and/or operated by the Contractor.

Where plant inspection is being done by the City, tickets made out by the plant operator must be approved by the testing Laboratory representative. The driver shall present one copy of the approved plant ticket to the Engineer.

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
501.08 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 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 shall be satisfied 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. The Fabricators of steel, other metal, or prestressed concrete members shall be approved by the Engineer. Request for such approval shall be made by the Contractor in writing. This request shall be submitted to the Engineer on or before the date of the preconstruction meeting. The Fabricator must be approved before shop Drawings are submitted for approval and before any steel, other metal, or prestressed concrete members requiring fabrication are ordered by the Contractor.

Fabricators of structural steel for Structures furnished under ODOT Item 513, exclusive of bearings, Roadway expansion joints, and secondary and detail material as defined in ODOT 513.01, shall be certified in accordance with the requirements of the AISC Quality Certification Program in the appropriate category.

Fabrication under AISC certification categories shall be as listed in the appropriate Ohio Department of Transportation “Supplement” based on the fabrication level required. Fabricators of prestressed concrete members shall meet the requirements defined in ODOT Item 515.

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 or Fabricator in accordance with AASHTO "Standard Specifications for Highway Bridges" and the Ohio Department of Transportation “Supplement” to the AASHTO Specifications in effect on the date of advertisement for Bids.

The Contractor, or the Fabricator if designated by 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.

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. Plans described in paragraph (a) shall be submitted at least fifty Days before construction begins. Plans described in paragraph (c) shall be submitted at least thirty Days before construction begins. Plans described in paragraphs (b), (d) and (e) shall be submitted at least twenty Days before construction begins. Construction shall not begin until approval is obtained. For such approval, three copies of the Plans plus an additional four copies for each involved railway company shall be submitted. The Plans shall be prepared by a Registered Professional Engineer and shall bear the signature and registration number or the P.E. seal. Two copies of the designed 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.

(c) Plans for the proposed erection and handling procedure for

(1) multiple span plate girder Bridges,
(2) rolled beam Bridges except single span Bridges with spans less than 80 feet,
(3) trusses,
(4) arches, and
(5) Structures carrying railway traffic.

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.

(e) Plans for proposed erection of prestressed concrete beams where erection involves placement of cranes or launching devices on previously erected spans.

(f) Plans and procedures for proposed demolition of Structures over railroad properties. The Drawings shall include the Contractor's sequence of Work and methods of protecting railroad properties.

Approval of the above construction Plans does not relieve the Contractor of responsibility for the behavior of the temporary Structures and procedures proposed.

501.08 Utilities. When appurtenances for gas, 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 designed unit stresses, 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.

501.10 Traffic. Traffic, including heavy construction Equipment, shall not be allowed on a Structure, the principal members of which, in the main Structure or in the floor system, are concrete, until fourteen Days after the concrete is placed in case ordinary portland cement concrete is used or until seven Days in case high-early-strength cement concrete is used, or on Structures, the principal members of which, in the main Structure or in the floor system, are other Materials than concrete, but in which the floor slab is concrete, until seven Days after the concrete is placed in case ordinary portland cement concrete is used or until three Days in case high-early-strength cement concrete is used, all subject to temperature or strength requirements as stated under 508.02, without the written permission of the Engineer.

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 Additional Excavation
503.08 Disposal of Excavated Material
503.09 Backfill
503.10 Basis of Payment

503.01 Description. This Work shall consist of the excavation of all Materials necessary for the construction of retaining walls, Culverts other than pipe Culverts, foundations for Culverts and for other Structures, except those Materials included under Item 200. Included in this item are:

(a) The constructing, maintaining and subsequent removing of cofferdams, cribs and sheeting, or other Materials used for this Work.

(b) The providing of adequate protection of excavation where cofferdams are not separately itemized.

(c) Pumping, dewatering and backfilling.

(d) The disposal of Materials not required or not suitable for backfill.

503.02 Classification. Excavation shall include all the necessary excavation not classified on the Plans or in the Special Provisions or Proposal.

503.03 Cofferdams, Cribs, and Sheeting. This item shall include the construction, maintenance and subsequent removal of all cofferdams, cribs, sheeting, shoring, bracing, or other Materials necessary to safely support the sides of excavations, embankments, adjacent buildings, tracks or other premises, and all pumping while excavating and concreting.

When sheeting is used, it shall be driven a sufficient depth below the bottom of footings, unless rock is encountered at a higher elevation, to obtain adequate stability. If practicable, cofferdams shall be so designed that the wales and cross bracing will clear the top of footings by at least 1 foot, and that no cross bracing will be left in the concrete. If this is not practicable, such bracing shall be of structural steel and shall be left in place. The ends of those structural members that would be exposed when the Structure is completed 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. The ends of other such structural members shall be burned off flush with the surface of the concrete.

Where water is not encountered, cofferdam sheeting may be placed on neat lines and used as forms for footing concrete, provided the requirements for wales and bracing mentioned elsewhere in 503.03 are met. This sheeting either shall be left in place at least to top of footing or shall be properly separated from the footing concrete so that the sheeting may be removed without injury to the concrete.

Where water is encountered and cofferdams, cribs and sheeting are necessary, they shall be practically watertight before any excavation is made below water level. Drainage facilities shall be provided outside of footing forms so as to drain all water to a sump and sufficient pumping facilities shall be provided to remove all water until the concreting has progressed above water level. Sub foundation and footing concrete shall be effectively protected from displacement due to the pumping operations. If a concrete seal is used to stop the flow upward from the bottom of a cofferdam it shall be placed below the regularly planned footer and it shall be considered as a part of the cofferdam and not allowed as concrete yardage unless a seal is specifically called for on the Plans.

503.04 Protection of Excavation. Excavation shall be made by such methods that the sides of all excavations are protected from caving and the original material below the bottom of footings will not be disturbed. Blasting, when permitted, shall be done in a manner that will not damage the material which supports the Structure vertically or laterally or promotes subsequent slides that will damage the Structure, road or adjacent property. Where the material below the bottom of footings has been removed or disturbed, any loose material shall be removed and the entire space filled with concrete at the Contractor's expense, except on pile foundations. In case of pile foundations the material removed or disturbed shall be replaced and compacted as directed. If caving occurs outside the excavation area, the resulting hole shall be backfilled as specified hereafter. All excavation adjacent to railroad tracks shall be done subject to the supervision of the railway company involved and shall be sufficiently braced to insure the proper support of railroad Roadbed and tracks. See approval of Plans for sheeting and bracing 501.06.

503.05 Footings in Rock. Where foundations are shown as extending into rock, they shall be carried into rock the minimum distance called for on the Plans, or where not otherwise called for shall extend into solid rock a distance at least equal to 2 feet 6 inches minus one-half the vertical distance from flow line down to top of rock, with a minimum depth into rock of 3 inches.

Where excavation for footings is rock or hard shale, the entire portion of excavation in the rock or shale, below tops of footings, shall be completely filled with concrete, and there shall be no payment made for rock excavation or concrete outside of the footing dimensions shown on the Plans.

503.06 Approval of Foundations. The Contractor shall notify the Engineer in due time as to when excavation will be completed to the depth shown on the Plans and no footings shall be placed until the Engineer has approved the sub foundation.

Culverts, other than pipe and pipe-arches, may be placed directly on solid rock, if rock exists for the full length of the Culvert, but boulders and unstable material, and rock over a portion of the length, shall be removed and replaced with suitable compacted material within the limits specified in 503.07.

503.07 Additional Excavation. The elevations for bottoms of footings shown on the Plans shall be considered as approximate. Excavation including cofferdams to a depth of 1 foot below plan elevations of the bottoms of footings, if required, shall be included for payment in the price Bid for the specified Structure. This shall include any additional pumping required; and where cofferdams and pumping are a separate pay item, the lump sum price shall be considered as including any extra cost involved either for cofferdams, pumping, or both, for this additional depth. Excavation deeper than this may be provided for as extra Work, as described in Item 117.

For Culverts other than pipe or pipe-arches, rock, boulders and unstable material shall be removed and replaced 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 for a width on each side of the Culvert equal to the span of the Culvert.

503.08 Disposal of Excavated Material. Material which is not needed or not suitable for backfill shall be disposed of in accordance with 203.05.

503.09 Backfill. Backfill under this item shall be considered as all replaced excavation and new embankment adjacent to Structures. Backfill shall be made of Materials meeting the requirements of 203.08.

Backfill shall be constructed in accordance with Item 203, except as modified in 503.09, and except that where soil backfill is permitted, the compaction required shall be ninety-five percent of maximum Laboratory dry weight.

All structural foundation units shall be backfilled as soon as practicable after the concrete has cured sufficiently so that it will not be damaged, to avoid the ponding of surface water and the accumulation of debris. Backfill in front of wing walls and retaining walls shall be made simultaneously with the backfill behind them. The channels of all ditches or water courses shall be left free from any excavated material or other refuse incident to the Work.

No backfill shall be placed against wing walls, retaining walls or other Structures until the walls have been approved by the Engineer. Where backfill is placed against a waterproofed surface, care shall be taken that no damage is done to the waterproofing material.

Backfill behind wing walls, retaining walls or other Structures will not be permitted until the concrete has attained adequate strength as determined either by the length of curing time or by the testing of beams. For full height of backfill, the minimum curing time shall be fourteen Days when ordinary Portland cement is used and seven Days for high-early-strength cement concrete. For half height of backfill, the respective curing times shall be seven Days and three Days. These requirements are subject also to the temperature and strength requirements of 508.02.

Embankments shall not be placed over concrete Structures until the same requirements for strength or age have been complied with as given for placing backfill behind wing walls, retaining walls or other Structures in the preceding paragraph.

Whenever a Culvert is placed by trenching into existing foundation material, the backfilling and operation of heavy construction Equipment, after the placing of the Culvert, shall be governed by the requirements of Method (b). In all other instances, Method (a) and Method (b) shall be considered Alternates.

Method (a). Where Culverts are placed without trenching, the backfill shall be placed in layers not to exceed 4 inches in thickness (loose depth) and compacted by means of mechanical tampers or other approved mechanical compactors for a distance beyond each side of the Culvert equivalent to the span of the Culvert, with a maximum requirement of 4 feet, and a minimum depth of 2 feet over the top of the Culvert, unless the finished embankment is of lesser depth.

Construction Equipment, other than approved tampers and compactors, shall not be operated within the above limitations except that light weight motor graders and light weight dozers may be used after a minimum cover of 12 inches has been placed and compacted over the top of the Culvert.

Heavy earth moving and compaction Equipment shall not be operated closer to the Culvert than 4 feet until after a cover equivalent to at least one-fourth the span of the Culvert, but in no case less than 2 feet, has been placed

and compacted over the top of the Culvert. For multiple span Culverts, the span as used above shall be the longest individual span.

Any additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the City.

Method (b). When a Culvert is to be placed within or beneath new embankment, before placing the Culvert the embankment shall be placed and compacted, in accordance with Item 203, to a depth of at least 2 feet above the top of the Culvert unless the top of the finished embankment is of lesser depth. A trench shall then be excavated to sufficient width for the placing of the Culvert and the proper placing and compaction of the backfill.

The operation of heavy construction Equipment over the Culvert shall be governed by the requirements of Method (a). Additional excavation incurred by use of this alternate method shall be made at no additional cost to the City.

503.10 Basis for Payment. Excavation for Structures shall not be paid for separately, but its cost shall be included for payment in the price Bid for Item 511 or the lump sum Bid for the specific Structure involved.

When cofferdams, cribs and sheeting are separately itemized, they shall be paid for at the Contract lump sum price bid for Item 503 cofferdams, cribs and sheeting.

These prices and payment shall constitute full compensation for performing all of the requirements of this item including pumping, bailing and dewatering. Payment will be made under:

Item	Unit	Description
503	Lump sum	Cofferdams, cribs and sheeting

ITEM 504 SHEET PILING LEFT IN PLACE

504.01 Description
504.02 Materials
504.03 Driving
504.04 Method of Measurement
504.05 Basis of Payment

504.01 Description. This Work shall consist of the furnishing and driving steel sheet piling to be left in place including the furnishing and installing of any specified anchors or other attachments to Structures, and the mobilization of the pile driving Equipment to and from the Project site.

504.02 Materials. New sheet piling shall conform to the requirements of 711.03. Used sheet piling in good condition which meets the sectional and strength requirements may be used if inspected and approved by the Engineer.

504.03 Driving. Steel sheet piling shall be driven to the tip elevation shown on the Plans.

504.04 Method of Measurement. The quantity shall be the number of square feet of sheeting complete in place as required by the Plans.

504.05 Basis of Payment. Payment will be made at Contract price for:

Item	Unit	Description
504	Square feet	Steel sheet piling left in place (minimum section modulus of_____cubic inches per foot of wall)

ITEM 508 FORMS

508.01 Description
508.02 Forms
508.03 Oiling Forms
508.04 Payment

508.01 Description. This Work shall consist of the designing and building of forms for the purpose of holding concrete in place until it has set up.

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 as described under 503.03, if cofferdams substantially conform to the footing out lines, cofferdam sheeting may be considered as forms for footings, but the volume of concrete paid for will be based on plan dimensions.

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. Advantage is to be taken of rustication strips in breaking joints to reduce the form marks showing on the finished surface. Forms shall be properly braced or tied together with approved form ties so arranged that when forms are removed, no metal will be within 1 inch 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.

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.

Formwork for Structures shall remain in place until the concrete has attained adequate strength as determined either by the length of curing time or by the testing of beams. For slabs with spans of 10 feet or more, the minimum curing time shall be fourteen Days when ordinary Portland cement is used and seven Days for high-early strength cement concrete. For slabs with spans of less than 10 feet, the respective curing times shall be seven Days and three Days. Days when the temperature of the air surrounding the concrete is below 50°F shall not be counted in curing time. When concrete strength is determined by transverse beam bending tests the average modulus of rupture of two beam tests shall be not less than 650 pounds per square inch. However, in no case shall the curing time be less than seven Days for ordinary portland cement concrete and three Days if high-early-strength cement is used, both subject to the above temperature requirement.

If weep holes through wing walls 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 or more than 10 foot centers and placed so that the bottom of weep holes, at face of wall, are 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. 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 Material
509.04 Method of Placing Material
509.05 Bending
509.06 Shop Assembled Units
509.07 Approval of Placing
509.08 Splicing
509.09 Supports
509.10 Epoxy Coated Reinforcing Steel
509.12 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 709.00.

The bar size number is specified on the Plans in the bar mark column. The first digit where three digits are used, and the first two digits where four are used, indicates the bar size number. For example, P601 is a number six bar.

Sufficient additional reinforcing steel shall be provided for sampling. Random Samples shall be replaced in the Structures by additional steel spliced in accordance with 509.08.

509.03 Care of Material. 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.

509.04 Method of Placing Material. Steel reinforcement shall be accurately placed in the positions shown on the Plans and firmly held during the placing and setting of concrete. Bars in the Superstructure shall be tied at all intersections except where spacing is less than 1 foot in each direction, in which case alternate intersections shall be tied. At the Contractor's option, a portion not to exceed twenty-five 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 reinforcing is prohibited except as permitted by 709.10 and 709.12. 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 not be less than:

(a) 2 1/2 inches at the top surfaces of 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.

The clearance between the reinforcing steel and the top surfaces of cast-in-place concrete deck slabs shall be 2 1/4 to 2 1/2 inches.

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.

Table 509.05-1 STANDARD BEND

	Bar			Dimension % A D		Dimension % A D		Dimension % A D	
	Nominal Dimensions			180° Bend		90° Bend		135° Bend	
Bar	Diameter	Area	Weight	D	A	D	A	D	A
Size	in	in^2	lb/ft	in	in	in	in	in	in
3	0.375	0.11	0.376	2 1/4	5	2 1/4	5	1 1/2	4
4	0.500	0.20	0.668	3	6	3	7	2	4 1/2
5	0.625	0.31	1.043	3 3/4	7	3 3/4	8 1/2	2 1/2	5 1/2
6	0.750	0.44	1.502	4 1/2	8	4 1/2	10		
7	0.875	0.60	2.044	5 1/4	10	5 1/4	12		
8	1.000	0.79	2.670	6	11	6	13 1/2		
9	1.128	1.00	3.400	9 1/2	15	9 1/2	15 1/2		
10	1.270	1.27	4.303	10 3/4	17	10 3/4	18		
11	1.410	1.56	5.313	12	19	12	20		
14	1.693	2.25	7.650	18 1/4	27	18 1/4	25		
18	2.257	4.00	13.600	24	36	24	33		

Tolerances: For diameter of bends, "D", the tolerance may be plus or minus the diameter of the bar. Standard fabricating tolerances shall be in accordance with the CRSI Manual of Standard Practice. No weight allowances will be made for tolerances.

509.06 Shop Assembled Units. The use of unit frames or shop assembled reinforcement, where applicable, 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.

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.

Number 14 and 18 bars shall be spliced with approved mechanical connectors.

Mechanical connectors shall be capable of developing one hundred twenty-five percent of the yield strength of the bars connected. Bars used to replace random Samples shall be lapped as follows:

BAR SIZE	LAP LENGTH (UNCOATED)	LAP LENGTH (EPOXY COATED)
4	**22”**	**27”**
5	**29”**	**35”**
6	**34”**	**41”**
7	**43”**	**52”**
8	**57”**	**69”**
9	**72”**	**87”**
10	**92”**	**111”**
11	**113”**	**137”**

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. The supports for reinforcing steel shall not be spaced more than 4 feet apart transversely or longitudinally. Where metal supports are used, the portion at and near the surface of the concrete shall be stainless steel, 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 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 Epoxy Coated Reinforcing Steel. 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. Damage as defined by Item 709 shall be repaired in accordance with that item.

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.

509.12 Basis of Payment. Payment shall be included in the Contract prices for Item 511 or the item specified.

ITEM 510 DOWEL HOLES

510.01 Description
510.02 Construction
510.03 Placement
510.04 Curing and Loading
510.05 Basis of Payment

510.01 Description. This item consists 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 Item 509.

510.02 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 cement grout (cement and water) or cement mortar composed of one part of portland cement and three parts of sand, by volume, and water. The bars shall be forced into the holes the specified depth spreading the grout or 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 Placement. Grout shall not be installed when the temperature of the substrate material is below 40°F. Dowel bars shall be forced into the holes the specified depth spreading the grout around the bar and solidly filling the hole.

Cement grout dowel holes shall be saturated with water and all excess water blown out before installation of the cement grout and dowels. The holes shall be filled with enough cement grout to completely fill the holes when the dowel is installed.

Cement grout not completely filling the holes will require removal of the dowel, installation of additional grout into the hole, and reinstallation of the dowel.

Nonshrink, nonmetallic grout holes shall be clean and dry. The grout shall be placed in the prepared holes immediately after mixing and shall be of sufficient amount to provide complete coverage around the dowel to ensure anchorage. When using nonshrink, nonmetallic grout, any hole not completely filled flush during the dowel installation shall have additional grout poured in until the hole is filled flush.

Care shall be taken to obtain the correct protrusion of the anchors or dowels and they shall be held in the plan position within the holes until the material has initially hardened.

When horizontal holes are specified, the Contractor shall provide a means of retaining the grout in the hole, flush with the vertical face. Any material used for this purpose shall not bond to the grout and shall be removed after the grout hardened.

510.04 Curing and Loading. Nonshrink, nonmetallic grout shall be cured as follows before any stresses are applied to the dowels.

Daily Minimum Ambient Temperature	Minimum Curing Time
33°F to 50°F	three hours
51°F to 68°F	1 1/2 hours
above 68°F	one hour

510.05 Basis of Payment. Payment for drilling or forming holes and furnishing and placing Materials shall be included in the Contract price for Item 511.

ITEM 511 CONCRETE FOR STRUCTURES

511.01 Description
511.011 Reference
511.02 Materials
511.03 Proportions
511.04 Concrete Test Specimens
511.05 High-Early-Strength Concrete
511.06 Measurement of Materials
511.07 Mixing of Concrete
511.08 Slump
511.09 Placing Concrete
511.10 Construction Joints
511.11 Emergency
511.12 Depositing Concrete Under Water
511.13 Depositing, Protecting, and Curing Concrete During Cold Weather
511.14 Removal of Forms
511.15 Curing and Loading
511.16 Surface Finish
511.17 Method of Measurement
511.18 Basis of Payment

511.01 Description. This item shall consist of furnishing and placing Portland cement concrete including forms, dowel holes, and reinforcing steel in accordance with these Specifications and in reasonably close conformity with the lines, grades, and dimensions shown on the Plans.

511.011 Reference. For additional construction procedures and material requirements, refer to the following:

Item 503 Excavation for Structures
Item 508 Forms
Item 509 Reinforcing Steel
Item 510 Dowel Holes
Item 512 Treating Concrete

511.02 Materials. Materials shall conform to 499.02 except as follows:

Aggregate; all concrete above the ground line, in a given Structure, shall be made of aggregates of the same kinds and colors, except upon the written permission of the Engineer.

Portland cement; only one brand, grade or kind shall be used in a given Structure above the ground line except by written permission of the Engineer.

Curing Materials; 705.05, 705.06 (white opaque), 705.07 Type 1 or 1D, 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.

511.03 Proportions. Concrete for Structures shall be proportioned according to 499.03, using Class D or Class E as specified, except as modified below.

If it is found impossible (1) to prepare concrete of the proper consistency without exceeding the maximum net water content specified or (2) to obtain the compressive strength indicated by 511.04, the total weight of aggregate shall be reduced until concrete of the proper consistency and strength is obtained without exceeding the maximum net water content specified. However, the Contractor shall not be compensated for any additional cement which may be required by reason of such adjustment.

511.04 Concrete Test Specimens. Test cylinders shall be made at frequent intervals from each class of concrete that is incorporated in the Work.

The design stresses for concrete for Structures, for which the specification reference in the Proposal (for the pertinent pay item) in Item 511, are based on a compressive strength at twenty-eight Days of 4,000 pounds per square inch for the Class D concrete and a compressive strength at twenty-eight Days of 3,400 pounds per square inch for the Class E concrete.

When necessary to permit early removal of falsework or to permit backfilling, concrete test beams shall be made and tested.

511.05 High-Early-Strength Concrete. When high-early-strength concrete is required, it shall be obtained by the use of cement meeting the requirements of 701.05. Curing shall be done in accordance with 511.15 for a period of not less than three Days.

511.06 Measurement of Materials. Measurement of cement, aggregates and admixtures shall be according to 499.05.

511.07 Mixing of Concrete. Mixing shall be according to 499.06.

511.08 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 quantity of mixing water shall be determined by the Engineer in accordance with 499.03 and shall not be varied without his consent.

The slump of concrete placed by the vibration method shall be in accordance with 499.03.

For mass concrete and reinforced concrete sections easily accessible for spading and working, such as slabs, not over 3 inches, except that under the adverse condition of high temperature, low humidity and considerable wind, the slump for slabs may be increased to 4 inches, if approved by the Engineer.

For reinforced concrete sections, not easily accessible for spading and working due to amount or spacing of steel or other reasons, not over 4 inches.

All concrete shall be as dry as it is practicable to place and all batches in the same section shall be of uniform consistency.

511.09 Placing Concrete. The Contractor shall notify the Engineer at least twenty-four hours in advance of placing concrete.

In order that the concrete will be properly finished, when the amount of concrete to be placed continuously is such that it cannot be finished before the end of the regular working Day, the time of starting the concreting operations shall be subject to the approval of the Engineer.

The Contractor shall furnish assurance to the Engineer of an adequate and uniform source of supply of concrete to permit proper placing and finishing, and of the availability of coverings for protection in case of rain, before Work will be permitted to start.

Before placing the concrete, all forms shall be thoroughly cleaned and the space to be occupied by the concrete shall be free from all laitance, silt, dirt, shavings, sawdust, and other debris. The methods of depositing shall be such as to insure that all reinforcing steel is completely enveloped in concrete mortar and such that this condition can be verified by inspection. The concrete shall be deposited in thin layers to facilitate spading, ramming or packing. The method or device used for conveying the concrete from the mixer to its place in the Work shall be such as to insure against separation of the coarse aggregate from the mortar. When concrete is being deposited in shallow members, such as slabs, it

shall be placed by the method which will insure as short a vertical drop as practicable. In beams, girders and similar members, mortar of the proportions used in the concrete may be placed in the bottom of the form to insure against honeycomb. This mortar shall be placed immediately ahead of the concrete. In other sections where it is extremely difficult to place concrete containing the larger sizes of the coarse aggregate a modified mix, secured by deleting that part of the coarse aggregate that is No. 4 size, may be used. The concrete shall be deposited at various places so as to maintain a surface practically horizontal over the section being placed.

When a chute is used, its slope shall be such as to allow concrete of the proper consistency to flow readily without separation of the ingredients. Concrete shall be deposited as near as possible to its final position. Concrete shall not be dropped into the forms a distance of more than 5 feet unless drop chutes are used. The delivery end of the drop chute shall be as nearly vertical as practicable.

The Contractor shall designate one or more Persons, preferably form carpenters, to continually inspect the forms during the placing of concrete, and any bulges or settlements shall be corrected, the concrete being removed if necessary, at the Contractor's expense.

The use of mortar topping shall not be permitted.

The use of the vibration method of placing all concrete is required. The Contractor shall furnish and have in use sufficient vibration Equipment of an approved type and size to properly compact each batch immediately after it is placed in the forms.

The vibrators shall generally be of a type that is applied directly to the concrete and that has a frequency of at least 4,500 impulses per minute, but where inaccessibility precludes this method of vibration, the vibrators may be applied to the forms.

The concrete shall be deposited as near its final position as possible and shall not be caused to flow long distances. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. Vibrators shall be pushed into and pulled out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but not continued so as to cause segregation. Care must be used not to disturb partially hardened concrete.

Such spading as is necessary to insure smooth surfaces and dense concrete shall be done along form surfaces and in corners and locations impossible to reach with the vibrators. The Engineer shall with the collaboration of the Contractor closely observe the results obtained on the first concrete placed

and such alterations shall be made in the mix, as permitted by these Specifications, as are necessary to secure the best results.

511.10 Construction Joints. When construction joints are definitely shown on the Plans, all concrete between consecutive joints shall be placed in a continuous operation. Concrete shall not be placed against the second side of construction or contraction joints for at least twelve hours after that on the first side has been placed.

Approval of the Engineer must be obtained for the placing of any construction joints not shown on the Plans.

The Plans 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.

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 wing walls and retaining walls generally shall be avoided and when used shall not be located within 2 feet of the normal water level.

In wing walls and retaining walls requiring a construction joint, it generally shall be a keyed vertical joint extending the full height above the footer. The second portion placed at a vertical joint shall be placed not earlier than twenty-four hours after the first portion placed.

Construction joints, not shown on the Plans and above ordinary low water, in wing walls and retaining walls that retain earth fills shall be waterproofed on the back with a premolded sealing strip or a 36 inch strip of Type B waterproofing according to 512.05 at the Contractor's expense.

Joints in cantilevered members shall be avoided.

When making a horizontal construction joint, care shall be taken to have the concrete below the joint as dry as possible and any excess water or creamy material shall be drawn off before the concrete sets up. Within twelve hours after the concrete below the joint has been placed the top surface shall be thoroughly cleaned by the use of wire brushes and all laitance and loose material removed so as to expose clean solid concrete. Care must be taken not to loosen any of the coarse aggregate in the concrete. If for any reason this laitance is not removed within twelve hours after the concrete is placed, it shall be removed

using such tools and methods as may be necessary to secure the results specified above. Immediately before placing concrete above the joint, the surface of the concrete below the joint which has been cleaned as specified above shall be thoroughly wetted and, if required by the Engineer, shall be flushed with mortar of the proportions used in the concrete. This mortar shall be thoroughly brushed into all openings and crevices with a stiff broom. On all exposed surfaces the line of the proposed joint shall be made truly straight, by tacking a temporary horizontal straightedge on the inside of the form, with its lower edge on the line of the joint and then placing the concrete 1/2 inch higher than this edge, to allow for settlement.

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 two hours shall elapse for settlement before placing concrete in the horizontal member.

511.11 Emergency. When the Work is unexpectedly interrupted by break-downs, storms or other causes and the concrete as placed would produce an improper construction joint, the Contractor shall rearrange the freshly deposited concrete, until a suitable arrangement is made for a construction joint. When such a joint occurs at a section on which there is shearing stress, the Contractor 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.

511.12 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 except for cofferdam seals is deposited under water, the proportion of cement used shall be increased at least ten 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.

511.13 Depositing, Protecting, and Curing Concrete During Cold Weather. When concrete is placed at or below an atmospheric temperature of 40°F or whenever the predicted temperature will fall below 40°F within the curing period, the water, aggregates or both shall be heated and suitable enclosures and heating devices shall be provided. The concrete shall be placed at a temperature of not less than 50°F and not more then 70°F and the air

surrounding the forms and deposited concrete shall be maintained within this temperature range for a period of not less than five Days when ordinary portland cement is used and not less than three Days when high-early-strength cement is used. The enclosures and heating devices shall not be removed at the end of this period until the temperature of the concrete has been permitted to drop, at a rate not to exceed 20°F per twenty-four hours, to within 20°F of the atmospheric temperature.

Mixing water shall be heated under such control and in sufficient quantity to avoid appreciable fluctuations in temperature from batch to batch. In no case shall the water be heated to a temperature greater than 160°F.

Aggregates shall be uniformly heated to eliminate all frozen lumps, ice and snow, but in no case shall the aggregates be heated to a temperature of more than 100°F.

The following formula may be used as a guide for estimating the temperature of mixed concrete:

$$\text{Temperature of mixed concrete} = \frac{Wt + 0.2W't'}{W + 0.2\,W'}$$

In which:

W	=	Weight of water
W'	=	Weight of cement and aggregates
t	=	Temperature of water
t'	=	Temperature of cement and aggregates

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 enclosed and heated before the concrete is placed.

Before any concrete is placed, the enclosures and heating devices shall be as nearly complete as the placing of concrete will permit. Throughout the entire operation of placing concrete the completion of enclosures and the application of heat, when required to bring the air surrounding the forms and deposited concrete to the specified temperature, shall follow the placing of concrete as closely as possible.

Enclosures shall be strong and wind proof and adequate space shall be provided to allow a free circulation of air around the forms and deposited concrete.

Heat may be supplied by any method which will maintain the required temperature continuously and with a reasonable degree of uniformity in all parts of the enclosure without overheating or discoloring the concrete.

If heat is supplied by any method other than free steam, all exposed concrete shall be covered with two thicknesses of wet burlap or wet cotton mats, as soon after placing the concrete as it can be done without marring the surface. The burlap or mats shall be kept continuously wet and shall not be removed during the heating period, except as required for rubbing. Wood forms without liners, if left in place more than two Days after the placing of concrete, shall be thoroughly wet down 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 wet burlap or mats for the remainder of the heating period.

An operator shall be in active charge throughout the entire twenty-four hours each Day and adequate fire protection Equipment shall be accessible at all times during the period of heating.

Footing concrete may be protected and cured by the use of insulating Materials if the concrete is maintained at a minimum temperature of 50°F for a period of not less than five Days. Insulating Materials and methods of application shall meet the approval of the Engineer. The Engineer will keep a permanent record of the surface temperatures of the concrete throughout the curing period.

In the case of footers that can be flooded, the following method for curing may be used when approved by the Engineer: The heat may be discontinued after forty-eight hours when ordinary portland cement concrete is used and after twenty-four hours when high-early-strength cement concrete is used and the footer flooded to a depth of at least 1 foot above the top of the concrete and kept flooded for a period of at least one hundred twenty hours; or the footer may be flooded as soon after placing the concrete as is possible without damaging the concrete and the water heated to a temperature of at least 50°F and not more than 75°F, by the use of steam or otherwise and kept at this temperature for forty-eight hours if ordinary portland cement concrete is being used or twenty-four hours if high-early-strength cement concrete is used and kept flooded for an additional period of at least seventy-two hours after heat is discontinued.

In lieu of the heated enclosures herein above specified the Contractor may protect Structure concrete by the use of insulation.

When form insulation is used, the concrete shall be placed at a temperature of not less than 50°F and not more than 70°F, as directed by the Engineer, and maintained by the insulation at a surface temperature of the concrete of not less than 50°F and not more than 100°F. Sufficient 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, exceeds the specified maximum temperature, the forms or insulation shall be loosened or otherwise vented until the surface temperature is 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 heat furnished as provided herein above.

The insulating material shall be wind and water resistant. Special precautions shall be taken at edges and corners to insure that such points of extreme exposure are adequately protected. The tops of pours shall be protected by a tarpaulin, or other approved waterproof cover, over the insulation.

At the close of the protection period, the temperature of the concrete within the forms shall be gradually decreased by loosening the forms or insulation to permit a rate of cooling not to exceed 20°F per twenty-four hours, to within 20°F of the atmospheric temperature.

In any case, responsibility for any defective concrete shall rest with the Contractor, who will be held for the replacement of any defective concrete.

511.14 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 injured.

511.15 Curing and Loading. All construction joints and all surfaces which receive a rubbed surface finish or are to be waterproofed 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.

Method (a) Water Curing. All surfaces not covered by form 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 by means of suitable sprinkling devices for a period of not less than seven Days. Wood forms without liners, if left in place longer than two Days after the placing of concrete, shall be thoroughly wet down at least once each Day for the remainder of the curing period. Formed surfaces shall, after the removal of forms be cured in like manner for the remainder of the curing period, 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 or mats 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.

Method (b) Waterproof 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 seven 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 at least 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 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.

The surface area of concrete construction joints shall be cured in accordance with the requirements of Method (a) until the adjacent concrete is placed.

Unless adequate precautions are taken to protect the surface of the membrane, workers, Materials and Equipment shall be kept off the membrane for the duration of the curing period.

If high-early-strength cement concrete is used, the curing shall be done in accordance with the provisions of Method (a) for a period of not less than three Days and such additional time or by such methods as specified.

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 footer, workers and Materials shall be kept off of 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 same be less than thirty-six 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 workers 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, workers shall be moved or temporarily removed so that the concrete may be thoroughly wetted and kept wet until the curing is completed. Great care

shall be exercised to prevent the bond between new concrete and the embedded portion of reinforcing steel projecting from the new concrete from being damaged by bending or otherwise disturbing the steel.

511.16 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 except air bubble holes, shall be cleaned and after having been kept saturated with water for a period of not less than two hours shall be completely filled, pointed and 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 satisfactory to the Engineer as to color, texture and smoothness, need not be grout cleaned or rubbed unless specifically called for on the Contract Plans. Exposed surfaces which are not satisfactory to the Engineer in these respects or because of excessive patching and/or other corrective Work shall be grout cleaned or rubbed as required by the Engineer and 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 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 time. 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 pointing 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.

511.17 Method of Measurement. The volume shall be the number of cubic yards as determined by calculations from plan dimensions, in place, completed and accepted.

No deduction will be made for the volume of the reinforcing steel in the concrete, but a deduction will be made for the volume of any encased structural steel (including steel piling) and for the volume of encased timber or concrete piles, assuming the volume to be 0.8 cubic foot per linear foot of such timber and concrete piles.

511.18 Basis of Payment. The accepted quantities measured as provided above shall be paid for at the Contract price per cubic yard for each of the pay items listed below. The cost of furnishing, preparing and placing all reinforcing steel as specified on the Contract Plans shall be included in the price Bid for the items listed as reinforced Class D concrete and reinforced Class E concrete.

Payment will be made under:

Item	Unit	Description
511	Cubic Yard	Class D concrete
511	Cubic Yard	Class E concrete
511	Cubic Yard	Reinforced Class D concrete
511	Cubic Yard	Reinforced Class E concrete

ITEM 512 TREATING CONCRETE

512.01 Description
512.02 Materials
512.03 Sealing Concrete Surfaces
512.04 Sealing Cracks by Epoxy Injection
512.05 Waterproofing
512.06 Method of Measurement
512.07 Basis of Payment

512.01 Description. This item consists of furnishing the necessary labor, material, and Equipment required to seal and treat concrete surfaces, seal cracks in concrete, and apply the designated type of waterproofing to Structures as indicated on the Plans.

512.02 Materials. Concrete treatment Materials shall conform to the following:

Epoxy-urethane sealer	705.23
Non-epoxy sealer	705.23
Epoxy injection Materials	705.24
Asphalt primer for Waterproofing	702.02 (RC-70 or RC-250), 702.05
Emulsified asphalt primer	702.04 (MS-2, SS-1)
Asphalt for waterproofing	702.06
Waterproofing fabric	711.24
Hot applied joint sealer	705.04
Sheet type 2 membrane waterproofing	711.25
Sheet type 3 membrane waterproofing	711.29
Type 3 membrane primer	705.04

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. The sealer listed in the pay item description shall be applied to locations described in the Plans.

(a) Equipment. The Contractor shall use application Equipment as recommended by the sealer manufacturer. Spray Equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc. shall be clean and free of foreign matter, oil residue, and water.

(b) Mixing. The sealer shall be mixed according to the manufacturer's recommended procedures. The Contractor shall furnish the Engineer with the manufacturer's application instructions prior to mixing or applying the sealer. Materials shall be mixed to a uniform consistency and be maintained during application.

(c) Storage. All sealer components shall be stored in tightly sealed containers, in a dry location, and as recommended by the manufacturer. Unopened drums or containers of the sealer or sealer components shall be delivered to the job site with the manufacturer's numbered seal intact.

(d) Surface Condition. Sealers shall be applied to surfaces which are dry, free from dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings, and other foreign Materials. Any structurally unsound surfaces, weak sections or spalled areas shall be repaired before applying any sealer.

Concrete surfaces shall be air dried for at least five Days after completion of required curing. Any cavities which require grout filling and curing shall be air dried for five Days. Sealer shall not be applied until the air drying is complete. Accelerated cured precast concrete shall be sealed after it has attained the required twenty-eight Day strength and after any cavities which require grout filling have been filled, cured, and air-dried for five Days.

(e) Surface Preparation. Dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings, and other foreign Materials shall be removed from surfaces to be sealed. If removal requires chemicals or other cleaning compounds, only products approved by the sealer manufacturer shall be used. Documentation of the sealer manufacturer's approval shall be furnished to the Engineer. The sealer shall be applied within forty-eight hours of surface preparation.

Suitable traps, filters, drip pans, and other separation devices shall be installed in the cleaning Equipment so oil and other foreign material isn't deposited on the surface.

The following cleaning methods shall be used depending on the surface type:

(1) New water cured exposed concrete surfaces.
    (a) Water blast at 7,000 pounds per square inch minimum
(2) Exposed surfaces of new prestressed concrete box beams.
    (a) Clean with high pressure hot water or steam jenny, or
    (b) Water blast at 7,000 pounds per square inch minimum, or

(c) Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surfaces and opened pores.

(3) Existing concrete surfaces.

(a) Water blast at 7,000 pounds per square inch minimum, or

(b) Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores.

(f) Application and Coverage. If rain is anticipated within two hours after application, sealer shall not be applied. If not continuous, clearly mark where the sealer application stops.

(1) Epoxy - Urethane sealers.

(a) Each coat of the Epoxy-urethane sealer shall be applied at the coverage rate specified in the Plans. If no application rate is listed, each coat shall be applied at 120 square feet per gallon or per manufacturer's recommendations.

(b) Sealer shall only be applied when the surface temperature is 50°F or above.

(c) Sealer shall be applied with a brush, squeegee, roller. or spraying Equipment and as recommended by the manufacturer.

(d) One coat of epoxy and one coat of the urethane top coat shall be applied. Time between coats shall meet the manufacturer's recommendation. Epoxy and urethane shall be used from the same manufacturer. Specified coverage shall be achieved regardless of the number of passes per coat.

(e) 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.

(f) Sags and runs are not acceptable in the sealer.

(g) For sealed Sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, 1-1/2 pounds per square yard of silica sand shall be integrated into the surface of the second coat to produce a non-skid surface satisfactory to the Engineer.

(2) Non-epoxy sealer.

(a) The sealer shall be applied according to the manufacturer's recommended mode of application and under the observation of the Engineer.

(b) Coverage.

(i) Surfaces subject to abrasive wear (Bridge decks, Bridge deck Shoulders, and Sidewalks); Minimum, 1 gallon of sealer for each 100 square feet;

(ii) Curbs, vertical surfaces of beams and deck slabs subject to direct Roadway drainage; Minimum, 1 gallon for each 125 square feet;

(iii) Other surfaces (for example, parapets, abutments, pier caps, and median dividers); Minimum, 1 gallon for each 150 square feet.

(c) Sealer shall be applied 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. If recommended by the manufacturer, the sealer shall be broomed in.

(d) Vertical surface sealer spraying will create runs. If coverage rate is not achieved with first pass, additional passes shall be applied in ten to fifteen minutes. If recommended by the manufacturer, sealers shall be applied with a brush or roller.

(e) On smooth finished or dense concretes where the required coverage is not absorbed, excess material shall be squeegeed off after ten to fifteen minutes.

(f) For sealed Sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, 1 1/2 pounds per square yard of silica sand shall be integrated into the sealer application to produce a non-skid surface satisfactory to the Engineer.

(g) Clear non-epoxy sealers shall be tinted with a vanishing dye that will not damage the concrete.

(h) If the ambient temperature is below 40°F or will fall below 32°F within twelve hours after application, the sealer shall not be applied.

(g) Test Site/Application. Sealer shall be applied to measured coverage areas, both on horizontal and vertical surfaces, and on different concrete types, demonstrating:

(1) The Project's visual effects for the epoxy/urethane sealer application at the required coverage rate.

(2) Visually, the absorption necessary to achieve the specified coverage rate for the non-epoxy sealer. At least 1/2 gallon of sealer shall be used, following the manufacturer's recommended method of application, for the total of the test surfaces.

(3) To ensure that different textures are tested, sealer shall be applied to the deck, curb, or Sidewalk for the horizontal test surface and to an abutment, parapet, or pier face for the vertical test surface.

(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. Traffic shall be allowed on deck Shoulder areas after twelve hours of drying time for an epoxy/urethane sealer. Traffic shall be kept off of non-epoxy sealers until the sealer appears totally dry.

(j) Safety Precautions. Precautions defined on the manufacturer's MSDS shall be followed. A copy of the MSDS shall be provided to the Engineer before any Work commences.

(k) Protection of Adjoining Surfaces and the Public. The public shall be protected 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, surfaces not being sealed shall be masked off or protected by other means. Asphalt and mastic type surfaces shall be protected from spillage and heavy over spray. Sealers shall not be applied 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 forty-eight hours after the sealer has been applied. Nearby steel, aluminum, or glass surfaces shall be protected when non-epoxy over spray could be deposited on those surfaces.

(l) Environmental Requirements. Plants and vegetation shall be protected from over spray by covering with drop cloths.

512.04 Sealing Cracks by Epoxy Injection. This specification covers the repair of dry, moist or wet cracks or fractures that are 2 to 100 mils 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 pounds per square inch 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.

The Contractor shall arrange to have a manufacturer's representative at the job site to familiarize the Contractor 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.

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, shall be furnished to the Engineer. The Contractor shall 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.

Concrete surfaces shall be cleaned 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. The use of solvents or thinners shall not be permitted in cracks or on bonding surfaces.

Injection ports or tees shall be installed in cracks to be injected. Injection ports or tees shall be spaced at 6 to 12 inches vertically and 6 to 18 inches 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. Ports or tees shall be set in dust free holes made either with vacuum drills or chipping hammers. After injection ports or tees have been inserted into the holes, all surface cracks in the area to be repaired shall be sealed with paste epoxy between ports to ensure retention of the pressure injected epoxy within the confines of the member. The application of paste epoxy shall be limited to clean and dry surfaces. Substrate temperatures shall be limited to not less than 45°F during epoxy applications.

The epoxy injection shall begin 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.

Injection procedures and the depths and spacing of holes at injection ports or tees shall be established prior to beginning injection. Epoxy with flow characteristics and injection pressures shall be used that ensure no further damage will be done to the member being repaired. The Contractor shall 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.

The injection ports or tees shall be removed flush with the concrete surface after the fractured area has been filled and the epoxy has partially cured (twenty-four hours at ambient temperature not less than 60°F, otherwise not less than forty-eight hours). The surfaces of the repaired areas shall be roughened to achieve uniform surface texture. Any injection epoxy runs or spills shall be removed from concrete surfaces.

Two 4 inch diameter core samples shall be obtained in the first 100 linear feet of crack repaired and one core for each 100 linear feet thereafter. The core samples shall be taken 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. The core holes in the concrete shall be repaired with material specified in 705.21.

512.05 Waterproofing

(a) General Bituminous Materials shall be applied with brushes or spray Equipment, care being taken to secure an even and uniform coating. Spraying Equipment for applying asphalt Materials, shall be of the portable power pressure type, that can be handled and moved to the direct location of the waterproofing operation. Concrete surfaces not covered with waterproofing shall be protected from the bituminous Materials.

The edge of any exposed application shall be sharply defined true to line and with a uniform exposure.

(b) Preparation of Surface Surfaces to be waterproofed, shall have all projections dressed off, and the outside film of cement, together with all dirt, removed with wire brushes and clear water. The concrete shall be clean and dry and the temperature of the concrete shall be not less than 40°F when the bituminous Materials are applied.

Surfaces for Type 2 membrane shall be clean, dry, and free of protrusions. Dirt and dust shall be swept off and the surface blown clean. All joints or cracks greater than 3/8 inch wide shall be filled with Portland cement mortar. In addition, surfaces for Type 3 membranes shall have all oil or grease deposits removed by using water and a detergent designed to remove oil and grease from concrete. Any residual detergent shall be thoroughly flushed from the surface. No traffic shall be permitted on the cleaned surface prior to installation of the membrane.

(c) Primer Coat All surfaces to be waterproofed shall be clean and dry when the primer coat, using 0.10 to 0.15 gallon of bituminous material per square yard, is applied.

For primer coats applied between June 1 and September 1, the bituminous material shall be asphalt primer for waterproofing or emulsified asphalt primer conforming to 512.02.

For primer coats applied between September 1 and June 1, the bituminous material shall be asphalt primer for waterproofing conforming to 512.02.

When asphalt emulsion is used as a primer coat it shall preferably be applied with spray Equipment.

The primer coat shall be sanded to protect it when subjected to traffic. Any excess sand shall be broomed off before waterproofing asphalt is applied.

(d) Type A Waterproofing This type of waterproofing consists, in addition to the primer coat, of applying not less than two coats of bituminous material 702.06 using a total of not less than 1 gallon of asphalt per square yard on flat areas and not less than 1/2 gallon on vertical or sloping surfaces. The application shall begin at the lowest point and progress to a higher elevation. The surface shall be uniformly covered at all points except that in corners and over construction joints a greater amount of asphalt shall be used. The bituminous material shall be applied at a temperature of not less than 250°F or more than 350°F.

(e) Type B Waterproofing This type of waterproofing consists in addition to the primer coat, of three coats of bituminous material 702.06 and two layers of waterproofing fabric 711.24, using asphalt saturated fabric with asphalt applied as follows:

(1) On the cleaned dry and well primed surface there shall be applied a thorough coating of asphalt at temperature of not less than 250°F, nor more than 350°F, using not less then 1/3 gallon per square yard of surface.

(2) Into this, while hot enough that the bitumen will penetrate the fabric, the fabric shall be laid according to the following procedure:

(a) Surfaces wider than normal fabric strip. Where the surface to be covered is of a width greater than the width of normal fabric strip, there shall first be laid a half-width (normally 18 inches) of fabric. The second strip shall be full width and shall lap the entire width of the first strip. Each succeeding strip shall lap 2 inches more than half its full width. The fabric strips shall be lapped in the direction of flow of water.

(b) Surfaces with same width as fabric. Where the surface to be covered is of the same width as the fabric strip, the first strip laid shall be full width and the second strip also full width, covering the first. Each strip shall be laid without wrinkles, folds or pockets, and shall be given a thorough coating for the full width of the lap before the succeeding strip is laid.

(3) The final application shall provide a thorough covering for the fabric.

(4) Each application shall be complete and entirely conceal the texture of the fabric. Not less than a total of 1 gallon of bituminous waterproofing material per square yard shall be used for the three coats. End laps shall break joints with each other and shall provide a lap of at least 12 inches.

(f) Type D Waterproofing This type of waterproofing consists of a primer coat, one ply of waterproofing fabric 711.24 over joints, three coats of bituminous material 702.06 and two shingled plies of asphalt saturated waterproofing fabric 711.24.

The surface to be waterproofed shall be primed and allowed to dry. Joints and irregularities in the surface shall be filled with asphalt cement 702.01 (AC-20). A ply of fabric shall be laid to extend at least 9 inches on each side of all joints; the underside of this ply shall remain unbonded to the concrete surface.

The asphalt shall be applied at a temperature not less than 250°F, and not more than 350°F, and the texture of each layer of fabric shall be entirely concealed by the asphalt, however, not less than 1/3 gallon of asphalt per square yard of surface shall be used for each application. The application of the asphalt and placement of the fabric shall begin at the low side or sides of the surface and shall proceed toward the apex or high side so that water will run over and not against or along the laps of the fabric. Fabric shall be laid without wrinkles, folds or pockets. Ends of fabric strips shall be lapped 12 inches minimum and these joints shall be staggered.

The asphalt first shall be applied by mopping a surface slightly wider than half the width of the fabric strip; a half width strip of the fabric shall be laid into it immediately. This strip and an adjacent surface slightly wider than half the width of the fabric shall then be mopped with asphalt and covered with a full width of fabric. The first placed strip shall be entirely covered by the second placed strip. The second half of this second strip and an adjacent concrete surface shall then be mopped and a third strip of fabric placed to lap the first strip not less than 2 inches. This process shall be continued until the entire surface is covered; each strip of fabric lapping at least 2 inches over the next to last strip already placed and terminate with a partial width strip as required. The entire surface shall then be given a final mopping of asphalt.

(g) Type 2 Membrane Waterproofing This type of waterproofing consists of a rubberized asphalt, peel-and-stick waterproofing membrane 711.25. When the ambient temperature is below 50°F, a manufacturer recommended primer coat shall be used for vertical surface application. After installation of the primer coat, if required, the membrane's release liner shall be removed and the adhesive side placed on the prepared concrete surface. Lay the membrane smooth and free of winkles. Lap joints in membranes should be a minimum of 1 inch wide. Membrane Materials shall be stored indoors at temperatures not to exceed 120°F.

For precast concrete three and four sided Structures, the Contractor shall install Type 2 membrane on the exterior vertical and exterior to horizontal surface.

(h) Type 3 Membrane Waterproofing This type of waterproofing consists of a primer coat 705.04 and a waterproofing membrane consisting of high density asphalt mastic sandwiched between two layers of polymer fabric, 711.29.

The Contractor shall heat the membrane primer in an oil primer heated, double jacked kettle. The kettle shall be essentially clean and free of other Materials with any obvious buildup scraped out. A single jacked kettle may only be used if the primer is capable of being heated to application temperature in direct fire. Heating of primers must stay within the manufacturer's recommendations.

On Bridges with curbs, the Contractor shall apply the primer and membrane 3 inches up the curb face. On prestressed box beam Bridges with no approach slab, the primer and membrane shall be applied 6 inches over the ends of the beams. On prestressed and slab Bridges with approach slabs, the primer shall be applied 2 feet 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, the membrane and primer shall overlay the vertical exterior sides of the Structure by 12 inches.

The Contractor shall apply a uniform coat of primer at a rate of 0.5 gallons per square yard. The primer shall be applied no further than 5 feet in front of the membrane. The membrane shall be applied from the low to the high side of the membrane. An extra bead of primer shall be applied at the edge of the membrane. Lap joints in membranes shall be a minimum of 3 inches. After completing installation of the membrane over the entire surface, all joints in the membrane shall be sealed by applying primer and smoothing with a V squeegee.

Membrane and primer Materials shall be kept dry before installation.

512.06 Method of Measurement. The quantity of the sealing of concrete surfaces shall be lump sum or the actual area in square yards of surface treated.

The quantity of crack repair by epoxy injection shall be lump sum or the actual length in linear feet of cracks sealed.

The quantity of waterproofing shall be lump sum or the number of square yards of the specified type.

512.07 Basis of Payment. Payment will be made at Contract prices for each of the pay items listed. The cost for the obtaining and repairing the two cores used by the Engineer to determine the extent of the epoxy penetration shall be considered as incidental to the Work of repairing the concrete by epoxy injection.

Item	Unit	Description
512	Lump Sum or Square yard	Sealing of concrete surfaces
512	Lump Sum or Square yard	Sealing of concrete surfaces (epoxy urethane)
512	Lump Sum or Square yard	Sealing of concrete surfaces (non-epoxy)
512	Lump Sum or Linear feet	Concrete repair by epoxy injection
512	Lump sum or Square yard	Type A waterproofing
512	Lump sum or Square yard	Type B waterproofing
512	Lump sum or Square yard	Type D waterproofing
512	Lump sum or Square yard	Type 2 waterproofing
512	Lump sum or Square yard	Type 3 waterproofing

ITEM 514 PAINTING OF STRUCTURAL STEEL

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514.01 Description. This item shall consist of cleaning and painting all steel surfaces.

514.02 Materials. A three coat paint system consisting of an organic zinc prime coat, an epoxy intermediate coat, and a urethane finish coat shall be applied on existing steel. The coating system shall conform to 708.01.

A three coat paint system consisting of an inorganic zinc prime coat, an epoxy intermediate coat, and a urethane finish coat shall be applied on new steel. The prime coat shall conform to 708.17, and the intermediate and finish coats shall conform to 708.01. The intermediate and finish coats shall be supplied from the same manufacturer. The Contractor may supply the prime coat from a manufacturer other than the manufacturer of the intermediate and finish coats.

For caulking, a two component, non-sag, non-shrink one hundred percent solids epoxy capable of filling voids up to 1 inch wide shall be used.

514.03 Superintendent. A Superintendent shall be provided on the project at all times, irrespective of the amount of subcontract Work. The Superintendent must be capable of reading and understanding the contract documents and experienced in the type of Work being performed. The Superintendent shall receive instructions from the Engineer. The Superintendent shall promptly execute the Engineer's orders or directions and promptly supply the required Materials, Equipment, tools, labor, and incidentals. In addition, the Superintendent must successfully complete a Bridge Painting pre-qualification course and training offered by the Ohio Department of Transportation. The course must have been completed within the past four years and an individual course certificate must have been received by the Superintendent. Certificate shall be presented to the Engineer prior to commencing Work. No Work is permitted unless the Superintendent provides a valid course certificate.

514.04 Quality Control. Quality control consists of designating quality control specialists to control the quality of Work in each phase established by Quality Control Points (QCPs). Quality shall be controlled by inspection, tests, and cooperation with inspection and testing performed by the Engineer and Inspector.

(a) Quality Control Specialist. The individuals dedicated to performing duties as the painting quality control specialists shall be identified before starting Work in the field. A quality control specialist shall be provided for each Structure, but one quality control specialist must be provided for every three Structures for which Work is progressing concurrently on this Contract.

Each quality control specialist must be either a NACE (National Association of Corrosion Engineers) certified coating Inspector or a SSPC (The Society for Protective Coatings, SSPC) protective coating specialist or formally trained or retrained by a NACE certified coating Inspector or a SSPC protective coating specialist. The training shall be adequate to ensure that the quality control specialist is able to use all the testing Equipment and understands the requirements of this specification. A copy of the NACE or SSPC certification or a copy of the trainer's NACE or SSPC certification and a letter or certificate signed and dated by the trainer shall be provided to the Engineer. The Contractor shall ensure that the NACE or SSPC certification is current or retrain the quality control specialist every five years in accordance with the above requirements.

The quality control specialist must successfully complete a Bridge Painting prequalification course offered by the Ohio Department of Transportation. The training course must have been completed within the past four years and an individual course certificate must have been received by the quality control specialist.
All required certificates, letters of certification, and valid identification shall be presented to the Engineer prior to commencing Work.

The quality control specialist will be immediately removed from the Work and disqualified from future Work if any quality control failure occurs. A quality control failure shall be defined as any of the following:

(1) The dry film thickness has been approved by the quality control specialist and it is later found that over twenty percent of the spot measurements of any one member of a Structure, such as a cross frame, web, flange, stiffener, or other parts of the Structure are either under the minimum or over the maximum spot thickness.
(2) The dry film thickness has been approved by the quality control specialist and it is later found that the thicknesses of any area of a Structure as described in 514.20 are either under the minimum or over the maximum specification thickness.
(3) Two separate occurrences when the surface preparation has been approved by the quality control specialist of any one member type, such as the cross frames, webs, flanges, stiffeners, or other parts of the Structure and it is later found that the surfaces of those members were either not properly profiled or not properly cleaned as required by the contract documents. Occurrences are determined per Structure.
(4) Two separate occurrences of the quality control specialist performing production duties not allowed by the contract documents. Occurrences are determined per Structure.
(5) Two separate occurrences when the quality control specialist fails to perform any one of the duties assigned to the quality control specialist in the contract documents. Occurrences are determined per Structure.

Work shall be suspended if the quality control specialist is not available or has been removed. Work shall be resumed when a quality control specialist, qualified and approved as provided in 514.04, is available.

For Work in the fabrication shop, each Fabricator shall identify one or more full-time individuals who shall perform the duties of the painting quality control specialist.

The quality control specialist may not be used to perform production duties including supervision, blasting, painting, waste disposal, mixing, operating or repairing Equipment, or other tasks not associated with

duties of the quality control specialist while the Contractor is performing Work toward the completion of a Quality Control Point.

The Contractor shall ensure that each quality control specialist is trained and equipped with MSDS, product data sheets, tools, and Equipment necessary to provide quality control on all aspects of the Work. Each quality control specialist shall have a thorough understanding of the Plans for the Work, including any pertinent Addenda, Change Order, or other Contract Documents, and these Specifications. Duties each quality control specialist shall perform include:

(1) Inspect Equipment and abrasive at specified intervals.
(2) Approve the Work and provide documentation that the Work has been approved immediately before each QCP.
(3) Inspect the Work with the Engineer at each QCP.
(4) Verify the Contractor or Fabricator performed Work according to the contract documents.
(5) Cooperate with the inspection and testing performed by the Engineer.
(6) Document test results and compare test results with the Engineer's test results.
(7) Notify Superintendent of nonconforming Work.
(8) Stop Work when test Equipment is not available and when necessary to ensure the Work is performed according to the contract.

The Fabricator's quality control specialists shall provide the Engineer with a letter that includes specified information or check point data documenting acceptance of the Work and consisting of the following:

(1) Checks on the abrasive to ensure that it has not been contaminated with oil.
(2) The profile of the blasted surface.
(3) The air and steel temperature and dew point before blast cleaning and painting and at four hour intervals during the blasting and painting operation.
(4) Readings of the actual dry film thickness.
(5) The lot and stock number of the paint and the date of manufacture.
(6) TE-24 for the coating used in the shop.
(7) Documentation that the paint mixer is functioning properly, that each spray operator has demonstrated the ability to paint, and that all spray Equipment is used as per the manufacturer's recommendation.

(b) Quality Control Points (QCP). QCPs are points in time when one phase of the Work is complete and approved by the quality control

specialist and ready for inspection by the Engineer before commencing the next phase of the Work. At a QCP, the quality control specialist shall provide quality control tests bearing his signature to the Engineer. The Contractor or Fabricator shall provide the Engineer access to inspect all affected surfaces. If inspection identifies a deficiency, correct the deficiency according to the contract documents before starting the next phase of Work. Discovery of Defective Work or material after a Quality Control Point is past or failure of the final product before Final Acceptance, shall not, in any way, prevent the City from rejecting the final product or obligate the City to Final Acceptance. Final Acceptance will be determined as per 514.21

Quality Control Point		Purpose	New Steel	Existing Steel
1.	Solvent cleaning	Remove asphalt cement, oil, grease, etc.	Yes	Yes
2.	Grinding flange	Remove sharp corners edges	Yes	Yes
3.	Abrasive blasting	Blast surfaces to receive paint	Yes	Yes
4.	Containment/waste disposal	Contain, collect, & dispose of water blasting debris	No	Yes
5.	Prime coat application	Check surface cleanliness, apply prime coat, checking coating thickness	Yes	Yes
6.	Remove fins, tears, & slivers	Remove surface defects and slivers	Yes	Yes
7.	Washing of shop primer	Remove all water soluble Materials (salt, dirt, etc.)	Yes	No
8	Intermediate coat application	Check surface cleanliness, apply intermediate coat, check coating thickness	Yes	Yes
9.	Caulking	Caulk areas not sealed by the intermediate coat	Yes	Yes
10.	Finish coat application	Check surface cleanliness, apply intermediate coat, check coating thickness	Yes	Yes
11.	Final Review	Acceptance and check total system thickness	Yes	Yes

514.05 Testing Equipment. For the Project duration, the Engineer shall be provided with the test Equipment listed below for the type of Work at each Work site with ongoing Work. With the exception of the recording thermometer, the Fabricator shall provide its quality control specialists with the test Equipment listed below. The Contractor and Fabricator shall maintain all testing Equipment in good working order. When no test Equipment is available, no Work shall be performed.

(a) Film and a camera with the following features:

(1) Uses self developing color print film.
(2) Lens with auto focus system.

(3) Focuses from 2 feet to infinity.
(4) Built-in fill flash.

Or provide a digital camera with the following features:

(1) 5.0 Megapixel or greater resolution.
(2) Minimum 3X Optical zoom lens capability with automatic focus.
(3) Minimum 512M Memory capability.
(4) Built-in flash.
(5) Photograph printer with docking capability compatible with the camera including supplies necessary to print. (i.e. ink cartridges, photograph quality paper, and other consumables required for operation and photograph printing).

(b) One spring micrometer and extra-coarse replica tape on the Project at all times.

(c) One SSPC-PA2 Type 2 (electronic) non-destructive coating thickness gage and two sets of National Institute of Standards & Technology calibration plates. The first set of calibration plates shall be 1.5 to eight mils, Model No. 1362b, and the second set shall be 10 to 25 mils, Model No. 1363b.

(d) One Sling Psychrometer including Psychometric tables.

(e) Two steel surface thermometers accurate within 2°F.

(f) Flashlight 2 D cell.

(g) SSPC Visual Standard for Abrasive Blast Cleaned Steel (SSPC-VIS 1).

(h) One recording thermometer capable of recording the date, time, and temperature over a period of at least twelve hours.

514.06 Work Limitations. The prime coat shall be applied to new structural steel inside permanent buildings at the Fabricator's facility. If inside permanent buildings, the Fabricator may perform year-round abrasive blasting and painting. In the field, abrasive blasting and painting shall be performed from April 1 to October 31. The City will not issue a time extension due to adverse weather during the month of April. The Plans or other Contract Documents may require additional Work limitations for specific Bridges or Projects.

(a) Temperature. Except for inorganic zinc, paint shall be applied when the steel, air, and paint temperature is 50°F or higher and expected to remain higher than 50°F for the cure times listed below. Inorganic zinc shall be applied when the steel, air, and paint is 40°F or higher. Inorganic zinc shall be cured according to the minimum curing time and temperatures specified in the paint manufacture's printed instructions.

	50°F	60°F	70°F
Primer (organic zinc)	4 hrs	3 hrs	2 hrs
Intermediate	6 hrs	5 hrs	4 hrs
Finish	8 hrs	6 hrs	4 hrs

The temperatures listed above shall be monitored for cure times using the recording thermometer. The Contractor may use a heated enclosure or building. Heat shall be applied continuously and uniformly to maintain the required minimum curing temperature within the enclosure or building until the coating has cured.

If combustion type heating units are used, the units shall be vented away from the enclosure or building and shall not allow exhaust fumes to enter the enclosure or building. Open combustion shall not be used in the enclosure or building.

The Fabricator may use radiant heat when painting new structural steel inside permanent shop buildings. Radiant heaters shall be located at least 10 feet above all surfaces to be painted. Exhaust fumes shall be vented to prevent fumes from contacting surfaces to be painted.

(b) Moisture. Paint shall not be applied:

(1) If the steel surface temperature is less than 5°F above the dew point.
(2) If the steel surface is wet, damp, frosted, or ice-coated.
(3) If the relative humidity is greater than eighty-five percent.
(4) During periods of rain, fog, or mist unless the above moisture criteria is met.

If steel was abrasive blasted when the temperature of the steel was less than 5°F above the dew point, the steel shall be reblasted when the steel temperature is at least 5°F above the dew point.

514.07 Protection of Persons and Property. All rubbish, buckets, rags, or other discarded Materials shall be collected, removed, and disposed of, and the job site shall be left in a clean condition.

Except for deck bottoms and backwalls which have not been sealed or are not to have a sealer applied, all portions of the Structure that are not to be painted shall be protected from damage or disfigurement by splashes, spatters, and smirches of paint.

If the Contractor causes any damage or injury to public or private property, the Contractor shall restore the property, to a condition similar Or Equal to the condition existing before the damage or injury.

514.08 Pollution Control. The Contractor shall comply with pollution control laws, rules, or regulations of Federal, State, or local agencies and requirements of this specification.

514.09 Safety Requirements and Precautions. The Contractor shall comply with the applicable safety requirements of the Ohio Industrial Commission and OSHA.

Material Safety Data Sheets shall be provided at the preconstruction meeting for all paints, thinners, and abrasives used on this Project. Work shall not begin until the MSDS have been submitted to the Engineer.

514.10 Inspection Access. In addition to the requirements of 106.01, scaffolding and other appropriate Equipment shall be furnished, erected, and moved to allow the Engineer the opportunity to closely observe all affected surfaces during all phases of the Work and for at least ten Days after completely painting each Structure to allow for the Final Inspection as per 514.21. Complete details of the inspection access that complies with the applicable safety requirements of The Ohio Industrial Commission and OSHA shall be submitted to the Engineer for information. The details shall be reviewed, signed, stamped and dated by an Ohio registered Professional Engineer certifying that they meet these requirements. The in-place inspection access Equipment employed during original painting activities shall be maintained, or alternate inspection Equipment such as platform lifts, bucket trucks, snooper trucks, or equivalent as approved by the Engineer shall be provided. If scaffolding, or any hanger attached to the scaffolding, is supported by horizontal wire ropes, or if scaffolding is directly under the surface to be painted, it shall comply with the following requirements:

(a) If scaffolding is suspended 43 inches or more below the surface to be painted, two guardrails shall be placed on all sides of the scaffolding. One guardrail shall be placed at 42 inches above the scaffolding and the other guardrail at 20 inches above the scaffolding.

(b) If scaffolding is suspended at least 21 inches but less than 43 inches below the surface to be painted, one guardrail shall be placed on all sides of the scaffolding at 20 inches above the scaffolding.

(c) If 514.10(a) and 514.10(b) do not apply, two guardrails shall be placed on all sides of scaffolding. One guardrail shall be placed at 42 inches above the scaffolding and the other guardrail at 20 inches above scaffolding.

(d) Scaffolding shall be provided at least 24 inches wide if guardrail is used and 28 inches wide if guardrail is not used and scaffolding is suspended less than 21 inches below the surface to be painted. If using two or more parallel scaffolding to achieve the proper width, the scaffolding shall be rigidly attached together to prevent differential movement.

(e) Guardrail shall be constructed as a substantial barrier, securely fastened in place and free from protruding objects such as nails, screws, and bolts. A properly located opening shall be provided in the guardrail to allow the Engineer access onto the scaffolding.

(f) Guardrails and uprights shall be constructed of metal pipe, steel angles, or wood. If using pipe railing, pipe with a nominal diameter of at least 1 1/2 inches shall be provided. If using steel angle railing, $2 \times 2 \times$ 3/8 inch steel angles or other metal shapes of equal or greater strength shall be provided. If using wood railing, 2×4 inch nominal stock shall be provided. Uprights shall be placed no more than 8 feet on center. If using wood uprights, 2×4 inch nominal stock shall be provided.

(g) If the surface to be inspected is more than 15 feet above the ground or water and the scaffolding is supported from the Structure being painted, a safety harness (not a safety belt) and lifeline shall be provided for the Engineer. The lifeline shall not allow a fall greater than 6 feet. A method to attach the lifeline to the Structure that is independent of the scaffolding, cables, and brackets supporting the scaffolding shall be provided.

(h) If scaffolding is more than 2.5 feet above the ground, an access ladder and Equipment to attach the ladder onto the scaffolding capable of supporting 250 pounds with a safety factor of at least four shall be provided. Rungs, steps, cleats, and treads shall be uniformly spaced no more than 12 inches on center. At least one side rail shall be extended at least 36 inches above the landing near the top of the ladder.

(i) If the distance from the ladder to the access point on the scaffolding exceeds 12 inches, an additional landing that is capable of supporting a minimum of 1,000 pounds and at least 24 inches wide and 24 inches

long shall be provided. The landing shall be sized and shaped so that the distance from the landing to the point where the scaffolding is accessed does not exceed 12 inches. The landing shall be firmly attached to the ladder; however, the ladder shall not be used to support the landing.

(j) In addition to the scaffolding requirements above, the Contractor shall comply with all Federal, State, and local laws, ordinances, regulations, orders, and decrees.

(k) All necessary traffic control shall be furnished to allow inspection during and after all phases of the Project.

514.11 Job Site Visual Standards. Before starting abrasive blasting, job site visual standards shall be established by preparing a test section, subsequent test sections, and by using photographs of approved test sections. Job site visual standards and SSPC-VIS 1 standard shall be used for blasting. The Contractor or Fabricator shall prepare an approximately 20 to 30 square foot test section from a representative area on the first Structure to be painted. After the Engineer and the Contractor or Fabricator have agreed the test area was blast cleaned to the requirements of the Contract Documents, the test section shall be photographed, and the steel surface shall be checked for the proper profile. After the Engineer has approved the test section and the job site visual standards are documented by photographs and replica tape, the Contractor or Fabricator may start abrasive blasting. The quality control specialists and Engineer shall use the job site visual standards (photographs), Plans, Specifications, and requirements to determine acceptance of blast cleaning procedures. In all cases of dispute, the SSPC-VIS 1 standard shall govern. If the Contractor, Engineer, or Fabricator believes the initial test section does not establish the proper visual standard for a different Structure, another test section on the different Structure may be performed.

514.12 Quality Control Point Photographic Verification and Documentation. The Engineer or Inspector shall take a sufficient number of photographs to document the condition of the Work at Quality Control Points 3, 4 and 11.

514.13 Surface Preparation.

(a) Solvent Cleaning (QCP #1). Areas containing oil, grease, asphalt cement, diesel fuel deposits, or other petroleum products shall be cleaned per SSPC-SP 1 with a solvent.

(b) Grinding Flange Edges (QCP #2). Before abrasive blasting, all exposed bottom flange edges of all beams shall be rounded to a radius of 1/8 ± 1/16 inch. This Work has no weather and temperature restrictions.

(c) Abrasive Blasting (QCP #3). Areas that contain asphalt cement, oil, grease, or diesel fuel deposits shall not receive abrasive blasting. Before abrasive blasting, all dirt, sand, bird nests, bird droppings, and other debris shall be completely removed from the scuppers, bulb angles, and pier and abutment seats.

All steel to be painted shall receive abrasive blasting according to SSPC-SP 10 and as shown on the pictorial surface preparation standards for painting steel surfaces shown in SSPC-VIS 1. Steel shall be maintained in a blast cleaned condition until it has received a prime coat of paint. The Contractor may commercial blast clean the back side of end cross frame assemblies that are 3 inches or closer to backwalls according to SSPC-SP 6.

Galvanized and metalized steel (including corrugated steel Bridge flooring), adjacent concrete already or specified to be coated or sealed, and other surfaces not intended to be painted shall be covered and protected from damage caused by blasting and painting operations. Adjacent coatings damaged during the blasting operation shall be repaired. Backwalls and bottoms of decks not sealed nor specified to be sealed do not need to be covered and protected.

For field blasting, a recyclable steel grit shall be used. For shop blasting, an abrasive that produces an angular profile shall be used. All abrasives shall provide a profile from 1.5 to 3.5 mils as determined by replica tape according to ASTM D4417, Method C. The abrasive shall be cleaned of paint, chips, rust, mill scale, and other foreign material after each use and before each reuse. Equipment specifically designed for cleaning the abrasive shall be used.

Abrasives used at the job site or fabrication shop shall be checked for oil contamination at the beginning of each shift and at four hour intervals. Also each load of abrasives delivered to the job site or fabrication shop shall be checked for oil contamination before use. Oil shall be checked for by placing a small sample of abrasives and tap water into a jar. If an oil film is detected on the water surface, the abrasive shall be rejected.

To ensure that the compressed air is not contaminated, the quality control specialists shall blow air from the nozzle for thirty seconds onto a white cloth or blotter held in a rigid frame. If the cloth or blotter retains oil or other contaminants, abrasive blasting shall be suspended until

retests verify the problem was corrected. This test shall be performed at the start of each shift and at four hour intervals.

The Contractor may simultaneously abrasive blast and paint the same Bridge provided the abrasive blasting debris and dust does not contact freshly painted surfaces and does not contaminate paint during the curing period. For shop blasting, the Fabricator may simultaneously abrasive blast and paint if the two operations are separated by distance or containment that prevents paint contamination.

For surface preparation of new structural steel in the Fabricator's shop, the quality control specialist shall take replica tape readings as follows:

(1) For an automated blasting process, the greater of twenty percent of the main members or one member per shift shall be tested. These tests shall consist of taking five random readings per member.
(2) For a manual blasting process, each main member shall be tested. The test of a main member shall consist of taking five readings at random locations.
(3) For both an automated and manual blasting process, fifteen percent of all secondary members shall be tested. The test of a secondary member shall consist of taking one random reading.

Abrasives and residue shall be removed from all surfaces to be painted. All structural steel that was blast cleaned in the field or the Fabricator's shop shall be kept dust free. A prime coat shall be applied to steel that was blast cleaned in the field within twelve hours of the beginning of the abrasive blasting operation. A prime coat shall be applied to structural steel that was blast cleaned in the Fabricator's shop within twenty-four hours of the beginning of the abrasive blasting operation. If a prime coat is not applied within the times stated above, the steel shall be reblasted before applying the prime coat. All dust or abrasives shall be removed from adjacent Work and from the finish coat.

The Engineer shall be provided with field wash facilities and an adequate supply of running potable water, soap, and towels for washing face and hands during the surface preparation operation. The wastewater shall be properly contained, tested, and disposed of. A wash facility shall be located at each Bridge site and in an area that will not be contaminated by the blasting debris.

(d) Containment/Waste Disposal (QCP #4). Waste material generated by abrasive blasting operations in the field is a solid waste and may be a hazardous waste. The waste material shall be contained, collected, stored, evaluated, and properly disposed of. All Federal, State, and local environmental protection laws, regulations, and ordinances

including, but not limited to, air quality, waste containment, and waste removal shall be complied with. The Contractor shall be advised that various governmental bodies are involved with solid waste and hazardous waste disposal and the Contractor is responsible for complying with laws enforced by the various governmental bodies.

To prevent contamination of the pavement or soil, all Equipment shall be parked on ground covers free of cuts, tears, and holes.

Equipment shall be cleaned of spent abrasives or debris before bringing Equipment to the Project, moving Equipment from one Bridge site to another, and removing Equipment from the Project. Debris cleaned from Equipment shall be stored with the debris from the Structure that generated the debris.

An enclosure shall be erected to completely surround (around, under, and over the top on truss type Bridges) the blasting operations. The Contractor may use the ground as the bottom of the enclosure if the ground is completely covered with plastic or tarps.

The enclosure shall be constructed of flexible Materials such as tarpaulins (specifically designed for blasting containments), or the enclosure shall be constructed of rigid Materials such as plywood. All Materials shall be maintained free of tears, cuts, and holes. All seams shall overlap a minimum of 6 inches, and the seams shall be fastened together at 12 inch centers or in a manner that ensures a seal that does not allow openings between the edges of the containment material. The vertical sides of the enclosure shall be extended completely up to the bottom of the deck on a steel beam Bridge, and bulkheads shall be used between beams to enclose the blasting area.

All debris from blasting operations, Equipment, or filters, and all debris that fell to the ground shall be collected. The debris shall be stored in steel containers with lids that are locked at the end of each workday. The storage location shall be at the Bridge site unless the Engineer and Contractor agree on an alternate storage location. The debris for disposal shall be tested and evaluated. The location of centralized cleaning stations for recyclable steel shall also be agreed by the Engineer and the Contractor.

The services of a testing Laboratory shall be obtained to obtain directly from the Project site and evaluate a composite representative sample of the abrasive blasting debris for each Bridge site. The Person taking the sample shall be an employee of the testing Laboratory.

Composite sample shall be taken in the presence of the Engineer or Inspector, the requirements of U.S. EPA Publication SW 846 shall be

complied with, and individual samples shall be taken from all containers that are on the site at the time of the sampling. Individual samples of equal size shall be blended together to comprise one composite sample. One individual sample from each drum and four randomly spaced individual samples from each container other than drums shall be taken.

Individual samples shall be taken and placed into clean glass or plastic containers.

A chain of custody record (Chain of Custody) shall be prepared for all composite samples. The Chain of Custody shall include the name of the Person taking the sample, the name of the testing Laboratory for which the Person works, the date and time the sample was taken, the Bridge sampled, and the signatures and dates of all Persons in possession of the sample in the Chain of Custody.

The abrasive blasting debris shall be sampled within the first week of production blasting at each Bridge. If sampling is not performed within the first week of production blasting, all blasting and painting operations on the Bridge from which waste was generated shall be ceased.

Composite samples shall be tested for lead and chromium according to the U.S. EPA Publication SW 846. The Chain of Custody and test results shall be provided to the Engineer immediately after the test results are available. If the blasting debris is hazardous, as defined below, the Engineer shall be provided with the names of the hauler and treatment facility. All sampling and testing required shall be performed by the hauler, treatment facility, or disposal facility.

The existing paint removed from Bridges may contain lead or chromium. The Contractor shall be responsible for taking the proper safety precautions to ensure workers in this environment are properly protected.

(1) Hazardous Waste. The blasting debris shall be considered hazardous if the concentration of either lead or chromium exceeds 5.0 parts per million. All the containers of hazardous blasting debris shall be labeled “HAZARDOUS”. The storage location shall be secured by surrounding the site with a 5 foot high chain link fence fabric supported by traffic sign drive posts 10 feet apart. The traffic signposts shall be driven into the ground at least 2 feet deep. The fencing shall be secured with padlocks at the end of each Day. Hazardous waste warning signs shall be posted at obvious locations on the fenced enclosure.

The Contractor shall arrange for the hauling, treating, and disposing of the hazardous waste. A firm licensed by EPA to haul and

dispose of the hazardous waste shall be used. This firm shall also be responsible for providing the Uniform Hazardous Waste Manifest (EPA Form 8700-22A).

In every case, all hazardous waste shall be properly disposed of within sixty Days after it is generated. If hazardous waste is not properly disposed of within sixty Days, the City will consider the Contactor in breach of its Contract and the City will take the following actions:

(a) All abrasive blasting and painting of structural steel on the Project shall be immediately suspended until hazardous waste is properly disposed.

(b) All pay estimates shall be ceased.

(c) A breach of Contract notification shall be forwarded to the Contractor's Surety.

The Contractor shall be responsible for fines or liens assessed by any governmental agency that has jurisdiction over the disposal of this hazardous waste material.

All collection and containment Equipment shall be decontaminated or disposed of according to EPA guidelines.

(2) Non-Hazardous Solid Waste. The waste that the City determines to be non-hazardous shall be hauled to a facility licensed to accept non-hazardous solid waste and disposed of. Before disposing of any material, the Engineer shall be provided with documentation that the disposal facility is licensed by the EPA to accept non-hazardous solid waste. The Contractor shall obtain from the disposal facility and provide the Engineer with a receipt that documents disposal of waste material at the approved landfill.

514.14 Washing Shop Primer (QCP #7). Shop primed structural steel shall be washed after it is erected and the concrete deck is placed and within thirty Days of applying the intermediate coat.

The steel shall be washed with potable water. Equipment capable of delivering the water at a nozzle pressure of at least 1,000 pounds per square inch and at a rate of not less than 4 gallons per minute shall be used. The Contractor shall provide the Engineer with Equipment Specifications that verify both the delivery pressure and rate. Gauges on the Equipment shall be provided to verify the pressure during operation. The nozzle shall be held a maximum of 12 inches from the surface being washed. The surface shall be considered clean when clear rinse water runs off the Structure. After rinsing the surface, it shall be inspected for remaining dirt and dirty areas shall be rewashed until clean.

514.15 Handling. All paint and thinner shall be delivered in original unopened containers with labels intact. Containers with minor damage shall be accepted provided the container is not punctured. Thinner containers shall be a maximum of 5 gallons. Before use, the Engineer shall be provided with shipping invoices for all painting Materials used on the project.

Containers of paint and thinner shall be supplied with labels clearly marked by the manufacturer to show paint identification, component, color, lot number, stock number, date of manufacture, and information and warnings as may be required by Federal and State laws.

Paint shall be stored at the temperature recommended by the manufacturer and in a storage facility that prevents theft. Thermometers capable of monitoring the maximum high and low temperatures inside the storage facility shall be provided.

Before opening paint or thinner containers, the labels shall be checked to ensure the proper container is opened and the paint has not been stored beyond its shelf life. Paint that exceeded its shelf life shall not be used. Containers of paint and thinner shall not be opened until required for use and then the oldest paint of each kind shall be opened first. Solvent used for cleaning Equipment shall be exempt from the above requirements.

Paint that has livered, gelled, or otherwise deteriorated during storage shall not be used. The Contractor may use thixotropic Materials that can be stirred to the normal consistency. Unused paint and paint containers shall be properly disposed of.

514.16 Mixing and Thinning. All ingredients shall be thoroughly mixed immediately before use with a high shear mixer (such as a Jiffy Mixer). Paint shall not be mixed using paddle mixers, paint shakers, or an air stream bubbling under the paint surface. After mixing, the paint shall be carefully examined for uniformity and to ensure that no unmixed pigments remain on the bottom of the container. Before use, the paint shall be strained through strainers that remove skins or undesirable matter but not pigment.

Except for primer, paint shall be mixed as necessary during application to maintain a uniform composition. Primer shall be continuously mixed using an automated agitation system. Hand-held mixers shall not be used for primer paints.

Thinner shall not be added to the paint without the Engineer's approval, and thinner shall only be added if necessary for proper application as recommended by the manufacturer's printed instructions. In the Engineer's presence, the amount of thinner recommended and supplied by the manufacturer

shall be slowly added to the paint during the mixing process. Other additives shall not be mixed into the paint.

Catalysts, curing agents, or hardeners that are in separate packages shall be added to the base paint only after thoroughly mixing the base paint. With constant agitation, the proper volume of catalyst shall be slowly poured into the required volume of base. Liquid that has separated from the pigment shall not be poured off before mixing. The mixture shall be used within the pot life specified by the manufacturer and dispose of unused portions at the end of each workday.

514.17 Coating Application.

(a) General. All structural steel, scuppers, expansion joints except top surface, steel railing, exposed steel piling, drain troughs, and other areas as shown on the Plans shall be painted. Galvanized or metalized surfaces shall be painted if shown on the Plans. Unless otherwise shown on the Plans or specified below, paint shall be applied by brush, spray, or a combination of brush and spray methods. If brush and spray are not practical to paint places of difficult access, the Contractor may use daubers, small diameter rollers, or sheepskins.

Daubers, small diameter rollers, or sheepskins shall be used to paint the following areas:

(1) Where cross-frame angles are located within 2 inches of the bottom flange.
(2) Where end cross frames are within 6 inches of the backwall.
(3) Where there is less then 6 inches between the bottom of the bottom flange and the beam seat.

(b) Application Approval. The Engineer may inspect the initial application of the prime, intermediate, and final coats. If the Engineer discovers defects, the method of application shall be adjusted to eliminate the defects then application of the coat shall continue.

(c) Additional Information Pertaining to Shop Applied Primer. A prime coat shall be applied to all structural steel surfaces including insides of holes, behind stiffener clips and contact surfaces of connection, and splice material that is to be fastened with bolts in the shop or field. A mist coating from 0.5 to 1.5 mils shall be applied on surfaces that are to be imbedded in concrete and on surfaces within 2 inches of field welds other than those attaching intermediate or end cross frames to beams or girders. One coat of primer shall be applied to pins, pin holes, and contact surfaces of bearing assemblies, except those containing self-lubricating bronze inserts shall not be painted. Once the prime coat is

dry, erection marks shall be applied, using a thinned paint of a type and color that is completely concealed by, and compatible with, the second coat.

Structural steel coated with inorganic zinc primers from the shop shall not be handled or removed until the paint has cured as specified by the paint manufacturer's printed instructions.

The thickness of thick films of inorganic zinc primer shall be reduced by screening, sanding, or sweep blasting. If the primer paint cured longer than twenty-four hours, a re-coating of primer paint shall be applied according to the paint manufacturer's printed instructions. The Contractor shall abrasive blast and re-apply the primer to the affected area if "mud cracking" occurs. If "checking" occurs, the Contractor shall abrasive blast and reapply the primer or remove the "checking" by screening and evaluate the area by adhesion testing.

(d) Surface Cleanliness**.** All surfaces to be painted shall be free of dust, dirt, grease, oil, moisture, overspray, and other contaminants. If the surface is degraded or contaminated, restore the surface before applying paint. In order to prevent or minimize degradation or contamination of cleaned surfaces in the field, the prime coat of paint shall be applied within twelve hours of the beginning of the abrasive blasting operation as required in surface preparation above, for steel which is cleaned and painted in the shop, the prime coat of paint shall be applied within twenty-four hours of the beginning of the blasting operation.

Cleaning and painting shall be scheduled when dust or other contaminants will not fall on wet, newly painted surfaces. Surfaces that do not receive paint or have already been painted shall be protected from the effects of cleaning and painting operations. Before applying the next coat, overspray and bird droppings shall be removed with a stiff bristle brush, wire screen, or a water wash with sufficient pressure to remove overspray and bird droppings without damaging the paint. Before applying the next coat, all abrasives and residue from painted surfaces shall be removed with a vacuum system equipped with a brush type cleaning tool.

All visible abrasives on the finish coat that came from adjacent work shall be removed.

(e) Brush Application. The paint shall be applied to produce a smooth coat. The paint shall be worked into all crevices, corners, and around all bolt and rivet heads. Additional paint shall be applied as necessary to produce the required coating thickness.

(f) Spray Application (General). Paint shall be applied using spray application as follows:

Spray Equipment shall be kept clean so that dirt, dried paint, solvents, and other foreign Materials are not deposited in the paint film. Solvent left in the Equipment shall be removed before using the Equipment.

Paint shall be applied in a uniform layer with overlapping at the edges of the spray pattern. The border of the spray pattern shall be painted first, followed by the interior of the spray pattern. A spray pattern shall be completed before moving to the next spray pattern area. Within a spray pattern area, the gun shall be held perpendicular to the surface and at a distance that will ensure a wet layer of paint is deposited on the surface. The trigger of the gun shall be released at the end of each stroke. To ensure coverage, all bolts and rivet heads shall be sprayed from at least two directions or the paint shall be applied to bolts and rivet heads using a brush.

Each spray operator shall demonstrate to the Engineer or Inspector the ability to apply the paint as specified before the operator sprays paint.

If mud cracking occurs, the affected area shall be cleaned to bare metal in accordance with surface preparation above and repainted. All gaps and crevices 1/8 inch or less shall be filled with primer.

Spray Equipment recommended by the paint manufacturer and suitable for use with the specified paint shall be used. Adequately sized traps or separators shall be provided to remove oil and condensed water from the air. The traps shall be periodically drained during operations. To ensure that the traps or separators are working properly, the Contractor shall test by blowing air from the spray gun for thirty seconds onto a white cloth or blotter held in a rigid frame. The Engineer will verify the test results by inspecting the white cloth or blotter. If the cloth or blotter retains oil, water, or other contaminants, painting shall be suspended until retests verify the problem was corrected. This test shall be performed at the start of each shift and at four hour intervals. This shall not be required for an airless sprayer.

Spray application shall not be used unless the operation is totally enclosed as required for abrasive blasting, to prevent overspray damage to the ground, public and private property, vegetation, streams, lakes, and other surfaces not to be painted.

(g) Prime, Intermediate, and Finish Coat Application (QCP #5, #8, and #10). Paint shall be applied as a continuous film of uniform thickness, free of all defects such as holidays, pin holes, mud cracking, checking, drips, runs, and sags. The Contractor shall be responsible for applying

the manufacturer's paint as necessary to satisfy the above requirement. All thin spots or areas missed shall be repainted before the next coat of paint is applied.

The Contractor shall ensure that each coat of paint is properly cured before applying the next coat. The manufacturer's written instructions for the time interval between coats shall be complied with, and the next coat shall be applied when an additional coat will not cause detrimental film irregularities, such as lifting, wrinkling, or loss of adhesion of the undercoat. The following time intervals shall not be exceeded. If the prime coat is organic zinc, the maximum time between the prime and intermediate coats shall be thirty Days. There shall be no maximum time between the prime and intermediate coats for an inorganic zinc primer. The maximum time interval between intermediate and finish coats shall be thirteen Days. These maximum recoat times include adverse weather Days and the Engineer will not extend the times. If the next coating is not applied within the times stated above, the coatings shall be removed and the steel shall be re-blasted according to SSPC-SP 10.

The Completion Date (month and year) of the finish coat and the letters of the applied paint system shall be stenciled on the steel in 4 inch letters with black urethane paint. The appropriate letters for the paint systems shall be as follows:

System Comprised of:	Letters
Inorganic zinc prime coat, epoxy intermediate coat, and urethane finish coat	IZEU
Organic zinc prime coat, epoxy intermediate coat, and urethane finish coat	OZEU

The date and paint system shall be applied at four locations near the end of each outside beam on the outside web visible from the road or as directed by the Engineer.

514.18 Removing Fins, Tears, or Slivers (QCP #6). A grinder shall be used to remove all fins, tears, slivers, or any other burred or sharp edges that become evident after applying the prime coat. Ground surfaces shall be retextured to produce a profile from 1.5 to 3.5 mils, and ground surfaces shall be reprimed before applying the intermediate coat. The Contractor may begin removing fins, tears, and slivers after blasting and before priming. Temperature and weather restrictions shall apply to removing fins, tears, and slivers, and to applying the prime coat.

514.19 Caulking (QCP #9). After the intermediate coat cures and before applying the finish coat, gaps or crevices greater than 1/8 inch shall be caulked.

514.20 Dry Film Thickness (QCP #5, #8, and #10). Prime coat thickness shall be determined; prime and intermediate coat thickness shall be determined; and prime, intermediate, and finish coat thickness shall be determined using a Type 2 magnetic gage as follows:

Paint thickness shall be measured at separate, evenly spaced, spot measurement locations over each 100 square feet of area of structural steel. Five spot measurements shall be located on each of the following locations: top flanges; bottom flanges; webs; cross bracing; stiffeners; etc. At each spot location, three gage readings of either the substrate or the paint shall be taken. The probe shall be moved 1 to 3 inches for each new gage reading. An unusually high or low gage reading that is not consistently repeated shall be discarded. The spot thickness measurement shall be the average of the three gage readings.

The average of five spot measurements for each location in the 100 square foot area shall not be less than the specified thickness. No single spot measurement area shall be less than eighty percent of the specified minimum thickness nor greater than one hundred-fifty percent of the maximum specified thickness when organic zinc is applied and one hundred-twenty percent of the maximum specified thickness when inorganic zinc is applied. Any one of three readings which are averaged to produce each spot measurement, may under run or overrun by a greater amount. Five spot measurements shall be taken per location for each 100 square foot area as follows:

(a) For all shop primed steel regardless of size, each 100 square foot area shall be measured.

(b) For Structures not exceeding 300 square feet in area, each 100 square foot area shall be measured.

(c) For Structures not exceeding 1,000 square feet in area, three 100 square foot areas shall be randomly selected and then measured.

(d) For Structures exceeding 1,000 square feet in area, the first 1,000 square feet shall be measured as stated in Section 2 and for each additional 1,000 square feet, or increment thereof, one 100 square foot area shall be randomly selected and then measured.

(e) If the dry film thickness for any 100 square foot area (Sections 2 and 3) is not in compliance with the requirements of this subsection, then each 100 square foot area shall be measured.

(f) Other areas shall be measured or the number of spot measurements shall be revised as shown on the Plans.

Each coat of paint shall have the following thickness measured above the peaks:

	Min. Spec. Thickness	Max. Spec. Thickness	Min. Spot Thickness	Max.Spot Thickness (Inorganic Zn)	Max.Spot Thickness (Organic Zn)
Prime	3.0 mils	5.0 mils	2.4 mils	6.0 mils	7.5 mils
Intermediate	5.0 mils	7.0 mils	4.0 mils	10.5 mils	10.5 mils
Subtotal	8.0 mils	12.0 mils	6.4 mils	16.5 mils	18.0 mils
Finish	2.0 mils	4.0 mils	1.6 mils	6.0 mils	6.0 mils
Total	10.0 mils	16.0 mils	8.0 mils	22.5 mils	24.0 mils

Paint with a film thickness greater than the maximum specified thickness shall be removed unless:

(a) The paint does not exhibit defects such as runs, sags, bubbles, or mud cracking, etc.
(b) The manufacturer provides a written statement to the Engineer that the excessive thickness is not detrimental.

For any spot or average of five spots at any location of a 100 square foot area that exceeds the maximum spot thickness, either the coating shall be removed and replaced according to 514.22 or the Contractor shall prove to the Engineer that the excess thickness will not be detrimental to the coating system. In order to prove to the Engineer that the excess thickness will not be detrimental to the coating system, the Contractor shall provide the Engineer with the following information.

Certified Test Data proving that the excessive thickness will adequately bond to the steel when subjected to thermal expansion and contraction. The thermal expansion and contraction test shall take place over five cycles of a temperature ranges from -20°F to 120°F. After the thermal contraction and expansion cycles have taken place, the tested system shall be subjected to pull off tests and the results compared to the results of pull off tests that have been performed on a paint system with the proper thicknesses. In addition to the certified test results, the Contractor shall provide the Engineer a written statement from the paint manufacturer stating that the excessive thickness is not detrimental.

If the Engineer does not approve the excessive coating thicknesses or the Contractor elects not to provide the required written statement from the paint manufacturer and the certified test results when required, the Contractor shall remove and replace the coating. The removal and replacement of the coating shall be done as specified in 514.22.

514.21 Final Inspection.

(a) The Engineer will select locations for coating removal for inspection of surface preparation and dry film thickness. For all Structures in which the supporting members are rolled beams or girders, a minimum of one location per 150 linear feet of beam line for webs and flanges shall be removed and five percent of all cross frame assemblies and other secondary structural members shall be selected for destructive testing. For all other Bridge types with structural steel, one location for every 1,200 square feet of steel surface shall be removed for destructive testing.

(b) At the selected areas, the Engineer shall perform total dry film thickness testing using a type 2 magnetic gage. If the dry film thickness for that spot does not meet the requirements of 514.20, additional measurements shall be taken to determine the extent of the deficient coatings.

(c) At the selected areas, at least 9 square inches of the new top and intermediate coats and any loose prime coat shall be removed with the use of a welding chipping hammer and then scraping with a paint scraper. Power tools shall not be used. Removal shall be performed while in the presence of the Engineer. The Engineer shall document and photograph the selected areas after removal of the new coatings. If Work is found not to be in conformance with the Specifications and pertinent Contract Documents, additional locations may be selected for testing.

(d) Any remaining primer shall be removed, and areas where the coating was removed and other areas that were determined to be deficient shall be repaired. Repairs shall be made as per 514.22. If the Final Inspection reveals greater than fifteen percent of the areas inspected not in complete conformance with the Specifications and pertinent Contract Documents, the Engineer will require that surface preparation and painting of the structural steel be completely redone to meet the requirements of the Contract Documents at no additional cost to the City.

(e) Final Acceptance shall be based upon the results of the surface preparation observations and dry film thickness measurements obtained from the Final Inspection. Final Acceptance shall also take into consideration acceptable progressive Project documentation and progressive field measurements in determining the final acceptability of the Bridge Paint System.

Inspection access to the test locations to perform the required Final Inspection measurements shall conform to the requirements of 514.10.

514.22 Repair Procedures. Paint shall be removed and defects or damaged areas corrected, including areas damaged by welding, and in areas that do not comply with the requirements of this specification. Defects and damaged areas shall be corrected using the same paint as originally applied except the Engineer may approve using organic zinc to repair inorganic zinc in the field. The steel shall be retextured to a near white condition and a profile between 1.5 to 3.5 mils. The profile shall be measured immediately before applying the prime coat to ensure the profile is not destroyed during the feathering procedure. See 514.13(c).

The existing paint shall be feathered to expose a minimum of 1/2 inch of each coat.

During the reapplication of the paint, paint shall be applied as follows:

(a) The prime coat shall be applied only to the surface of the bare steel and the existing prime coat exposed by feathering. The prime coat shall not be applied to the adjacent intermediate coat.

(b) The intermediate coat shall be applied only to the new prime coat and the existing intermediate coat exposed by feathering. The intermediate coat shall not be applied to the adjacent finish coat.

(c) The finish coat shall be applied only to the new intermediate coat and the existing finish coat that was feathered or lightly sanded. The finish coat shall not be applied beyond areas that were feathered or lightly sanded.

At the perimeter of the repair area, the prime and intermediate coats shall be applied using a brush. The finish coat shall be applied using either brush or spray.

The Contractor may need to apply several applications to obtain the proper thickness for each coat.

During the application of the prime coat, the paint shall be continuously mixed.

All surface preparation and painting shall be performed according to this specification. Instead of abrasive blasting, the Engineer may allow alternate methods of preparing the surface.

Repair areas shall be blended with the adjacent coating and a finished surface shall be provided in the patched areas that is smooth and has an even profile with the adjacent surface.

The method of correcting areas with runs shall be submitted, in writing, to the Engineer for approval.

514.23 Method of Measurement. Surface preparation of existing structural steel and field painting of existing structural steel prime coat shall be measured by the number of square feet of structural steel painted or on a lump sum basis. Field painting structural steel, intermediate coat and field painting structural steel, finish coat shall be measured by the number of square feet or pounds of structural steel painted, or on a lump sum basis.

The number of pounds of new structural steel painted shall be determined by the accepted pay weight of the new structural steel.

For steel beam and steel girder Bridges, the surface area shall be determined by taking a nominal measurement of the beams (i.e., two times the beam depth plus three times the flange width). In addition to this nominal measurement, a percentage shall be added to account for incidentals such as cross frames, bearing assemblies, stiffeners, expansion joints, scuppers, etc. It shall not be necessary for the Engineer to field measure every detail of the Bridge to verify quantities. If there is a quantity dispute, exact field measurements of all painted surfaces and calculations shall govern over the above percentage to account for incidentals.

For extremely complex Bridges, such as trusses, painting shall be paid for on a lump sum basis.

Grinding fins, tears, slivers on existing structural steel shall be measured by the number of man hours expended by the workers actually doing the grinding and shall include the time when the workers are performing grinding and repairing prime coat and not limited to only the actual grinding duration (i.e., all hours of the workers when assigned to grinding regardless of actual grinding time shall be included) or shall be paid on a lump sum basis. Grinding fins, tears, and slivers on new steel shall not be measured but shall be considered incidental to the Unit Price for the new steel.

514.24 Basis of Payment. Accepted quantities shall be paid for at the contract prices as follows:

Paint may be considered as eligible for payment for material on-hand as specified in 114.05; however, only paint that the Contractor can prove to the Engineer will be used during the construction season shall be eligible for payment. The Contractor shall provide the Engineer calculations indicating the total square feet of steel to be painted during the construction season. The Contractor shall also provide calculations showing the total number of gallons required.

If the Contractor causes damage or injury to public or private property, restoring the property to its original condition shall not be paid for.

Repairing adjacent coatings damaged during the blasting operation shall not be paid for.

Removing and replacing an area of coating because a spot or maximum average thickness exceeds the maximum spot thickness shall not be paid for.

Additional testing required by any hauler, treatment facility, disposal facility or landfill shall not be paid for.

Caulking shall be paid for under Field Painting Structural Steel, Intermediate Coat.

Final Inspection access, test area preparation and test area repair at each selected area shall be paid for under Final Inspection Repair. Accessing, inspecting, and repairing areas that are not found to be in conformance with the Specifications and pertinent Contract Documents shall not be paid for.

Shop painting shall be included in the price bid for structural steel.

All other requirements of this specification shall be considered incidental to the Work.

Item	Unit	Description
514	Square Foot, Lump Sum	Surface preparation of existing structural steel
514	Square Foot, Lump Sum	Field painting of existing structural steel, prime coat
514	Square Foot, Lump Sum, Pound	Field painting structural steel, intermediate coat
514	Square Foot Lump Sum, Pound	Field painting structural steel, finish coat
514	Man Hour, Lump Sum	Grinding fins, tears, slivers on existing structural steel
514	Each	final inspection repair

ITEM 517 RAILINGS

517.01 Description
517.02 General
517.03 Materials
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, 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.

517.03 Materials. Railing Materials shall conform to the following:

Concrete, Class D	----------	499, 511
Reinforcing steel	----------	Item 709
Structural steel	----------	711.01
Ductile iron casings	----------	711.13
Aluminum	----------	711.20
Stainless steel fasteners	----------	711.14
Metal deep beam rail	----------	710.06
Timber	----------	711.26
Paint	----------	Item 708
Steel tubing	----------	707.10
Preformed fillers	----------	705.03, 711.28
Pipe	----------	748.01

517.04 Steel and Iron Railings. All parts of steel and iron railings shall be galvanized except where painting according to Item 514 is specified.

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 any 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 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 method without flux, or by other approved methods.

517.06 Method of Measurement. The length for payment shall be the actual length of railing including all posts. Where deep beam guardrail is used, the length for payment shall be length of railing between the first posts off the Bridge. The first posts off the Bridge shall not be included with the railing for payment. 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 measured length.

517.07 Basis of Payment. Payment will be made at Contract price for:

Item	Unit	Description
517	Linear foot	Railing, size ___, type ___

ITEM 519 PATCHING CONCRETE STRUCTURES

519.01 Description
519.02 Materials
519.03 Removal of Disintegrated Concrete
519.04 Preparation of Surface
519.05 Placing of Reinforcing Steel
519.06 Placing, Finishing, and Curing of Concrete
519.07 Method of Measurement
519.08 Basis of Payment

519.01 Description. This item consists 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, forms, and the placing of concrete patches, including curing of the same.

519.02 Materials. Materials shall conform to the following:

Concrete, Class D	499, 511*
Dowels	709.01, 709.03 or 709.05
Reinforcing steel	Item 509
Welded steel wire fabric	709.10 or 709.12

* Aggregate for superstructures shall meet the requirements of 703.02 and shall be No. 57 or 8 size

519.03 Removal of Disintegrated Concrete. All loose and disintegrated concrete shall be removed from the areas to be repaired in such a manner and to such an extent as to expose a sound concrete surface. The depth of a patch shall be not less than 4 inches, except on top horizontal surfaces, on which it shall not be less than 3 inches. Sound concrete (beneath the disintegrated concrete) shall be removed for a depth of not less than 1/4 inch and not more than 1 inch, provided that the above minimum depth of patch is maintained. Shoulders having a depth not less that the specified minimum depth of the patch shall be made square or, preferably, slightly undercut at the edges of all patches.

Only pneumatic or hand tools that will give results satisfactory to the Engineer shall be used in the removal of the disintegrated concrete and in preparing and shaping the areas to be patched.

Care shall be used in working around reinforcing steel so as not to damage or debond the steel, or to shatter the concrete around it, beyond the area to be patched.

Reinforcement which is loose shall be adequately supported and tied back into place. Reinforcement that is damaged during the operations shall be replaced at the Contractor's expense.

519.04 Preparation of Surface. After all disintegrated and loose concrete has been removed, the area to be patched shall be properly shaped, and any dowels or expansion bolts necessary to hold the wire fabric to be used in the patch shall be installed. The surface of the area to be patched and exposed reinforcing steel shall be thoroughly cleaned of all dirt, dust, or other foreign Materials by the use of water, air under pressure, or any other method that produces satisfactory results. The surface shall be thoroughly drenched with clean water. Before placing the concrete, the surface shall be allowed to dry to a damp condition.

519.05 Placing of Reinforcing Steel. Reinforcement will not be required for patches on top of horizontal surfaces. The reinforcement for patches on other surfaces 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 a distance not to exceed 18 inch centers in both directions.

519.06 Placing, Finishing, and Curing of Concrete. The concrete shall be Class D and shall be proportioned, mixed, placed, and finished in accordance with Item 499 and Item 511.

Forms shall be removed within twenty-four hours after placement of the concrete and all exposed surfaces shall be finished by rubbing so as to match as nearly as practicable the surrounding concrete. Membrane curing shall be applied immediately after rubbing the surfaces as noted in 511.15, Method (b).

After curing and before Final Acceptance, all patched areas shall be sounded. All unsound or visibly cracked areas shall be removed and replaced at the Contractor's expense.

519.06 Method of Measurement. The quantity shall be the actual area in square feet of the exposed surfaces of all completed patches, irrespective of the depth or thickness of the patch or on a lump sum basis. If a patch includes corners or edges of such members as beams, curbs, column, etc., all of the exposed surfaces shall be included; or if a patch extends completely through a member of a slab, both exposed surfaces shall be measured.

519.07 Basis of Payment. Payment will be made at Contract price for:

Item	Unit	Description
519	Square foot	Patching concrete structures

600 INCIDENTALS

ITEM 601 SLOPE AND CHANNEL PROTECTION

601.01 Description
601.02 Materials
601.03 Construction
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 Tied Concrete Block Mat
601.11 Method of Measurement
601.12 Basis of Payment

601.01 Description. This Work shall consist of protecting slopes, channels and gutters with riprap, interlock precast concrete blocks, concrete, grouted items, tied concrete block mats, crushed aggregate or dumped rock. Types, locations, dimensions, lines, grades and slopes shall be as specified.

601.02 Materials. Rock, broken concrete, and broken stone shall be sound and durable and not weathered beyond a degree of usefulness for the purpose intended. Rock and stone shall be relatively free of laminations, seams, and fractures, or injury due to blasting. Where the major portions of the material have shown the characteristic of acquiring a mudlike condition when tested for soundness, the material shall be tested for soundness and the maximum loss shall be five percent.

Other Materials shall be as follows:

Brick and blocks	704
Cement for grout	701
Concrete-Class E	499, 511
Crushed gravel, stone (Nos. 1, 2, 3, and 4)	703.04
Curing	451 or 705.07 Type 1
Filter Fabric, Type B	712.09
Joint sealer	705.04
Preformed expansion joint	705.03
Reinforcing steel	509.02
Sand for grout	703.03
Water for grout	499.02

For tied concrete block mats, the articulating concrete blocks are held together by galvanizing steel wire, HDPE mesh, stainless steel wire, or any seventy-five year mat material. The size of the concrete blocks, the space between the concrete blocks, and the required wire or mesh area shall be approved by the Engineer.

601.03 Construction. 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. 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 Item 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 E, mixed and placed in accordance with Item 511, and finished with a wood float. Concrete shall be cured as described in Item 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 four alternates:

(a) Flat stones, precast concrete blocks or broken concrete roughly rectangular in cross section, not less than 1/3 cubic foot in volume not less than 3 inches thick may be used. The individual pieces shall be placed by hand, one upon the other so that they will break joints with the piece in the course below. They shall be placed with their flat surfaces roughly perpendicular to the slope, forming contact with the courses immediately below and above. The spaces between the larger pieces shall be filled with spalls rammed into place. The surface of the finished riprap slope shall not vary more than 3 inches from that shown on the Plans, and shall present an even, tight surface, pleasing in appearance. When required by the Plans the riprap shall be grout filled. The backing shall be compacted as the construction of the riprap progresses. The thickness of the riprap, measured perpendicular to the slope, shall be not less than 9 inches and shall average not less than 12 inches.

(b) Concrete riprap in cloth or burlap bags may be used. The bags shall be soaked with water and filled with approximately 2/3 cubic foot of Class E concrete and the bags hand placed to protect the slope as shown on the Plans. The approximate size of each bag of concrete shall be 6x12x16 inches in length. 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. 1/2 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 stretchers. On slopes flatter than 1 1/2:1 all courses after the bed course shall be placed as headers. No. 4 reinforcing bars shall be driven approximately 18 inches deep and spaced approximately 12 inches apart through the top three courses. Voids shall be filled with grout as required.

(c) A 6 inch reinforced 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 in accordance with the standard construction drawing for pavement reinforcing, 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.

(d) Interlock precast concrete blocks may be used. Blocks shall be placed in accordance with manufacturer's recommendations.

601.05 Crushed Aggregate Slope Protection. The aggregate shall be crushed gravel or stone, Size No. 1 or No. 2. It 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, it 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 Superstructures.

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, 1 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. 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. Thin slablike pieces or any pieces having a dimension larger than 36 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. Reinforcing steel in broken concrete shall not protrude more than 1 inch beyond the surface of the concrete.

This item shall be of four types defined below:

Type A shall consist of sizes such that at least eighty-five percent of the total material by weight shall be larger than an 18 inch but less than a 30 inch square opening. At least fifty percent of the total material by weight shall be larger than a 24 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 eighty-five percent of the total material by weight shall be larger than a 12 inch but less than a 24 inch square opening. At least fifty percent of the total material by weight shall be larger than an 18 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 eighty-five of the total material by weight shall be larger than a 6 inch but less than an 18 inch square opening. At least fifty percent of the total material by weight shall be larger than a 12 inch square opening. The material smaller than a 6 inch square opening shall consist predominantly of rock spalls and rock fines and shall be free of soil.

Type D shall consist of sizes such that at least eighty-five percent of the total material by weight shall be larger than a 3 inch but less than a 12 inch square opening. At least fifty percent of the total material by weight shall be larger than a 6 inch square opening. The material smaller than a 3 inch square opening shall consist predominantly of rock.

601.08 Rock Channel Protection. Material for rock channel protection shall meet the requirements of Type A, Type B, Type C, or Type D dumped rock fill material as defined in 601.07 and shall be placed with or without a filter, as specified. The filter shall consist of filter fabric or a 6 inch bed of No. 3 or No. 4 crushed gravel or stone. 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.

Where filter fabric is used, the surface to receive the fabric shall be prepared to a relatively smooth surface free of obstruction and debris. The fabric shall be placed with the long dimension parallel to the direction of flow and shall be laid loosely but without wrinkles and creases. Where joints are necessary, strips shall be placed to provide a 12 inch minimum overlap, with the upstream strip overlapping the downstream strip. Securing pins with washers shall be placed at 2 foot minimum intervals along joints and at 5 foot intervals elsewhere to prevent slippage of the fabric. The securing pins shall be 3/16 inch diameter of steel pointed at one end and fabricated with a head to retain a steel washer

having an outside diameter not less than 1 1/2 inches. Pin lengths shall be at least 18 inches.

601.09 Paved Gutter. Paved gutter shall be constructed of concrete mixed and placed in accordance with Items 499 and 511. Concrete gutters shall be built to the dimensions and shape shown on the Plans or the standard construction drawing.

When gutter constructed under this item is to be tied to an existing concrete base, pavement or other rigid Structure, the type and location of joints in the gutter shall match with those in adjoining pavement.

When gutter is independent of other construction, impressed joints shall be formed in the gutter by impressing a device or bar shaped to the section of the gutter into the newly deposited concrete before initial setting. The device or bar shall be removed as soon as the concrete is in such condition to preclude distortion or injury to the concrete. The groove thus formed shall be 3/8 inch wide at the surface, 1/4 inch wide at the bottom and a depth equal to 1/3 the depth of the concrete. The joints shall be edged to a radius not greater than 1/4 inch. After the joint is formed, it must be protected from dirt or foreign matter until the filler is placed. The impressed joints shall be filled with joint sealer in such a manner that the material will be confined to the joint and in no way mar the surface.

The Subgrade for all paved gutters shall be compacted to not less than one hundred percent maximum dry density, as defined in 203.12, for a minimum dry depth of 6 inches below the surface of the Subgrade of the paved gutter. The cost of compacting the Subgrade shall be included in the Unit Price Bid for the paved gutter.

601.10 Tied Concrete Block Mat. Tied concrete block mat shall be used for protection of slopes, channels, and gutters as shown on the Plans and shall be placed directly on the filter fabric. The mat shall be toed in along the top of the slope and along the first or leading edge that is exposed to the flow. All voids shall be grouted as required.

601.11 Method of Measurement. Riprap, crushed aggregate slope protection, tied concrete block mat, and concrete slope protection will be measured by the square yard of finished surface complete in place. Dumped rock fill and dumped rock channel protection with or without filter will be measured by the cubic yard completed in place, and accepted in accordance with the dimensions shown on the Plans, excluding filter thickness. If it is not practical to determine the amount by measurement, the yardage may be measured in the vehicle or established by a job conversion weight from tonnage of acceptable

material delivered. Paved gutter will be measured by the linear foot complete in place.

601.12 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 all Materials, excavation, backfill, disposal of surplus Materials and incidentals necessary for completion of the specified items.

Payment will be made under:

Item	Unit	Description
601	Square yard	Riprap
601	Square yard	Crushed aggregate slope protection
601	Square yard	Concrete slope protection
601	Square yard	Tied concrete block mat
601	Cubic yard	Dumped rock fill, type "___"
601	Cubic yard	Rock channel protection, type "___" with filter
601	Cubic yard	Rock channel protection, type "___" without filter
601	Linear foot	Paved gutter

ITEM 605 UNDERDRAINS

605.01 Description
605.02 Materials
605.06 Method of Measurement
605.07 Basis of Payment

605.01 Description. This Work shall consist of constructing pipe underdrains with granular filter, and aggregate drains, all 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, pipe bends and branches, granular filter material, drain aggregate, and all other Materials necessary to complete the designated drains; and the removal and disposal of all surplus excavation and discarded Materials in accordance with Item 203.

605.02 Materials. Pipe shall be of the size and kind listed in the Proposal. When the type of pipe is not specifically itemized in the Proposal, any of the following types may be used:

Perforated Corrugated Polyethylene Drainage Tubing	AASHTO M252
Perforated Corrugated Polyethylene Drainage Pipe	AASHTO M294
Polyvinyl Chloride Plastic Pipe	ASTM F758, TYPE PS46

Other Materials shall be as follows:

Reinforcing steel	509.02
Concrete (Class E)	499 and 511
Sand for filter, gradation only	703.02 or 703.03
Filter fabric	712.09, Type A

605.06 Method of Measurement. The footage of pipe underdrains to be paid for will be the actual number of lineal feet of pipe with granular filter complete in place, horizontally measured from end to end.

605.07 Basis of Payment. The accepted quantities of pipe underdrains and aggregate drains, measured as provided above, will be paid for under:

Item	Unit	Description
605	Lineal foot	Pipe underdrains
605	Lineal foot	Aggregate drains

ITEM 606 GUARDRAIL

606.01 Description
606.02 Materials
606.03 Setting Posts
606.04 Erecting Rail Elements
606.05 Guardrail Rebuilt
606.07 Basis of Payment
606.06 Method of Measurement

606.01 Description. This Work shall consist of the construction or reconstruction of guardrail or guard posts in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

The types of guardrail are designated as follows:

Type 4.....Deep beam rail
Type 5.....Deep beam rail
Type 7.....Deep beam rail

The construction of the various types of guardrail shall include the furnishing, assembling, and erecting of all component parts and Materials complete in place, at the location shown on the Plans or as directed by the Engineer.

Standard design (single faced) guardrail of the type shown on the Plans shall be erected unless otherwise specified. Barrier design (double faced Type 4 or Type 5) guardrail shall be erected when called for on the Plans.

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	711.02
Pressure treated guardrail posts and spacer blocks	710.14
Steel guardrail posts	710.15
Concrete(Class D, E or F)	499 and 511
Reinforcing steel	509.02

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.

For Type 4 guardrail, posts shall be spaced at 12 feet 6 inches on centers measured along the centerline of the rail and shall be constructed without spacer blocks. Type 4 guardrail barricades shall be constructed with flared end section at each end.

For Type 5 guardrail, posts shall be spaced at 6 feet 3 inches on centers measured along the centerline of the rail and shall be constructed with spacer blocks. Type 5 guardrail barricades shall be constructed with flared end section at each end and without spacer blocks.

For Type 7 guardrail, posts shall be spaced at 12 feet 6 inches on centers measured along the centerline of the rail, except on curves with radius under 220 feet. Type 7 guardrail will be constructed without spacer blocks.

For flexibility, transition guardrail posts shall be spaced as detailed on the standard construction drawing for guardrail transitions.

606.04 Erecting Rail Elements. 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 125 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. Splice bolts shall not extend more than 1/2 inch beyond the nuts. For double-faced guardrail, bolts through posts shall extend from 1/4 inch to 1 inch beyond the nuts.

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 protected in a manner as may be specified or directed.

Type 4, Type 5 and Type 7 guardrail shall be erected so that the bolts at expansions 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 Item 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 the following new Materials: posts, spacer blocks, bolts, washers, and such incidental hardware as may be necessary to complete the guardrail, except that: (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 not removed during salvage may be reused.

606.06 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 and transition sections to be paid for will be the actual number furnished and erected complete as specified.

Guard posts to be paid for will be the actual number of posts furnished and erected as specified or as directed.

606.07 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 and transition sections will 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:

Item	**Unit**	**Description**
606	Linear foot	Guardrail, type "___"
606	Linear foot	Guardrail, barrier design, type "___"
606	Linear foot	Guardrail, rebuilt, type "___"
606	Each	Anchor assembly
606	Each	Anchor assembly, barrier design
606	Each	Transition section
606	Each	Bridge terminal assembly
606	Each	Guard posts

ITEM 607 FENCE

607.01 Description
607.02 Materials
607.03 Clearing, Grubbing, and Grading
607.04 Post Assemblies
607.05 Horizontal Deflection
607.06 Line Post
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 (chain link fence fabric with top rail)

(d) Type CLT (chain link fence fabric with tension wire)

607.02 Materials. Fence Materials shall meet the following requirements:

Fence posts, braces and dimension lumber	710.11
Woven steel wire fence	710.02
Steel line posts and ties (Type 47 fence)	710.11
Barbed wire	710.01
Reinforcing steel	509.02
Chain link fence	710.03
Concrete (Class D)	499 and 511
Expansion shield anchors, self drilling	712.01

607.03 Clearing, Grubbing, and Grading. The Contractor shall perform such clearing, grubbing, 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.

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 1 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 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 one degree but not more than four degrees. Where the change in alignment is in excess of four 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, where the fence changes alignment between one degree and five degrees, line posts encased in concrete shall be installed at all horizontal deflection points. At points of deflection where the fence changes alignment by more than five 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 five degrees shall be constructed as specified for end posts.

607.06 Line Post. 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 dips 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.

On tangents, line posts shall be placed so that the fabric, when installed on the side toward the Roadway, will be 2 feet from the Right-of-Way line. Adjacent to Right-of-Way lines in excess of one degree curvature, line posts shall be constructed on chords so that the fabric, when installed on the side toward the Roadway, will be not less than two or more than 8 feet from the Right-of-Way line.

Posts at points of horizontal deflection shall be located so that the fence fabric will bear against the post.

(b) For Type CL fence, line posts shall be spaced at not more than 10 foot centers and shall be so placed that, when the wire is fastened on the side toward the Roadway, it shall be 1 foot from the Right-of-Way line. 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 and Type CLT 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 midheight 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 top rail or top tension wire with bands or tie wires at approximately 24 inch intervals.

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. The accepted quantities of fence and gates measured as provided above will be paid for under:

Item	Unit	Description
607	Linear foot	Fence, type, "___"
607	Each	Gate, type "___", "___ " x "___"

ITEM 608 WALKS, CURB RAMPS AND STEPS

608.01 Description
608.02 Materials
608.03 Concrete Walks
608.04 Curb Ramps
608.06 Concrete Steps
608.07 Method of Measurement
607.08 Basis of Payment

608.01 Description. This Work shall consist of constructing walks, wheelchair ramps and steps of specified Materials in reasonably close conformity with lines, grades and dimensions shown on the Plans or established by the Engineer.

608.02 Materials. Materials shall be:

Concrete (Class D)	499 and 511
Course sand	703.02
Base course material	304.01 and 304.02
Expansion joint material	705.03
Reinforcing steel	509.02

608.03 Concrete Walks.

(a) Excavation shall be made to the required depth and to a width that will permit the installation and bracing of forms. The Subgrade shall be shaped and uniformly compacted to a firm surface conforming to the Plans or as directed by the Engineer.

(b) Forms shall be of wood or metal and extend for the full depth of the concrete, and of sufficient strength to resist the pressure of the concrete without springing.

(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 to obtain a sandy texture. No plastering will be permitted. All outside edges and joints shall be edged with a 1/4 inch radius edging tool. The surface of the walks shall be divided into equally spaced blocks at approximately 5 foot intervals, to form rectangular blocks.

(d) Joints. A transverse expansion joint 1/2 inch thick shall be provided as shown on the Plans or as directed by the Engineer. An expansion joint shall be placed at the end of each section adjoining an alley mouth, driveway, walk, concrete pavement or curb. Expansion joints shall also be provided at all cross walks between the curb and walk, between new walk and all buildings, and around all poles, fire hydrants, cellar holes, inlets, catch basins and the like. A transverse contraction joint shall be provided at intervals of 20 feet, unless otherwise shown on the Plans or directed by the Engineer. It shall consist of cutting the concrete 1 inch deep with a trowel causing a plane of weakness, and then it shall be marked with a jointer. Where concrete walk is built against the curb, all joints shall be made at the same location and form a continuous straight line with those in the curb.

(e) Curing and Protection. Concrete shall be cured as required in Item 451, except that the curing operations shall be continued for a period of at least three Days. In cold weather the curing period shall be lengthened as directed by the Engineer. The Contractor shall provide and use sufficient tarpaulins or other suitable covering to prevent damage by the weather. The Contractor shall erect and maintain suitable barriers to protect the walk from traffic. Any section damaged by traffic or other causes prior to acceptance shall be repaired or replaced by the Contractor.

(f) Slope. The surface of the walk shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the Roadway.

608.04 Curb Ramps. Excavation, forming, placing and finishing, and curing shall conform to 608.03. The final surface texture shall be rougher than adjacent walk and obtained by coarse brooming or other method approved by the Engineer to obtain striations transverse to the ramp slopes.

608.06 Concrete Steps.

(a) Excavation and forms shall conform to 608.03 (a) and (b).

(b) Placing and finishing shall be in accordance with Item 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 Item 511.

(e) Hand railing, when specified, shall be in accordance with Item 517.

608.07 Method of Measurement. Walks, curb ramps, and steps will be measured by the square foot of finished surface complete in place.

608.08 Basis of Payment. The accepted quantities of specific items of walks, curb ramps, and steps will be paid for at the Contract prices designated for each of the pay items listed. Excavation, backfill, base course material, reinforcing steel, hand railing, expansion joint material and other related miscellaneous items shall be included in the cost of the walks, curb ramps, or steps of which they are a part.

Payment will be made under:

Item	Unit	Description
608	Square foot	Concrete walks
608	Square foot	Concrete steps
608	Square foot	Curb ramps

ITEM 609 CURBS

609.01 Description
609.02 Materials
609.03 Cast in Place
609.07 Method of Measurement
609.08 Basis of Payment

609.01 Description. This Work shall consist of furnishing and constructing curb and combination curb and gutter of the specified Materials and types, in 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 Item 203.

609.02 Materials. Concrete shall be Class D in accordance with Item 451 and Item 499 and the ratio and size of coarse aggregate shall be as ordered to secure a workable mix.

Bituminous joint sealers shall be 705.04 or 705.11.

Expansion joint material shall be 705.03.

Reinforcing steel shall conform to Item 709.

609.03 Cast in Place. Concrete curb and combination curb and gutter shall be as follows:

(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.

Curb and combination curb and gutter shall be constructed independent of adjacent pavement, base, and Sidewalk, and shall have 1/4 inch contraction joints constructed at 5 foot intervals. The joint may be constructed with the use of metal separator plates, by the use of a grooving tool or sawed in accordance with Item 451. The depth of joint shall be 2 inches or more for combination curb and gutter, and for barrier curb shall average 1/5 or more of the curb height. The bottom of the saw kerf shall slope to the pavement for curb. Where expansion joints occur in the abutting pavement, they shall be provided for by

separation of the section being placed with 1/2 inch 705.03 preformed joint filler.

Expansion joints of not less than 1/2 inch shall be placed at each end of all sections of circular curb, drives, catch basins and inlets and shall extend through the entire width and depth of the curb. The preformed joint material shall meet the requirements of 705.03.

All joints of the type used in the pavement shall be constructed in the curb and spaced identically with the joints in the base or pavement.

Curb forms shall remain in place until their removal does not crack, shatter or otherwise injure the concrete.

Where the curbs built under this item are to later serve as a support for a 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 may be used for construction of circular curb where radius is 200 feet, or less.

(b) Placing. The concrete shall be placed in the forms, prepared as above described, in layers thin enough to permit thorough vibrating. It shall be vibrated in such a manner as to eliminate all voids.

(c) Curb Machine. Concrete curb or curb and gutter may be placed with a self-propelled machine consisting of a hopper, power-driven screw or screws and a metering device. 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 faces.

The slump test may be omitted and the yield determined from the volume required, adjusted for waste.

(d) Finishing. The top of the curb shall be floated in such manner 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 edge of the curb shall be rounded by the use of a tool especially designed for the purpose. The exposed 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.

(e) Protection. Concrete curb and combination curb and gutter shall be cured in accordance with Item 451.

609.07 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.

609.08 Basis of Payment. The accepted quantities of specific items of curb and combination curb and gutter will be paid for at the Contract price.

Payment will be made under:

Item	Unit	Description
609	Linear foot	Barrier curb
609	Linear foot	Combination curb and gutter
609	Linear foot	Mountable curb

ITEM 610 CELLULAR RETAINING WALLS

610.01 Description
610.02 Approval of Materials
610.03 Material
610.04 Excavation
610.05 Backfill
610.06 Construction
610.07 Method of Measurement
610.08 Basis of Payment

610.01 Description. This Work shall consist of constructing retaining wall systems, including masonry unit, geotextile fabric, and backfill material composed of a series of cells formed by assembling precast concrete units to form walls of satisfactory stability, in conformity with lines, grades, and cross sections as shown on the Plans or established by the engineer.

610.02 Approval of Materials. The Contractor shall 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 that have been in successful commercial use for a period of at least three years will be considered for approval.

Materials shall be sampled and tested as directed by the Engineer.

610.03 Material. All Materials shall conform to manufacturer's recommendations for the approved type of wall system.

610.04 Excavation. Excavation, including accurate grading for foundation, will be measured and paid for as Item 203. Bearing for the foundation of the walls shall be to grade in accordance with the manufacturer's recommendations and shall be approved by the Engineer before the erection of the wall.

610.05 Backfill. All backfill shall be in accordance with Item 304. The material shall be placed in layers not to exceed 6 inches compacted depth, and

compacted to the density established as satisfactory 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 system shall be filled in accordance with 503.09 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.

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.

610.06 Construction. The individual types of walls shall be constructed in accordance with manufacturer's recommendations.

610.07 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.

610.08 Basis of Payment. The accepted quantities of cellular retaining wall will be paid for at the Contract price per square foot. These prices shall include compensation for all Materials, backfill and disposal of surplus Materials.

Payment will be made under:

Item	Unit	Description
610	Square foot	Cellular retaining wall

ITEM 612 CONCRETE MEDIAN AND TRAFFIC ISLAND

612.01 Description
612.02 General
612.03 Method of Measurement
612.04 Basis of Payment

612.01 Description. This Work 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.

612.02 General. Materials and other requirements shall be the same as Item 451 except as follows:

(a) Steel reinforcement is not required.

(b) 703.02 manufactured sand may be used.

(c) 705.07 Type 1 membrane curing may be used.

Medians and islands shall be installed in compliance with the Americans with Disabilities Act.

612.03 Method of Measurement. The quantity measured shall be the number of square yards or the number of cubic yards as specified complete in place.

612.04 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 Materials necessary for completion of the items.

Payment will be made under:

Item	Unit	Description
612	Square yard or cubic yard	Concrete traffic island
612	Square yard or cubic yard	Concrete median

ITEM 613 BUMPER BLOCK

613.01 Description
613.02 Materials
613.03 Construction
612.04 Method of Measurement
612.05 Basis of Payment

613.01 Description. This Work shall consist of furnishing bumper blocks of the kind and size specified and installing them at the locations specified.

613.02 Materials. Concrete shall be Class D in accordance with Item 499 unless otherwise specified.

613.03 Construction. The bumper blocks shall be placed as shown on the Plans and/or as directed by the Engineer. If required, they shall be fixed in place using suitable metal bars.

613.04 Method of Measurement. The number of bumper blocks measured will be the actual number furnished and installed as specified.

613.05 Basis of Payment. The number of bumper blocks 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 bumper blocks including anchor bars if specified.

Item	Unit	Description
613	Each	Bumper block

ITEM 614 MAINTAINING TRAFFIC

614.01 Description
614.02 Traffic Facilities
614.03 Traffic Control General
614.05 Road Closed
614.06 Detour Signing
614.07 Traffic Maintained
614.08 Flaggers
614.11 Work Zone Pavement Markings
614.12 Pavement Marking Operations
614.13 Asphalt Concrete for Maintaining Traffic
614.14 Performance
614.16 Basis of Payment

614.01 Description. This Work shall consist of maintaining and protecting vehicular and pedestrian traffic according to these provisions. For through traffic, the Plans will designate whether the street will be closed with detours, roads and run arounds provided or whether traffic will be maintained through all or portions of the Project.

614.02 Traffic Facilities. The Contractor shall construct and maintain facilities for vehicular and pedestrian traffic of the street, including all walks, roads, Bridges, Culverts, and traffic control devices. The City will maintain public streets used as a detour beyond the Work limits of the Contract.

(a) For local traffic, the Contractor shall provide and safely maintain drives, roads, run-arounds, walks, Structures, and other facilities. The Contractor shall provide safe vehicular and pedestrian ingress and egress for all property adjacent to any improvement. The Contractor shall provide approaches and crossings of intersecting streets and maintain them in a safe condition.

(b) When the street under construction is being used by through traffic, including periods of suspension of the Work, the Contractor shall maintain it so that it is smooth, free from holes, ruts, ridges, bumps, and dust. For the portions of street being used, provide the necessary outlets to allow free drainage. The Contractor shall maintain pipe trenches or other openings left in hard surface pavements with material of comparable quality. Contractor maintenance responsibilities, including pothole patching begins for a section of street when the Contractor begins the work in that section and ends with the acceptance of the Work under Item 115. The two directions of a divided street are considered separate street sections and the start of Work on one

direction does not begin maintenance responsibilities on the other direction.

(c) The Contractor shall remove from the Project as necessary, abrasives and salt residues left by City snow and ice control operations.

614.03 Traffic Control General. The Contractor shall conform to the requirements of the plan, standard construction Drawings shown on the Plans, and the OMUTCD for Streets and Highways, hereinafter called the Ohio Manual, for the installation, maintenance, and operation of all traffic controls and traffic control devices. When the Plans or standard construction Drawings do not cover a specific traffic control situation, the Contractor shall place the necessary traffic control devices according to the Ohio Manual and use the procedures required by the Ohio Manual.

The Contractor shall use portable changeable message signs, prequalified according to ODOT Supplement 1061.

The Contractor shall use drums, signs, sign supports, barricades, impact attenuators, and other traffic control devices that are certified to meet NCHRP 350 safe-crash standards or as modified by Contract Documents. The Contractor shall not use heavy non-yielding devices or supports that do not conform to the current standards of NCHRP 350 unless allowed by Contract Documents.

The Contractor shall use Type G or H reflective sheeting complying with 730.19 and 730.192, respectively, for faces of construction signs, barricades, vertical panels, object markers, and stripes on glare screen panels. In addition, the Contractor may also use Type G sheeting referred to as damage control for these devices, provided it meets 730.19.

The Contractor shall use fluorescent orange reflective sheeting for all orange construction signs, object markers, and stripes on glare screen paddles.

The Contractor shall furnish drums with Type G reboundable reflective sheeting complying with the requirements of 730.191. The Contractor shall ensure that Owner identification markings on construction drums are no more than 1 inch in character height and are located at least 2 inches below the reflectorized bands or on the top or bottom horizontal surfaces of the drum. The Contractor shall ballast the drums according to the manufacturer's recommendations.

The Contractor shall furnish traffic cones consisting of a highly visible orange predominant color. The pavement markings for traffic maintenance shall conform to Item 640.

The Contractor shall furnish warning signs in advance of channelizing devices such as barricades, drums, vertical panels, and cones. The Contractor shall keep retro-reflective Materials clean and in good condition.

If Equipment, vehicles, and material are stored or parked on street rights-of-way, the Contractor shall locate them not less than 6 feet behind existing guardrail or not less than 30 feet beyond the traveled way unless otherwise permitted by the Engineer. At night if any such material or Equipment is stored between the side ditches, or between lines 6 feet behind any raised curbs, clearly outline them with dependable lighted devices that are approved by the Engineer.

614.05 Road Closed. When the street is closed to traffic, the Contractor shall furnish, erect, maintain, and subsequently remove advanced warning signs and supports, barricades, ROAD CLOSED signs on the barricades, and Type B yellow flashing lights at the following locations:

(a) Work limits of the Project.

(b) Work limits on all intersecting roads.

(c) Any other points specified in the Contract.

Throughout construction, the Contractor shall furnish, erect, maintain, and subsequently remove all signs, lights, barricades and other traffic control devices required by the Ohio Manual, Plans, or standard construction Drawings for the maintenance of local traffic.

614.06 Detour Signing. When the Plans provide a detour-signing plan, the Contractor shall provide, maintain, and subsequently remove all required detour signing and supports according to the detour signing plan.

614.07 Traffic Maintained. Where the street under construction is being used by through traffic, including periods of suspension of the Work, the Contractor shall furnish and maintain pavement markings, lights, construction signs, barricades, guardrail, sign supports, and such other traffic control devices. The Contractor shall maintain pre-existing Roadway safety hardware at an equivalent or better level than existed prior to Project implementation. Also, the Contractor shall provide law enforcement officers, watchmen, and flaggers as necessary to maintain safe traffic conditions within the Work limits as directed by the Engineer.

The City will furnish and erect regulatory signs and guide signs, unless otherwise shown on the Plans, within the Work limits on all traffic maintained Projects. The Contractor is responsible for maintenance of these signs. The

Engineer will approve the erection and removal of any regulatory signs not shown on the Plans.

The Contractor is required to keep existing signs and traffic control devices in use within the Work limits during the construction period unless otherwise indicated on the Plans. If existing signs and other traffic control devices must be relocated or modified as a consequence of the Work, the Contractor shall provide suitable supports and modify the devices with prior approval of the Engineer. The Contractor shall keep existing STOP or YIELD signs functioning at all times. The Contractor may adjust the position of these signs with the Engineer's approval. The Contractor may relocate existing signs that must be adjusted laterally according to the Ohio Manual. The Contractor shall restore relocated or modified signs to the position and condition that existed before construction as directed by the Engineer. When signs are to be covered, the Contractor shall provide an opaque covering that covers the entire message, symbol and all of the sign within the border. The Contractor shall not use fastenings that damage the sign or reflective face; however, the Contractor may use rivets to attach rigid overlay panels. The Contractor shall not apply adhesive tapes directly to the face of the sign.

When an existing signal operation must be interrupted for a period of time, the Contractor shall provide a traffic control method approved by the Engineer.

Whenever it is necessary to divert the flow of traffic from its normal channel into another channel, the Contractor shall clearly mark the channel for such diverted traffic with cones, drums, barricades, vertical panels, pavement markings, or flashing arrow panels. Also the Contractor shall use this method of marking when working adjacent to the part of the street in use by the public.

The Contractor shall obtain the approval of the Engineer before closing a traffic lane or establishing a one-way traffic operation.

614.08 Flaggers. Whenever one-way traffic is established, the Contractor shall use at least two flaggers unless the Engineer authorizes otherwise, and erect signs, cones, barricades, and other traffic control devices according to the Ohio Manual. The Contractor shall reflectorize traffic control devices as previously noted. The Contractor shall maintain positive and quick means of communication between the flaggers at the opposite ends of the restricted area.

The Contractor shall equip flaggers according to the standards for flagging traffic contained in the Ohio Manual. For a flagging operation, other than an intersection or a spot location best controlled by a single flagger, the Contractor shall ensure that each flagger uses a STOP/SLOW paddle conforming to the Ohio Manual. The Contractor shall mount the paddle on top of a 6 1/2 foot

handle. The Contractor shall ensure that each face of the paddle is made of Type G reflective sheeting meeting the requirements of 730.19. While flagging, the Contractor shall not allow flaggers to perform other Work activities.

614.11 Work Zone Pavement Markings. The Contractor shall furnish, install, maintain, and when necessary, remove Work zone retro-reflective pavement markings on existing, reconstructed, resurfaced or temporary roads within the Work limits, according to the following requirements.

(a) Acceptability and Expected Duration. The Engineer will evaluate the markings according to the three performance parameters contained in ODOT Supplement 1047. The Contractor shall repair or replace the markings when the numerical rating is six or lower for durability and four or lower for visual effectiveness and night visibility. The Contractor shall repair or replace unsatisfactory markings immediately and at no additional cost to the City, if the markings were in place for one hundred twenty calendar Days or less. The City will compensate under the applicable Contract pay item for Work zone pavement markings for the ordered replacement of worn markings after one hundred twenty calendar Days under traffic.

(b) Work Zone Marking Specifications. Unless otherwise shown on the Plans, the Contractor may use either 740.02 Type 2 paint or 740.06; Type I or Type II preformed material for Work zone pavement markings. Painted markings shall be furnished according to Item 642 except that:

(1) When applied to new asphalt concrete pavement surfaces placed by the Contractor, use the specified application rate from Table 614.11-1.

Table 614.11-1

	Gallons per Mile of Line Width of Line (inches)		
Type of Pavement Marking	4	8	12
Solid Line	24	48	72
10 foot Dashed Line	6		
4 foot Dashed Line	2.4		
Dotted Line	8		
Arrows, Symbols, and Words	1.5 gallons per 100 square feet		

(2) When applied to planed asphalt concrete pavement surfaces, use the specified application rate from Table 614.11-2.

Table 614.11-2

	Gallons per Mile of Line Width of Line (inches)		
Type of Pavement Marking	4	8	12
Solid Line	29	58	87
10 foot Dashed Line	7.2		
4 foot Dashed Line	2.9		
Dotted Line	9.6		
Arrows, Symbols, and Words	1.8 gallons per 100 square feet		

The Contractor shall ensure that Type I and II preformed material conform to 740.06, except do not place any preformed material containing metal on any surface unless it will be removed later. The Contractor shall remove Work zone pavement markings of 740.06 preformed material before placement of Items 642 or 644 surface course markings at that location

(c) Work Sequence. The Contractor shall ensure that Work zone markings are complete and in place on all pavement, including ramps, before exposing the pavement to traffic. When Work zone markings conflict with the traffic pattern, the Contractor shall remove them according to 641.09.

(d) Tolerances. The Contractor shall place lines for final surfaces according to the tolerances of 641.07. On surfaces other than final, the City will allow tolerances twice that in 641.07. The Contractor shall perform layout and premarking according to 641.06.

(e) Marking Dimensions. The plan will indicate the dimensions of the markings.

(f) Conflicting Markings. Before placing Work zone markings, the Contractor shall remove or cover all conflicting, existing markings visible to the traveling public.

(1) Removal and Covering of Markings.

(a) Removal Methods. The Contractor shall remove the markings by using small handheld grinders or scarifiers, sandbasting, or other methods approved by the Engineer. The Contractor shall exercise care during marking removal not to scar, discolor or otherwise damage the pavement surface.

(b) Covering Conflicting Markings. The Contractor shall not cover, remove, or obliterate existing markings by overlaying them with black paint or asphalt; however, with the Engineer's approval, use removable, nonreflective, preformed tape that minimizes contrast with the pavement where markings need to be covered temporarily.

(2) Raised Pavement Markers. The Contractor shall remove the prismatic retro-reflector within any raised pavement marker that is in conflict with the Work zone pavement markings. When the Work zone pavement markings are removed and the raised pavement marker is no longer in conflict, the Contractor shall thoroughly clean the recessed reflector attachment area of the casting and install a new prismatic retro-reflector of the same kind and color. The cost for this Work is included in the lump sump pay item for maintaining traffic.

(g) Allowable Duration of Work Zone Markings.

No Passing Zones. When existing permanent no-passing-zone markings are removed or obliterated as the result of a construction operation (pavement grinding, asphalt concrete pavement overlays, etc.) and the section of pavement continues to be used by the traveling public, the Contractor shall place final center line markings as specified by the plan within three Calendar Days.

(1) Subsequent Work in No Passing Zones. If, after the original markings are removed or obliterated, the Contractor returns to the subject no passing zone and places a plan-specified pavement course within the 3 Calendar Day limit, or performs Work in preparation for a subsequent pavement course, the Contractor shall have temporarily satisfied the conditions of the previous paragraph. In this event, the 3 Calendar Day limit will begin again.

(2) Liquidated Damages. For each Calendar Day beyond three Days that this Work remains incomplete, the City will assess Liquidated Damages in the amount of one thousand dollars per Calendar Day. The City will treat the time for the completion of no-passing-zone markings as an interim Completion Date.

614.12 Pavement Marking Operations. The Contractor shall perform moving marking operations with a truck equipped with necessary flashers and signs, and protect the operations with a similarly equipped vehicle or vehicles separated a sufficient distance to provide adequate advance warning. The Contractor shall use the extreme left or right lane for the marking operation when possible. Where three or more lanes exist in one direction, the Contractor shall perform the marking operation so that traffic passes on one side only.

The Contractor shall protect stationary marking operations in intersections, school zones, gores and other areas with traffic control devices such as advance warning signs and cones.

For stationary operations such as loading material and cleaning Equipment, the Contractor shall make every effort to have all Equipment completely off the traveled way. When Equipment cannot be removed from the traveled way, the Contractor shall operate all traffic control devices on the vehicles and station flaggers and vehicles to protect the Worksite and the traveling public while maintaining two-way traffic.

614.13 Asphalt Concrete for Maintaining Traffic. The Contractor may use Item 403 asphalt concrete or an asphalt concrete surface course the Engineer approves. Place surface course Materials as and where the Engineer directs for maintenance of the existing pavement, Shoulders, or Structures.

Where Materials are placed in small quantities or under adverse conditions, the Engineer may waive specification requirements for placing and finishing if, in the judgment of the Engineer, it is determined that the Contractor can obtain satisfactory results in providing a smooth and durable pavement surface.

614.14 Performance. If, in the opinion of the Engineer, the Contractor is not furnishing proper maintenance of traffic facilities and proper provisions for traffic control, the City may take the necessary steps to place them in proper condition, and the City will deduct the cost of such services from any money that may be due or become due the Contractor.

614.16 Basis of Payment. Unless separately itemized, the lump sum price Bid for Maintaining Traffic shall include the cost of removal or covering of conflicting pavement markings and layout, application and removal of pavement markings when required, maintaining the existing street in a safe condition for public use, removing abrasive and salt residue remaining from snow and ice control performed by the City, providing flaggers; and their Equipment; and furnishing, maintaining in an acceptable condition, and subsequently removing

the following Work zone traffic control items as required by the Contract Documents:

(a) Signs, supports, and warning lights.

(b) Drums, cones, gates, barricades, and vertical panels.

(c) Flashing arrow panels.

(d) Detour Signing

The City will pay for this item at the Contract price as follows:

Item	**Unit**	**Description**
614	Lump Sum	Maintaining traffic

ITEM 615 LOW STRENGTH MORTAR BACKFILL

615.01 Description
615.02 Materials
615.03 Mix Proportioning
615.04 Mix Adjustment
615.05 Alternate Mixes
615.06 Mixing Equipment
615.07 Mixing the Materials
615.08 Placing Mortar
615.09 Method of Measurement
615.10 Basis of Payment

615.01 Description. This Work shall consist of the placement of a flowable material consisting of portland cement, fly ash and/or sand with an expected twenty-eight Day unconfined compressive strength less than 100 pounds per square inch. This item shall be used for backfilling at locations as shown on the Plans or as specified. The Work shall be in accordance with Item 499 unless otherwise specified herein.

615.02 Materials. Materials shall be:

Cement	701.01 or 701.04
Fly Ash	705.13 (Except where provided for under 615.05)

Fine aggregate shall be natural sand or sand manufactured from stone, or gravel. 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.

615.03 Mix Proportioning. The low strength mortar mixture shall consist of the following quantities of Materials per cubic yard:

	Type 1* Pounds Per Cubic Yard	Type 2 Pounds Per Cubic Yard	Type 3 Pounds Per Cubic Yard
Cement	50	100	0
Fly Ash, Class F	250	**	1500
Fly Ash, Class C***	0	0	500
Sand****	2910	2420	0
Water (target)	500	210-300	850

* 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 (approximately five percent).

*** Class C fly ash may be substituted for Class F fly ash in Type I mixes with an approved mix design meeting the alternate mix design criteria of this specification.

**** Saturated Surface Dry.

These mixtures of Materials are expected to yield approximately 1 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 product. No additional compensation for a change in the material blends shall be allowed.

615.04 Mix Adjustment. The Contractor shall make 1 or more 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 615.05.

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 pound increment of fly ash to maintain the original yield.

615.05 Alternate Mixes. Other mixes may be substituted to the Engineer for approval. The Contractor shall submit the mix design and test data from an independent test lab thirty Days prior to the intended usage for approval. Foundry sand is not allowed.

This requirement is for all mixes that:

(a) 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.

(b) Have less than 50 pounds of cement in the Type 1 mixes or less than 100 pounds of cement in the Type 2 mixes.

(c) Utilize alternate Materials.

(d) Contain fly ash not meeting 705.13

(e) Use fine aggregate gradations other than 703.05.

All alternate mixes shall have an unconfined compressive strength between 50 and 100 pounds per square inch at twenty-eight Days when tested in accordance with ASTM D4832. The long term (twelve 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 twelve hours (four 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.

615.06 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 Type 2 mixes or Type 1 and Type 2 alternate mixes shall be delivered and placed from ready mixed concrete trucks or delivered from a batch plant.

615.07 Mixing the Materials. The mixture shall be discharged within 2.5 hours after the water is added.

615.08 Placing Mortar. The flowable material shall be discharged from the mixing 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, the Contractor shall secure Conduits to prevent them from floating during placement of the flowable material.

615.09 Method of Measurement. Low strength mortar backfill will be measured by the number of cubic yards computed from the plan lines and placed, unless included as backfill in Item 810.

615.10 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. No payment will be made for over-excavated areas or changes in material blends.

Item	Unit	Description
615	Cubic yard	Low strength mortar backfill type ___

ITEM 616 DUST CONTROL

616.01 Description
616.02 Construction
616.03 Method of Measurement
616.04 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 from earthwork construction operations from within the Project construction limits.

616.02 Construction. 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, and shall be used to minimize dust but not to create saturated soil conditions. The Engineer will determine whether 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 or sodded.

Water used for dust control shall be furnished and applied by means of tanks equipped with suitable sprinkling devices and in the quantities ordered.

Dust palliative shall consist of calcium chloride, 712.02, or a brine solution containing a minimum of thirty percent by weight of calcium chloride. The calcium chloride shall be spread uniformly over the surface.

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 measured, 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 will be made under:

Item	Unit	Description
616	M gallon	Water
616	Ton	Calcium chloride

If no items for water or calcium chloride appear in the Proposal, it shall be understood that their cost shall be included for payment in the Unit Prices bid for the various Contract items completed.

ITEM 619 FIELD OFFICE

619.01 Description
619.02 General
619.03 Bases of Payment

619.01 Description. This item shall consist of providing, maintaining and subsequently removing a field office for the exclusive use of the City for the duration of the Contract at a location approved by the Engineer. The field office will be designated as type A, B, or C.

619.02 General. The field office shall be available and completely functional at the direction of the Engineer. The office shall have a minimum ceiling height of 7 feet and have provisions for maintaining a room temperature between 68°F and 80°F. The type C field office shall have a separate enclosed room for the Engineer. The Contractor shall provide and maintain electric service. One speaker phone and one copying machine shall be required for Type B or Type C facilities. The copier shall be provided with all necessary maintenance and paper supplies, and be capable of producing multiple copies of documents up to 8 ½ by 14 inch in size.

The office shall be provided with potable hot and cold water. The office shall also have neat, sanitary, enclosed toilet accommodations; associated lavatory and sanitary supplies shall be furnished. Portable facilities may be provided with the approval of the Engineer.

On all Projects requiring moisture and density control of construction Materials, the field office shall contain a storage box for a nuclear density gauge in accordance with Drawings on file with the Engineer.

Additional requirements for field office and office Equipment are as specified in the following table:

FIELD OFFICE Item	Type A	Type B	Type C
Floor Space (square feet)	150	500	1,000
Telephone	2	3	3
Base Radio & Four Hand Held Units	-	-	1
Ten Column Electronic Calculator with Tape	1	2	3
Desk and Chair Set	1	3	5
Work Tables, 30 by 72 inch	1	2	
Four Drawer, Legal Size, Lockable Metal File Cabinet	-	1	2
Two Drawer, Metal File Cabinet	1	2	2
Portable Fire Extinguishers-Type 2A10BC-5#	1	1	2
All Weather Parking Spaces	4	8	10
Plan Rack2	1	1	2

(a) Units shall be capable of transmitting and receiving voice communication between office and any area on the Project site.

(b) Capable of handling the Breakdown of 22x34 inch sized Plans into ten sections.

The preceding requirements for the field office may be modified only upon written approval of the Engineer.

619.03 Basis of Payment. The field office will be paid for at the Contract 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.

Item	**Unit**	**Description**
619	Lump sum	Field office, type ___
619	Month	Field office, type ___

ITEM 623 CONSTRUCTION LAYOUT STAKES

623.01 Description
623.02 General
623.03 Basis of Payment

623.01 Description. This item shall consist of furnishing, placing and maintaining all construction layout stakes necessary for the proper prosecution of the Work under this Contract, all in accordance with these Specifications.

623.02 General. The City will establish bench marks along the line of the improvement at locations mutually agreeable with the Contractor.

The Contractor will be required to provide the field forces which are needed to establish pavement, Sewer, water line and grade, and other horizontal control, including supplemental bench marks, necessary to secure a correct layout of the Work. Stakes (or marks) for line and grade of the pavement shall be set at sufficient intervals to assure conformation to plan line and grade.

The Contractor shall be responsible for having the finished Work conform to the lines, grades, elevations and dimensions called for in the Plans and Specifications. The Contractor shall use qualified personnel and suitable Equipment for the layout of Work required and shall provide that it be done under the supervision of a registered surveyor or registered engineer. It shall be the Contractor's responsibility to verify any survey information appearing in the Plans which he may use to layout the Work.

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 will be made under:

Item	Unit	Description
623	Lump sum	Construction layout stakes

ITEM 624 MOBILIZATION

624.01 Description
624.02 Materials
624.03 Construction
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 for the Project, such as shops, plants, storage areas, sanitary facilities, moving in personnel and Equipment, incidental 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 Item 624 shall be performed but will not be paid for directly, and shall be considered as a subsidiary obligation of the Contractor.

624.02 Materials. The Contractor shall furnish all Materials and furnishings required for this item. These Materials and furnishings will not be considered as part of the various items of the completed Contract.

624.03 Construction. The Contractor shall provide all tools, Equipment, Materials, labor and Work for the construction and furnishings 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 Contract Amount		The maximum total of partial payments
More than ($)	Up to, inclusive ($)	shall be ($)
0	50,000	0
50,000	100,000	2,000
100,000	200,000	4,000
200,000	500,000	10,000
500,000	1,000,000	20,000
1,000,000	2,000,000	40,000
2,000,000	5,000,000	100,000
5,000,000	10,000,000	200,000
10,000,000	20,000,000	400,000
20,000,000		500,000

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 performance 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 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.

(a) One half of the Contract lump sum amount bid for the 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 fifteen Days after the start of Work at the Project site.

(b) An additional forty percent of the Contract lump sum bid for mobilization or forty percent of the amount shown in 624.04, whichever is less, will be released with the first regular estimate after ten percent of the original Contract amount, including payments for delivered Materials but excluding mobilization, is earned.

(c) Upon completion of all Work on the Project, including final cleanup, payment of the remaining ten percent of the Contract lump sum bid for mobilization and any amount of the Contract lump sum price bid for mobilization, in excess of the total amount shown in 624.04 for partial payment, will be released.

Payment will be made under:

Item	Unit	Description
624	Lump sum	Mobilization

ITEM 625 HIGHWAY LIGHTING

625.01 Description
625.02 Materials
625.03 General
625.04 Working Drawings
625.05 Light Poles and Towers
625.06 Light Pole Foundations
625.061 Terminal Cabinet and Control Cabinet Bases
625.07 Luminaires
625.09 Glare Shields
625.10 Grounding
625.11 Pull Boxes
625.12 Trench
625.13 Conduit
625.131 Conduit Jacked or Bored Under Pavement
625.14 Cable
625.15 Unit Type Duct-cable Systems
625.16 Markers
625.17 Connections
625.18 Power Service
625.21 Structure Junction Boxes
625.22 Tests
625.24 Method of Measurement
625.46 Basis of Payment

625.01 Description. This Work shall consist of furnishing and installing electrical Materials and Equipment for street lighting and/or traffic signals, or components thereof, complete and ready for service, in reasonably close conformity with locations, dimensions and grades shown on the Plans or ordered by the Engineer. This Work shall also include necessary excavation and backfill, and disposal of discarded Materials in accordance with 203.05, restoration of disturbed facilities and surfaces, and testing as specified.

625.02 Materials. New, first quality Materials shall be furnished. They shall comply when applicable with the Underwriters Laboratories requirements, and meet the applicable minimum requirements of Standards of EEI, NEMA, IES, ASA, IPCEA, AASHTO, ITE, IMSA and ASTM organizations. The Materials shall also comply with the National Electric Code and local codes for the area of installation. All electrical parts, wires, switches and other elements of the installations shall be of ample capacity to carry the required current without heating or causing an excessive drop of potential. All major items of electrical Equipment, such as cables, poles, etc., installed under the Contract, shall be the same type and consist of products of the same manufacturer in order to secure

uniformity, single responsibility, interchangeability and most satisfactory service. Reference to any name, make or manufacturer's number for an article of Equipment or material is intended to set a standard of desired quality, style and interchangeability, and shall be the basis of the Bid.

Specific Materials and items shall be as follows:

Anchor bolts and nuts	713.01, 713.21
Cable	713.02
Cable connectors and connector kits	713.15
Cable splicing kits	713.15
Concrete	499, 511
Conduit	713.04, 713.07
Power service components	713.19
Ground rods	713.16
Junction boxes	713.10
Lamps	713.14
Light poles, bracket arms	713.01
Light towers	713.21
Luminaires	713.11, 713.13, 713.21
Portable winch drive power units	713.21
Pull boxes	713.081 713.082, 713.09
Reinforcing steel	509.02
Sand	703.06
Structure ground cable	713.17
Unit type duct-cable systems	713.03
Wood service poles	713.19

625.03 General. In general, definitions of electrical terms used shall be in accordance with the American National Standard Practice for Roadway Lighting.

As far as practicable, items of electrical Equipment shall consist of products of the same manufacturer.

Each system shall conform as to voltage, amperage, frequency and type specified. 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 Electric Code and National Electric Safety Code, and shall also conform to local laws and

codes governing such Work. The Contractor shall apply and pay for, as an incidental to the construction of the lighting installation, all permits required.

The Contractor shall coordinate and cooperate with the power company in order to provide for all necessary requirements to establish electrical service.

625.04 Working Drawings. The Contractor shall submit, to the Engineer prior to incorporation, two copies of the shop Drawings and catalog cuts which identify and describe each manufactured item which is being incorporated into the construction. The Contractor shall certify in writing that each manufactured item is in conformance with all Contract requirements for that item. The Contractor shall ensure that all documents describing each item indicate the Project number 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 ensure that the documentation contains all of the information needed to allow the Engineer to determine that the item to be supplied meets all applicable requirements along with all of the information needed to obtain an identical replacement unit from the manufacturer.

The Contractor shall not order electrical material until written approval of such submissions is received from the Engineer. No deviation from the approved Plans will be permitted without the written order or consent of 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 of the specified type and sizes shall be erected upon the completed concrete foundations and plumbed by using metal shims or leveling nuts. When shims are used, use only shims of an approved design and installed in an approved manner. Do not install more than the minimum number needed to plumb the pole and neither exceed the maximum allowed total thickness of the shim pack nor the maximum number of shims permitted. When leveling nuts are used, ensure that such nuts are installed in approved locations and that both the anchor and the leveling nuts are properly tightened.

After erection, each pole shall be adequately connected to the ground provided for in 625.10 and the resultant ground shall be within the earth resistance limit specified.

A suitable lubricant shall be applied to each cover fastener to prevent seizing and all such fasteners shall be installed.

After erection, the Engineer shall inspect each pole for defects in the surfaces and determine for each defect discovered whether the defect is minor enough that the Contractor may be allowed to field repair the finish or major enough that the Contractor must replace the pole. The Contractor shall make finish repairs and provide and install replacement poles as directed by the Engineer for no additional charge to the Project.

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 Engineer.

Apply the identification when the ambient air temperature, the temperature of the labeling material, and the temperature of the surface to which the labels are applied are all above 40°F. Identification shall be located approximately 7 feet above the ground line, on the quadrant of the surface of the pole that faces oncoming traffic. Identification of the light poles or light towers and the removal of any previous such identification in the case of light poles or light towers being reassigned shall be considered as incidental Work.

Type I light poles are designed for supporting street lighting luminaires only. Each Type I pole shall consist of an upright shaft fitted with a removable pole top, bracket (luminaire support) arm with welded simplex type attachment, a 4 x 8 inch handhole with reinforcing frame and cover curved to follow the outside contour of the pole, a cast anchor base welded to the butt end, anchor bolt covers and any other accessories or hardware as required to make a complete installation.

Type II light poles are designed for supporting street lighting luminaries and also trolley cables of the Regional Transit Authority. They shall be identical to the Type I poles above except for the dimensions of the upright shaft and the addition of span wire clamps needed to support trolley cable approximately 22 feet above the pole base. These poles, as required, shall also be provided with wire outlets welded into the pole 21 feet from the base as noted on the Plans.

Type III & IV light poles are designed for supporting street lighting luminaries, trolley cables and traffic signals suspended from span wires. They shall be identical to the Type II poles described above except for the dimensions of the upright shaft.

625.06 Light Pole Foundations. Excavation for foundations shall be completed as nearly as practicable to the dimensions shown for the foundations. Concrete shall be Class D and construction shall be in accordance with Item 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 concrete.

Reinforcing steel as specified shall be placed in accordance with Item 509.

Light pole anchor bolts shall be installed in the foundations in strict conformance with approved shop Drawings and anchor bolt setting templates. The tops of foundations shall be finished smooth and level. The direction of the spare Conduit ell shall be scribed in the top of the foundation.

After forms have been removed, excavated spaces around the foundations shall be backfilled with suitable material placed and tamped in thin layers.

625.061 Terminal Cabinet and Control Cabinet Bases. Excavation for the foundations of terminal cabinets and control cabinets shall be completed as nearly as practicable to the dimensions shown on the Plans for the foundations. The concrete shall be Class D and the construction shall be in accordance with Item 511 except that forms will not be required for the portion of the foundations extending more than 6 inches below the ground line.

The tops of the foundations shall be finished smooth and level.

After the forms have been removed, the excavated spaces around the foundations shall be backfilled with suitable material placed and tamped in thin layers.

625.07 Luminaires. A luminaire shall consist of a housing with a lamp, a lamp socket, the optical components to direct the output from that lamp, and the electrical components needed to operate the lamp.

All luminaires of the same type in a given installation shall be of the same brand.

Luminaires shall be aligned vertically and horizontally to provide the required mounting height and the specified alignment with the Roadway.

After all other Work has been completed and just prior to leaving the job, refractors shall be cleaned with a detergent and reflectors cleaned with an approved cleaner to provide the maximum lumen output possible. Tower luminaires shall be leveled by means of the adjustment device provided.

The Contractor shall provide the Engineer with two copies of all data normally supplied by the manufacturer with each type of luminaire, plus any additional ballast wiring diagrams, socket adjustment instructions and parts bulletins necessary for the successful maintenance of that particular luminaire. Each piece of such information shall be identified by labeling with the Project number and year.

625.09 Glare Shields. At the locations designated in the Plans or as designated by the Engineer, the Contractor shall furnish and install glare shields obtained from the manufacturer of the luminaire.

625.10 Grounding. The Contractor shall connect each light pole, light tower, or power service to a local earth ground.

The Contractor shall provide continuity of grounding by bonding the metallic portions of fixtures, apparatus enclosures, supports, Conduits, raceways, junction boxes, and pull boxes together and connecting them to earth ground. At a light pole or light tower, the Contractor shall install a bonding cable between the grounding bushing on each metal Conduit and the ground lug or bolt in the pole base. At a junction box or a pull box, the Contractor shall install a grounding bushing on each metallic Conduit not bonded to the box through the Conduit connector, and install a bonding cable between the grounding bushings on the Conduits and the ground lug or bolt in the box.

For a light pole, light tower, power service, or other such item mounted independently, the Contractor shall install one or more 3/4 inch diameter by 10 foot minimum length, copper-clad ground rods with driving points.

One rod shall be driven in the bottom of the cable trench approximately 1 foot from the pole or foundation. The top of the rod shall extend approximately 4 to 6 inches above the bottom of the trench to facilitate exothermic welding of the insulated ground wire to the rod.

For a luminaire, light pole, light tower, switch enclosure, or other such item mounted in or on a Structure, the Contractor shall connect the item to the Structure grounding system.

For a lighting contactor, lighting circuit panel, or other such item mounted in a building, the Contractor shall connect the item to the grounding system provided for the building.

For each Bridge, wall, or other Structure having electrical elements contained therein or attached thereto, the Contractor shall furnish all Materials necessary including grounding electrodes and install a complete Structure grounding system to bond all exposed metallic portions of the Structure (i.e.

beams, railings, etc.) electrically together and connect those items to good earth ground. Wire used in grounding Structures shall be No. 1/0 AWG 7 strand 600 volt insulated copper cable. In the case where Structures are separate but adjacent, the multiple Structures shall be connected together to avoid any difference in earth potential between the Structures.

The permanent connection between each ground rod and the grounding cable shall be by exothermic welding.

If the earth resistance measurement exceeds ten ohms for a ground for a traffic signal controller or a light tower or 25 ohms for any other ground, a second ground rod shall be installed at least 10 feet from the first and be temporarily connected to the first. If the earth resistance still exceeds the above specified values, the first two rods shall be permanently connected and additional rods added one at a time as directed by the Engineer. Additional rods shall be connected either in parallel or in series to the original rod, using No. 1/0 AWG 7 strand 600 volt insulated copper cable. Cables connecting the additional ground rods shall be protected by furnishing and installing either a 2 x 6 inch treated wood board or a 4 x 6 inch Class D concrete slab, approximately 4 inches above the cable.

Where rock does not permit the driving of ground rods, an earth connection shall be developed by constructing a grid from the partially driven rods supplemented by buried bare cable as directed by the Engineer.

625.11 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. A 6 inch gravel base shall be provided below 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.

When pull boxes are installed in paved areas, an adequate area shall be removed by saw cutting on the sides, or by removal back to an expansion joint. The cover surface shall be adjusted to be slightly above the surrounding pavement. Pavement matching the surrounding area shall be placed from the pull box rim to the existing pavement, permitting no gaps larger than 1/4 inch.

Each cover screw shall be lubricated with a compound to prevent the screw from seizing and all cover screws shall be installed.

625.12 Trench. Trenches shall be excavated to the dimensions and lines specified. When depths are not specified, the trenches shall have a minimum depth of 30 inches. Trenches located adjacent to and parallel with

curbs or pavements shall not deviate more than 6 inches from the lines designated.

The Contractor shall place a dielectric polyolefin film warning tape, one millimeter thick, 3 inches wide, and orange in color, approximately 12 inches below finished grade the length of the trench, except in paved areas, where the tape shall be placed at a depth midway between the pavement and the encasement. Materials and ink colors shall be used that will not change when exposed to acids and other destructive substances commonly found in soil. Warning tape shall be printed every 6 feet with “CITY OF DAYTON CONDUIT CALL 937-333-4075”.

Trench backfill shall be placed in layers not to exceed 4 inches in thickness and compacted with mechanical tampers or other approved mechanical compactors 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 either of suitable soil or granular material. For Unit Type Duct Cable Systems the backfill material in the first 4 inches above the top of the duct shall not contain pieces larger than 1 inch.

For trenches in paved areas, the existing pavement shall be removed for at least 6 inches beyond the edge of the underlying trench. Sawcut lines shall follow existing joints or grooves where possible and shall be premarked and be approved by the Engineer before sawing. Replacement for flexible pavement shall be Class D concrete placed to within 2 inches of the surface to match the existing concrete base, with an Item 404 surface course. Replacement for rigid pavement shall be Class D concrete placed, finished and textured to the satisfaction of the Engineer.

625.13 Conduit. Conduit of the type and size specified 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 Electric Code in so far as Conduit fill is concerned.

All underground Conduits shall be encased in concrete, the concrete encasement shall be Class D and shall have a minimum thickness of 4 inches.

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. All bends in Conduit are to be factory made. 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. Cut threads shall be painted with a zinc-rich paint in such a manner that there will be no unprotected surfaces and the joint will be watertight. All 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.

Appropriate expansion or deflection joints shall be installed in each Conduit at all locations where movement must be accommodated (such as expansion joints on Structures) and suitable bonding installed 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.

The Contractor shall check each Conduit run by rodding or by pushing a mandrel through the Conduit run. Any obstructions which may develop in the Conduit shall be removed.

After installation, all Conduit which will not have circuit wire or cable pulled into it during construction shall have a No. 10 AWG copper clad or aluminum clad pull wire 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 conductor wire or cable, shall be completely sealed in an approved manner with a removable sealing compound which is compatible with the cable jacket, the insulation and the Conduit material.

The Contractor shall temporarily seal the ends of a Conduit immediately after placement of Conduit when the conductors or cable cannot be installed promptly.

Where Conduit enters a junction box through a slip hole, locknuts shall be provided to fasten the Conduit to the junction box and a lead washer shall be installed under the inside locknut to weatherproof the connection.

625.131 Conduit Jacked or Bored Under Pavement. Conduit placed under existing pavement or paved Shoulder shall comply with 725.04 and will be installed by jacking or boring, subject to the approval of the Engineer. If placed by jacking, the Contractor shall use a machine designed for jacking, not the bucket or blade of a machine designed for earthwork. In unpaved areas, horizontal boring may be used to install a Conduit or duct that has adequate strength, flexibility, and joints to withstand the process. If placed by boring, the bore shall not exceed the Conduit diameter by more than five percent. The Conduit shall be placed with a minimum amount of disturbance to the Roadway.

625.14 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 wire mesh cable grips attached to J hooks at the tops of the poles. The cable shall not drag against the openings to the bracket arm.

The Contractor shall identify all cables, except bare ground bonding cables, as to circuit and function with tags or bands in the base of each light pole or light tower, each junction box or pull box, each apparatus cabinet, and other similar locations.

Cable shall be unwound from the shipping reel, spool, or coil and shall not be spiraled from off the side of the spool, reel, or coil.

625.15 Unit Type Duct-cable Systems. Factory preassembled cable in a polyethylene duct shall provide the number and size of insulated conductors specified. The number of conductors used in the duct and the duct fill shall conform to the requirements of the National Electric Code but in no case shall the nominal inside diameter of the duct be less than 1 1/4 inches. The duct-cable shall be laid parallel to the trench prior to installation and shall be provided in sufficient lengths to be installed without splices between pull boxes, lighting standards and sign supports. Allowances shall also be made for extensions into pull boxes for splicing, and for extension of the conductors through the handholes in light poles and sign supports.

Duct-cable shall not be installed when the temperature of the duct-cable cannot be kept above 32°F except with the permission of the Engineer.

625.16 Markers. Precast or cast in place concrete cable and Conduit markers of the size specified shall be furnished and installed flush with the ground at locations shown on the Plans or directed by the Engineer. Concrete construction shall be in accordance with the requirements of Item 511. Precast units shall be manufactured in accordance with Item 704.

625.17 Connections. Cable connections in pull boxes and junction boxes, and in the hand holes of all light poles shall be accomplished by the use of approved factory preassembled cable connector kits. Kits employed in the handholes of all poles shall be of the quick disconnect type, and in addition the kit used in the hot leg shall be a fused type. Fused kits shall also be employed in junction boxes on Structures to provide circuit protection.

Cable connections below the 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 the manufacturer's instructions.

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.

Disconnect kits employed at the last light pole or sign Structure on a circuit shall have the vacant wire opening plugged in accordance with the manufacturer's recommendations.

The Contractor shall supply to the Engineer, the exact style number of each kit used on the Project and the location where used.

625.18 Power Service. The Contractor shall furnish and install all Equipment necessary to provide complete electrical service to the Roadway facilities. The Contractor shall also make all necessary arrangements with the supplying agency for connections to establish electrical service. Equipment shall include, but is not necessarily limited to, the following items: wood poles, hardware for dead-ending an overhead line, lightning arrestor, weatherhead, Conduit riser, meter base, fused main disconnect switch, magnetically held lighting contactor, Hand-Off-Automatic switch for control of contactor, photoelectric cell, over-current protection devices for each individual branch circuit fed by the control center, enclosures, Conduits, fittings, cables and connectors.

Unless otherwise directed by the Engineer, the components of the lighting control center shall be installed in the enclosure with the fused disconnect switch which is part of the power service. Where multiple enclosures are used, mark each enclosure in white letters engraved on a black plastic placard with the

function of the component contained therein, such as "SERVICE SWITCH," "SIGNAL POWER," "MAIN LIGHTING SWITCH," "TRANSFORMER," "LIGHTING CONTACTOR," or other appropriate designation.

Branch circuit neutrals shall not be fused. When grounded service is provided or when ungrounded service is provided and an isolation transformer is used, branch circuit neutrals shall be solidly connected and grounded. When ungrounded service is provided and no isolation transformer is used, branch circuit neutrals shall be ungrounded and switched simultaneously with their associated line conductors.

At the time of installation the photoelectric cell shall be faced due north unless other orientation is required. In no case shall the sensor element be rotated more than 45 degrees east or west of due north, tilted off of horizontal or shielded with auxiliary devices without prior approval by the Engineer.

All Equipment housings and Conduits shall be connected to a ground rod installed in accordance with 625.10. Lightning arrestors on incoming service shall be connected to Equipment ground wire only when grounded neutral service is used and transformation is not required. Otherwise these lightning arrestors shall be separately grounded to a butt ground or to an additional ground rod installed in accordance with 625.10 and located a minimum of 1 foot from the base of the pole and all other ground rods. Grounding cables installed on a pole shall be protected by wood or plastic ground wire moldings.

Fusing of service neutrals shall not be permitted. Grounded service neutrals shall not be switched but shall be connected to a neutral bar in the disconnect enclosure with a screw type pressure connector. All ungrounded neutrals shall be switched simultaneously with the associated line conductors.

625.21 Structure Junction Boxes. Junction or pull boxes shall be furnished and installed as required. Boxes shall be of sufficient size to accommodate cable connector kits and lamp ballasts as required. All boxes that are embedded in concrete shall be galvanized cast iron except that boxes in railing parapets shall be as specified on the Plans.

Boxes located in safety curbs or parapets shall be provided with 3/4 inch rigid galvanized steel Conduit or pipe drains.

625.22 Tests. The Contractor shall be responsible for furnishing all personnel and Equipment required to successfully perform the following tests as an incidental to the construction of the lighting installation. The Engineer shall witness each test and judge the results.

The Contractor shall submit to the Engineer the types, styles, or catalog numbers of all testing Equipment to be used for tests, as well as, a current Certification of Calibration for each instrument showing that the instrument is in current calibration using standards traceable to The National Institute of Standards in accordance with the manufacturer's recommended process by a service center authorized by the manufacturer to calibrate the instrument. The Contractor shall certify and demonstrate to the satisfaction of the Engineer that the instrument has remained sealed since the calibration, and that the manufacturer's recommended process for ensuring that the instrument is in working order and producing valid results has been followed in conducting the test.

(a) Ground Test. The Contractor shall furnish two certified copies of the completed test records to the Engineer on test reporting forms supplied to the Contractor by the Engineer or on alternate forms approved by the Engineer.

The earth resistance in ohms of each ground shall be measured immediately after it is installed and before the ground is attached to the item being grounded.

When the ground connection is by driven ground rods, each ground rod shall be measured separately. In the event that a ground rod has a high resistance and additional rods are being added, the earth resistance of the combined group shall be measured.

A structure grounding system shall be measured at each point where an exposed metallic item is to be connected to the system. When driven ground rods are used as the electrodes of the structure grounding system, each ground rod shall be measured separately prior to measuring the system.

Each ground grid shall be measured at each point where Equipment is to be connected to the grid.

(b) Circuit Continuity Test. Upon completion of each lighting circuit but prior to energizing the circuit, the Contractor shall verify the continuity of each conductor of the lighting circuit from the power service to the load side socket in the line side of the quick disconnect connector kit in the base of each light pole and the line side of each disconnect switch at each light tower, lighted sign, and underpass lighting system. The Contractor shall demonstrate that there is no cross connection between the conductor being tested and any other conductor (including conductors for other circuits) or earth ground. This test shall be conducted by applying a low test voltage between the conductor under test and one of the companion conductors for the same circuit and demonstrating that the test voltage is available between only those two

conductors at the power service, the load side socket in the line side of the quick disconnect connector kit in the base of each light pole, and the line side of each disconnect switch for a light tower, a lighted sign, or an underpass lighting system and repeating the process until all possible pairs have been so checked. Throughout this test, the Contractor shall ensure that each disconnect switch is in the open position and that the load side of each connector kit is unplugged. The Contractor shall temporarily disconnect the grounded neutral conductor from earth ground and check all pairings involving the neutral after which again connect the neutral to earth ground and check all pairings, both those involving the neutral and those that do not.

(c) Cable Insulation Test. After the continuity of a conductor has been verified, the Contractor shall test the insulation of that conductor and its connections. The Contractor shall ensure that each disconnect switch is in the open position and that the load side of each quick disconnect connector kit is unplugged during this test. The Contractor shall temporarily disconnect a grounded neutral conductor from earth ground when it is being tested. In addition, when a grounded neutral is under test and the circuit utilizes local Equipment earthing rather than continuous Equipment grounding back to the power service, the Contractor shall temporarily connect one of the companion line conductors to provide the equivalent of the continuous Equipment grounding cable.

When the circuit conductor is comprised of both new wire or cable and wire or cable installed prior to the current Project, the Contractor shall test the insulation by the megohmmeter method and the resistance of the conductor under test to earth ground or any other conductor shall exceed ten megohms.

When the circuit conductor is comprised of entirely new wire or cable, the Contractor shall test the insulation by high potential method in accordance with Ohio Department of Transportation Supplement 1003 High Voltage Direct Current Test Procedure.

(d) Performance Test. Prior to acceptance and after all other tests are done, the Contractor shall operate the completed lighting system on electrical energy from the power company through the permanent service connection in its intended normal manner from sunset to sunrise for ten consecutive Days without interruption or failure attributable to poor workmanship or defective material. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the ten Day test. The Engineer will consider the performance satisfactory when the lighting installation has operated for ten consecutive Days without a fault. The Contractor shall arrange with the servicing agency to purchase electric power necessary to conduct

the performance tests. All costs of personnel, Materials, Equipment, electrical energy and incidentals required for performing all tests shall be included in the Contract Unit Prices for the respective items tested.

625.24 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) Conduit. The number of linear feet of Conduit acceptably furnished and installed will be measured from center to center of pull boxes, foundations, etc., and shall include all fittings and appurtenances, joints, bends, concrete encasement where specified, and disposal of surplus material.

(b) Light Cable. The number of linear feet of circuit cable containing the number and type of conductors as specified in the Plans, acceptably furnished and installed will be measured from center to center of light pole foundations, pull boxes, etc., plus 10 feet per spacing to allow for slack and splicing leads. The number of linear feet of pole and bracket cable acceptably furnished and installed will be measured as shown on the Plans.

(c) Duct Cable. The number of linear feet of duct cable acceptably 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.

(d) 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.

(e) Power Service. The power service will be measured as one unit for each of the installations specified and shall include all Materials, Equipment and incidentals, complete in place.

(f) The number of light poles, light pole foundations, light towers, light tower maintenance platforms, portable power units, luminaries, lamps, glare shields, markers, pull boxes, connector kits, structure grounding systems, electrical manholes, terminal cabinet bases, controller cabinet bases, splice boxes, steel poles, wood poles and structure junction boxes acceptably furnished and installed will be the actual number of each, complete in place.

Light pole anchor bolts shall be furnished with the light pole and the setting of the anchor bolts included with the foundation. However, in the case of a light pole mounted onto Structures such as Bridges and retaining walls where the bolts normally furnished with the light pole are not of the proper length and shape and/or the setting of the bolts must be done when the Structure is constructed rather than being at the time of construction of the light pole foundation, the bolts shall be a separate item for payment in which case payment will be for each bolt with the count being the number of bolt ends projecting for the anchoring of the light pole. Separate payment shall also be made when the bolts are being set in a normal light pole or light tower foundation but the light pole or light tower is being furnished by others to the Contractor.

Foundations for light poles or light towers shall include excavation, reinforcing steel and, for light poles or light towers mounted on median barrier or retaining walls, the junction box at the point where the stub Conduit to the light pole or tower joins the main lighting circuit raceway and the stub Conduit from the junction box to the light pole or light tower. Anchor bolts, Conduit ells and surface restoration not included elsewhere are also included with the foundation.

(g) 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.

(h) When the Contract stipulates that payment will be made for a specific complete electrical Equipment installation on a lump sum basis, the pay item stipulated will include all electrical Materials, Equipment and incidentals required at the location and within the limits specified on the Plans complete in place.

625.46 Basis of Payment. The accepted quantities of specified items of electrical Work and Equipment measured as provided above will be paid for under:

Item	Unit	Description
625	Each	Light pole, type __
625	Each	Luminarie bracket arm
625	Each	Light pole foundation
625	Each	Light tower
625	Each	Light tower foundation
625	Each	Light tower maintenance platform
625	Each	Luminarie, (lamp wattage), (light source), (light distribution), (voltage)
625	Each	Glare shield
625	Each	Pull box, type___ lengthxheightxdepth
625	Each	Reinforced concrete electrical manhole
625	Each	Markers
625	Linear foot	Trench
625	Linear foot	__ Inch plastic duct
625	Linear foot	__ Inch conduit jacked or bored under pavement
625	Linear foot	__ Inch, rigid steel conduit
625	Each	__ Inch x __ foot rigid steel conduit riser
625	Linear foot	No. __ circuit cable
625	Linear foot	No. __ light pole and bracket cable
625	Linear foot	Duct cable, __ Inch, __ conductors, No. __ AWG, 600 v
625	Each	Cable connector kit, type ____
625	Each	Structure grounding system
625	Each	Structure junction box
625	Lump Sum	Complete electrical equipmenti Installation
625	Each	Terminal cabinet base

625	Each	Controller cabinet base
625	Each	Splice box
625	Each	Power service
625	Each	Portable winch drive power unit
625	Each	__ foot steel pole
625	Each	__ foot, class __ wood pole
625	Each	Install city furnished __ foot steel pole
625	Each	Install city furnished __ foot, Class __ wood pole

ITEM 630 TRAFFIC SIGNS AND SIGN SUPPORTS

630.01 Description
630.02 Materials
630.04 Sign Fabrication
630.06 Sign Supports
630.07 Sign Erection
630.08 Sign Shipment and Storage
630.10 Covering of Signs
630.12 Removal and Storage, Reerection, or Disposal of Signs and Supports
630.13 Inspection
630.14 Method of Measurement
630.15 Basis of Payment

630.01 Description. This Work consists of furnishing and installing traffic signs and sign supports. This Work also includes necessary restoration of disturbed facilities and surfaces to a condition equal to that existing before this Work started.

630.02 Materials. The acceptance of Materials and products is based on Certified Test Data, furnished in triplicate, or on test results of samples according to 107.31.

Transfer manufacturers' Guarantees or warranties on all traffic sign material to the City upon completion and acceptance of the Project.

The Contractor shall furnish Materials conforming to:

U-channel posts	730.015
Hardware	730.08
Messenger wire	732.18
Aluminum:	
Sheet and plate	730.11
Forgings	730.15
Hardware	730.17
Other Materials:	
Reflective sheeting, Type F	730.18
Reflective sheeting, Type G	730.19
Reflective sheeting, Type H	730.192
Reflective sheeting, Type J	730.193
Nonreflective sheeting	730.20
Silk screen inks	730.22
Transparent electronic cuttable films	730.23

630.04 Sign Fabrication. Flat sheet signs consist of one-piece units made of aluminum. Temporary overlay signs consist of an aluminum sheet covering portions or entire surfaces of extrusheet signs.

Prior to reflective sheeting application, the Contractor shall clean aluminum sign surfaces either by total immersion in a tank containing an alkaline solution of the manufacturer's specification or by steam cleaning with an alkaline solution of the manufacturer's specification, followed by a thorough rinsing with running water. After cleaning, the Contractor shall etch the surface with an acid solution, and dry. The Contractor shall not allow cleaned and etched surfaces to become contaminated by contact with oil or grease.

The Contractor shall not use reboundable or damage control sheeting for permanent signs. The Contractor shall use sign legends according to the OMUTCD and the FHWA Standard Alphabets for Highway Signs.

For flat sheet signs, the Contractor shall use Type G, H or J reflective sheeting for background and reflective legends. For overhead extrusheet signs, the Contractor shall use Type G, H or J reflective sheeting for the background, and use Type H or J reflective sheeting for reflective legends, shields and symbols (including arrows and borders). The Contractor shall drill or punch bolt holes to finish size. The Contractor shall apply reflective sheeting to the surface according to the manufacturer's recommendations, with no blisters, wrinkles, tears, or blemishes. For reflective legends, the Contractor shall use reverse silk screen transparent ink, electronic cuttable film, or direct applied reflective sheeting copy. For nonreflective legends, the Contractor shall use direct silk screen black ink or direct applied nonreflective black sheeting copy.

630.06 Sign Supports. Sign supports shall consist of ground mounted and span wire types. Steel hardware shall be galvanized according to 730.08.

(a) Ground Mounted Supports. Ground mounted supports consist of the material and weights required. The Contractor shall drive the ground mounted supports into the earth. The support lengths shown on the Plans are approximate.

(b) Post Supports. The Contractor shall mark each driven post with a line of paint 6 inches above the specified driving depth. The Contractor shall drive posts to the specified depth without bending, distortion, or end mutilation. The Contractor shall not splice posts unless otherwise specified. The Contractor shall not place posts in drainage ditches. If unable to install the post at the specified location, the Contractor shall relocate the post with the Engineer's approval.

The Contractor shall install posts located in paved areas through a hole provided by sleeving or core drilling. After the post is in position, the Contractor shall patch the hole with asphalt concrete or an approved asphalt material.

Temporary sign supports and their placement shall conform to the OMUTCD.

(c) Span Wire Supports. The Contractor shall furnish span wire sign supports with sign hanger and messenger wire assemblies. The Contractor shall furnish anchor bolts and Conduit ells [at least one two inch minimum diameter] for installation in the foundation.

The Contractor shall achieve a span wire sag under load of four to five percent of the span. The Contractor shall adjust poles to be essentially vertical after span wire tensioning.

630.07 Sign Erection. The Contractor shall erect signs on ground mounted supports according to the schematic signing layout. The Contractor shall not remove an existing sign until the replacement sign is either erected or available for immediate erection. The Contractor shall not erect a replacement sign on a new support more than twenty-four hours before the removal of the existing sign.

Flat Sheet Sign Erection. The Contractor shall use steel bolts, wide washers, lock washers and nuts. The Contractor shall use bearing plates between the sign and U-channel post at each bolt. The Contractor shall field drill signs mounted on messenger wire or mast arms to match holes in brackets.

630.08 Sign Shipment and Storage. The Contractor shall package and ship finished flat sheet signs to assure adequate protection of the sign face, using methods and Materials as recommended by the reflective sheeting manufacturer.

The Contractor shall store signs, whether provided by the Contractor or furnished by the City, off the ground in a vertical position with adequate covering or shelter to prevent packing material from getting wet. The Contractor shall immediately remove packing material that does become wet from contact with sign faces to prevent damage to the reflective sheeting.

630.10 Covering of Signs. The Contractor shall Install temporary covers, and subsequently remove and dispose of them as shown on the Plans or as directed by the Engineer. For the covering material, use a sturdy opaque

material and obtain the Engineer's approval of the proposed method of covering and attachment.

630.12 Removal and Storage, Reerection, or Disposal of Signs and Supports. The Contractor shall carefully dismantle signs and sign supports indicated for removal. The Contractor shall either store on the Project, reerect, or dispose of removed signs and sign supports. To ensure maintenance of adequate traffic control at all times, the Contractor shall remove signs only with the Engineer's approval.

The Contractor shall remove sign supports in a manner to avoid damage. The Contractor shall remove sign service to the support by disconnecting and removing cables at the service pull-box. The Contractor shall ensure that connection of remaining cables conforms to 625.17. The Contractor shall remove support foundations to at least 1 foot below Subgrade or finished groundline. The Contractor shall backfill and restore surfaces to a condition equal to that of the existing before the Work started and dispose of surplus material at no cost to the City.

The Contractor shall furnish mounting hardware for signs to be reerected. The Contracor shall field drill as necessary. The Contractor shall furnish anchor bolts and Conduit ells for installation in the foundation for overhead sign supports to be reerected.

The Contractor shall remove temporary overlay signs so as not to damage the underlying sign.

630.13 Inspection. After erection, the Engineer will inspect signs under both Day and night conditions. The Contractor shall correct deficiencies in lateral position or visibility to the Engineer's satisfaction.

630.14 Method of Measurement. The City will measure Ground Mounted Post Support by the number of feet, and will include driving, and furnishing and placing of patching Materials for excavations in paved areas.

The City will measure Temporary Sign Support by the number of feet or the number of each furnished, erected, maintained, and removed.

The City will measure Span Wire Sign Support by the number of each support, and will include 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.

For pole mounted sign supports, the City will measure Sign Support Assembly by the number of each, and will include bands, brackets, hardware, and posts sufficient to attach each sign or set of signs to an individual pole.

The City will measure Sign by the number of square feet of signs, and will include the furnishing of identification stickers, sign backing assemblies, mounting bolts, washers, nuts, bearing plates, clips, and rivets. For square, rectangular, circular, or irregular shaped signs, the City will determine measurement by multiplying the largest dimensions of width and height. For triangular shaped signs, the City will determine measurement by multiplying the largest dimension of width and one half the largest dimension of height.

The City will measure Sign Erected by the number of square feet of signs erected, and will include mounting hardware, the assembly of signs that are in more than one piece and the installation of required sign backing assemblies. The City will exclude the furnishing of signs. For square, rectangular, circular, or irregular shaped signs, the City will determine measurement by multiplying the largest dimensions of width and height. For triangular shaped signs, the City will determine measurement by multiplying the largest dimension of width and one half the largest dimension of height.

The City will measure Covering of Sign by the number of square feet of sign face covered, and will include the subsequent removal and disposal of the covering.

630.15 Basis of Payment. The City will not pay for relocating posts from their planned location.

The City will pay for accepted quantities at the Contract prices as follows:

Item	Unit	Description
630	Each	Span wire sign support foundation
630	Foot	Ground mounted support,___ Post
630	Foot	Temporary sign support, ___ Post or Each
630	Each	Span wire sign support, ODOT Type TC-17.10, Design ___
630	Each	Sign hanger assembly, (span wire)
630	Square Foot	Sign, (flat sheet)
630	Square Foot	Sign erected, (flat sheet, Temporary overlay)
630	Square Foot	Covering of sign
630	Each	Removal of ground mounted (major) sign and (storage, reerection, or disposal)
630	Each	Removal of ground mounted (beam, post) support and (storage or disposal)
630	Each	Removal of overhead mounted sign and (storage, reerection, or disposal)
630	Each	Removal of overhead sign support and (storage, reerection, or disposal), ODOT Type TC-___
630	Each	Removal of overlay sign

ITEM 631 SIGN LIGHTING AND ELECTRICAL SIGNS

631.01 Description
631.02 General
631.03 Materials and Equipment
631.04 Sign Service
631.05 Signs Wired
631.06 Disconnect Switch
631.07 Luminaire
631.08 Controls
631.09 Electrical Signs
631.10 Removal and Storage or Reerection
631.11 Inspection and Testing
631.12 Method of Measurement
631.13 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.

631.02 General. Installations shall be performed according to the National Electrical Safety Code. Overhead sign lighting shall be furnished with mercury vapor luminaries, and shall integrate electrical power with Roadway lighting circuits.

The requirements in 625.04 for working Drawings shall apply.

Wire and cable shall be protected by installing entirely within support Structure interiors, enclosures, junction boxes, and rigid or flexible Conduit. The methods, Materials, and locations of splicing and the methods of connecting and identifying wire and cable shall conform to Item 625, Item 725, and the Plans. Grounding systems shall be furnished according to 625.10.

Power service shall be furnished under Item 625.

631.03 Materials and Equipment. Materials and Equipment furnished shall be new, of first quality, of current design, and free from defects, and shall comply with the National Electric Code and local codes for the area of installation. Furnished Materials shall not contain polychlorinated biphenyls.

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.

Each item of Equipment shall bear a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer.

Specified Materials and items shall be as follows:

Ground rod……..…… 625.10
Sealing, Conduit……..…… …….625.13
Cable and wire, 600-volt…….…….. 725.02
Conduit, rigid…….…….. 725.04
Mercury vapor ballast…….…… 725.11
Mercury vapor lamp…… 725.14
Power service…….…… 725.19
Disconnect Switch…….. 725.19
Switch Enclosure…….…….. 725.19
Mercury vapor luminaire…….. 731.01
Changeable message sign, electric type….. 731.03
Changeable message sign, drum type…….. 731.04
Internally illuminated fixed message sign……731.05
Sign flasher assembly…… 731.06
School speed limit sign assembly…… 731.07
Conduit, flexible…….. 731.08
Timer with enclosure…….. 731.10

631.04 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 shall be routed from a pull box to the switch enclosure for overhead supported signs by means of underground Conduit, foundation Conduit ell, and the interior of the structured member supporting the enclosure.

Sign service for overpass Structure mounted signs shall be routed through underground and Structure attached Conduit terminating at a switch enclosure. 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 cable from a distribution system direct drop shall be routed to the switch enclosure by means of a Conduit riser with weatherhead. A drip loop shall be formed into the cable. A cast aluminum or galvanized ferrous metal weatherhead of a threaded design shall be used. 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 use single conductor stranded copper cable. When the connection is to highway lighting distribution and circuit cable, the sign service shall use the same cable. In other applications, sign service cable shall be rated at 600 volts minimum and not smaller than No. 4 AWG.

631.05 Signs Wired. Signs wired shall complete the electrical system from the disconnect switch to the luminaries.

The Contractor shall furnish continuous wiring from the disconnect switch to a junction box mounted on the sign support or overpass Structure. A junction box shall be installed in a manner that allows 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.

The Contractor shall furnish continuous wiring from the junction box to the first luminaire and between additional luminaries.

The Contractor shall use wire rated at 600 volts, single conductor, and not smaller than No. 10 AWG.

Wire on overhead sign supports shall be routed 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 wiring in the disconnect switch enclosure, the nipple in the enclosure shall be sealed back with self-fusing high-dielectric insulating compound.

Flexible or rigid Conduit on sign Structures or lighting support arms shall be assembled with condulets which are attached to the Structure with clamps located within 6 inches of each Conduit end and separated by not more than 24 inches.

631.06 Disconnect Switch. Lighted signs shall be installed with a disconnect switch within a lockable, weatherproof enclosure. The Contractor shall furnish a two-pole (minimum), single-throw, fused safety disconnect type switch rated at 600 volts and 30 amperes fused as specified. A solid neutral bar shall be included.

The enclosure shall be stainless steel NEMA 250, Type 4. The enclosure back shall have room for a chase nipple. A hole shall be field drilled through the enclosure and a nipple installed. The enclosure shall 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 bronze or brass lock body and a corrosion protected steel shackle.

All padlocks for a Project shall be keyed alike. The appropriate master key number shall be obtained from the City.

When specified, the Contractor shall furnish and install bracket assemblies on existing overhead sign supports or on concrete Structures. Bracket assemblies shall be made of steel galvanized according to 711.02, or aluminum.

631.07 Luminaire. Luminaires shall include a lamp of the wattage specified.

Ballasts shall be located integral with the luminaire. A weatherproof ballast housing made from corrosion resistant material shall be furnished.

631.08 Controls. When specified, photoelectric controls shall be furnished when sign lighting is fed by uncontrolled circuits.

When specified, a timer with enclosure shall be furnished to provide automatic school speed limit sign operation.

631.09 Electrical Signs. The Contractor shall furnish changeable message signs that conform to the Contract Documents. The pay item will specify if the display capabilities are limited message or unlimited message. The Contractor may use line units of these types as inserts in a panel sign, singly or grouped to provide a multiline sign. Hardware and software shall be complete to operate and maintain the sign.

The Contractor shall furnish internally illuminated signs consisting of the single or double face type. The sign support is furnished under another pay item. The Contractor shall furnish suspended signs that hang plumb, are properly oriented, and locked in place.

The Contractor shall furnish sign flasher assemblies consisting of a pair of flashing beacons and source of illumination for a sign face. The sign, support, and foundation are furnished under other pay items.

The Contractor shall furnish school speed limit sign assemblies that conform to the Contract Documents. School speed limit sign assemblies shall consist of a reflectorized SCHOOL SPEED LIMIT 20 WHEN FLASHING sign, or legend as specified, with a pair of flashing beacons arranged above and below the sign.

631.10 Removal and Storage or Reerection. The Contractor shall carefully remove sign lighting Equipment (such as luminaries, disconnect switches, or ballasts) and electrical signs, and either store on the Project for salvage by the City or reerect elsewhere on the Project. The Contractor shall clean and restore luminaries to be reerected to an operating condition, fit with new lamp boots, relamp with the proper type and size lamp, and provide with new hardware.

631.11 Inspection and Testing. The sign lighting systems and electrical signs shall meet all requirements of the ground, cable insulation, and performance tests specified in 625.22. The Contractor shall correct lamps, ballasts, and transformers that fail during the performance test by replacing the faulty component; the entire test period will not require restarting.

During the performance test, the Contractor shall make final adjustment to sign lateral position and aiming angles of luminaries 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.

631.12 Method of Measurement. All of the following methods of measurement shall include all hardware necessary to securely mount the associated item including angles, plates, tubes, and channels.

The City will measure Sign Service by the number of complete units for each support, and will include Conduit, Conduit riser, weatherhead, fittings, cables, trenching, and backfilling.

The City will measure Sign Wired and Sign Wired, Overpass Structure by the number of complete units of wiring for each individual sign, and will include junction boxes, rigid or flexible Conduit, condulets, clamps, wires, and connectors.

The City will measure Disconnect Switch with Enclosure by the number of each, and will include field drilling and padlocks.

The City will measure Switch Enclosure Mounting Bracket Assembly by the number of each, and will include two brackets and field drilling.

The City will measure Ballast and Photoelectric Control by the number of each separate item.

The City will measure Mercury Vapor Luminaire by the number of each, and will include lamps and luminaire attachment hardware.

The City will measure Changeable Message Sign by the number of each, and will include cabinet, external enclosures, Conduit, electrical, electronic, and auxiliary components, and remote control units to provide a fully functional unit.

The City will measure Internally Illuminated Fixed Message Sign by the number of each, and will include lamps and ballasts.

The City will measure Sign Flasher Assembly by the number of each, and will include sign lighting fixtures, beacons, flasher control unit with enclosure, and lamps.

The City will measure School Speed limit Sign Assembly by the number of each, and will include sign, beacons, flasher control unit with enclosure, and lamps.

The City will measure Timer with Enclosure by the number of each, and will include field drilling and padlocks.

The City will measure Removal and Storage or Removal and Reerection of sign lighting Equipment or electrical signs by the number of each like item removed and stored or reerected.

631.13 Basis of Payment. The City will pay for grounding systems under Item 625.

The City will pay for accepted quantities at the Contract prices as follows:

Item	Unit	Description
631	Each	Sign service
631	Each	Sign wired
631	Each	Sign wired, overpass structure
631	Each	Disconnect switch with enclosure, Type ___
631	Each	Switch enclosure mounting bracket assembly
631	Each	Ballast, Type ___
631	Each	Photoelectric control
631	Each	Mercury vapor luminaire, Type ___, with ___-watt lamp
631	Each	Changeable message sign, (limited, unlimited) message
631	Each	Internally illuminated fixed message sign, Type ___
631	Each	Sign flasher assembly
631	Each	School speed limit sign assembly, ___ inches x ___ inches
631	Each	Timer with enclosure
631	Each	Removal of (luminaire, disconnect switch, ballast, etc.) and (storage or reerection)

ITEM 632 TRAFFIC SIGNAL EQUIPMENT

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632.01 Description. This Work shall consist of furnishing and installing traffic signal Equipment, complete and ready for service, in conformance with the specified material quality and performance, and at the locations shown in the Plans. 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 will be paid for under other items of Work.

632.02 Contractor Personnel Requirements. The Contractor shall have a foreman assigned to each crew performing traffic signal construction for a Project. A foreman shall be present at all times when Work is performed by the crew. Each foreman shall be an International Municipal Signal Association (IMSA) level one certified technician.

The Contractor shall present to the Engineer, prior to the commencement of Work, the required IMSA level certification papers for all signal technicians working on a Project.

632.03 Materials and Equipment. Materials and Equipment furnished shall be new, of first quality, of current design, and free from defects.

Electrical parts, wire, switches, and other elements of the installations shall be of capacity to carry the required current without excessive heating or drop of potential.

Major items or assemblies of Equipment shall bear a nameplate, indelible marking, or brand that shall identify it as to type, model, catalog number, and manufacturer.

Material and Equipment shall conform to the following:

Concrete, Class D	499,511
Steel*:	
Poles, supports, arms, appurtenances, and anchor bases	625.06, 632.14, 632.15 632.16, 732.11, 732.12
Pedestals	732.15
Other Items:	
Conduit, rigid	725.04, 725.07
Ground rod	725.16
Pull boxes	725.081, 725.082, 725.09
Identifying tags or bands	725.02
Signal heads	732.01, 732.02, 732.03, 732.05
Lamps	732.04
Pushbuttons	732.06
Detectors	732.07, 732.08, 732.09
Probes	732.10
Wood poles	732.13
Down guys	732.14
Conduit risers	732.16
Cable supports	732.17
Messenger wire	732.18
Cable and wire	732.19
Power service	732.20
Disconnect switch with Enclosure	732.21

*Acceptance of Materials and products will be based on Certified Test Data, furnished in triplicate, or on test results of samples in accordance with 107.31.

632.04 Working Drawings. The requirements in 625.04 for Working Drawings shall apply.

632.05 General. Major items of traffic signal control Equipment used in combination shall be compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier. Electrical Materials, Equipment, and installations shall comply with the National Electrical Code and the National Electrical Safety Code, and conform to local laws and codes. Structural aspects of design and Materials shall comply with AASHTO Standard Specifications for Highway Signs, Luminaires, and Traffic Signals.

Traffic control Equipment installed in controller cabinets shall be shop pre-wired according to a wiring diagram that conforms to plan and specification requirements of the specific Project and intersection, and shall show all wire harness and field connections required, with abbreviations according to Table 632.05-1. The wiring diagram shall be neat and legibly drawn, reproduced on durable paper, and two copies shall be placed in a plastic envelope fastened to the inside of the controller cabinet. All controllers shall be bench tested prior to placement into the street to assure correct signal phasing and timing.

Cable and wire shall be identified by tags or bands at pull boxes and controller cabinets, with size, material, and method of marking that conform to 725.02, except that the identification on the tags or bands shall conform 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.

Spade terminals shall be used for wiring connected at signal heads and the wiring connected at terminal blocks within controller cabinets. However, incoming power wiring may use either spade terminals or bared conductor wire connected to terminal points utilizing screw or spring applied clamping surfaces compatible with both copper and aluminum wire and providing a positive grip. Completed wiring shall be neatly lashed and fastened to interiors with clamps and/or ties.

TABLE 632.05-1 CABLE AND WIRE IDENTIFICATION

CABLE	TAG
GROUND	GND
Power (2 wire) 1Ø 120 volt	AC+ AC- or ACN
Power (3 wire) 1Ø 120/240 volt Neutral wire	AC + 1, AC + 2 AC- or CAN
Phase 1	Ø 1
Phase 1 northbound left turn lanes	Ø 1 NBLT
Phase 1, pedestrian signal	Ø 1 PED
Overlap, phase 1+6	Ø 1 + 6
Detector lead-in, phase 1	DET 1
Detector lead-in, phase 1 northbound left turn lanes	DET 1 NBLT
Detector lead-in, phase 1 (call type)	DET 1 CALL
Detector lead-in, phase 1 (call type) northbound thru lanes	DET 1 CALL NB-THRU
Detector harness*	DET 1
Interconnect	IC
Pre-emption, fire	PE FIRE
Pre-emption, railroad	PE RR

*Place the tag next to the MS plug at the detector amplifier.

Power supplied to the disconnect switch shall be 120/240 volt, single-phase, three-wire (grounded neutral).

After completion of the ten Day performance test in compliance with 632.28 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, the Contractor shall transfer to the City all manufacturers' Guarantees or warranties covering installed electrical or mechanical Equipment. Two copies of wiring diagrams, service manuals, and instructions on installation and maintenance shall be furnished for each different type, model, or system of Equipment used on the Project.

632.06 Vehicular Signal Head, Conventional. Heads shall be furnished 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. Signal faces shall be mounted 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.

Multi-way heads shall be furnished with top and bottom brackets for mounting purposes. Faces of lesser height in multi-way heads shall be fitted with pipe spacers. Openings unused for mounting purposes shall be closed with weatherproof caps.

Signals shall be installed in a plumb condition, using a balance adjustor only if necessary. Heads mounted on mast arms, except those intended to be rigidly mounted, shall be fitted with a universal hanger allowing the head to swing in both longitudinal and transverse directions. Drop pipes of suitable length shall be used only when necessary to bring the bottom of the signal heads to a proper Roadway clearance. Disconnect hangers shall be used for suspended heads when specified.

Each signal face shall be oriented to its traffic approach, and locked in place by the serrated or other type device incorporated in signal housing and support hardware.

Lamps of the proper wattage and light center distance shall be installed in each section or, when specified, LED lamps shall be installed in each section. Lamp sockets shall be rotated so as to position the open portion of the incandescent lamp filament in an upward position.

632.07 Vehicular Signal Head, Optically Programmed. Heads of this type shall be furnished so as to consist totally of optically programmed

sections unless an intermix of optically programmed and conventional sections is specified. Lamps shall be installed in each optically programmed section.

The Contractor shall program each signal section according to the plan requirements. For 8 inch sections, an extender tool as recommended by the manufacturer shall be used to program each section. Upon completion of the Project, one extender tool per Project shall be delivered to the City.

632.08 Pedestrian Signal Head. Heads shall be furnished with the type of light source and symbol height specified. Each signal head shall be oriented to its crosswalk, and locked in place by the serrated or other type device incorporated in signal housing and support hardware. Openings unused for mounting purposes shall be closed with weatherproof caps.

632.09 Pedestrian Pushbutton. Pushbuttons shall be properly oriented and installed on poles or pedestals. Pushbuttons mounted on steel poles shall be serviced by wiring inside the poles. Holes 3/4 inch in diameter shall be provided through the back of the housing and the pole wall, a rubber grommet shall be installed, and wiring routed through until no external wiring is visible. Any unused Conduit attachment holes shall be plugged. The housing shall be attached by machine or self-tapping screws in the housing back wall. Pushbuttons mounted on wooden poles shall be serviced through Conduit. Pedestrian pushbutton signs of the legend and size required shall be furnished.

632.10 Loop Detector Unit. Detector units shall be installed and tuned to their loops with the sensitivity set for optimum operation and any interference or cross talk eliminated between other detector units in the cabinet. A field check shall be performed 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, the Contractor shall eliminate the extraneous detections.

632.11 Detector Loop. Slots shall be sawed in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations required. An extension shall be cut from the loop to the pavement edge to allow wire routing to an adjacent pull box.

Slots 1/16 to 1/8 inch wider than the outside diameter of the loop wire or tubing shall be furnished. The slot depth shall provide a covering of not less than 3/4 inch above the uppermost detector wire or tubing after the loop installation is completed. Before installing loop detector wire, all slots shall be brushed and

blown clean of loose material and completely dry. Loop detector wire shall be installed according to 632.23.

The slots shall be filled completely with an approved flexible embedding sealant in accordance with the requirements of Item 705.

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 Magnetometer Detector Unit. Detector units shall be installed in cabinets and connected to pavement embedded sensor probes.

632.13 Magnetometer Sensor Probes. Probes shall be properly located and installed in holes in pavement or Bridge slabs. Probe holes shall be formed during concrete placement by pouring around a vertical piece of capped PVC or other non-metallic Conduit. Probe holes shall be drilled in existing pavement. Probe positions on Bridge slabs shall be centered in the steel reinforcing grid square nearest to the plan location using a metal locator, such as a Pachometer. Sensor probe leads shall be installed in non-metallic Conduit, in sawed pavement slots, or by other design methods. Probes, and leads if installed in slots, shall be embedded with flexible sealant according to 632.11.

632.14 Foundations. Support foundations shall be located by the Contractor and staked with the proper elevation. If underground or overhead obstacles are encountered during stakeout, or to correct slope and subsurface difficulties, the foundation location and orientation may be changed with the approval of the Engineer. The approved location shall provide a safe clearance from overhead power lines for construction operations, in compliance with the National Electric Safety Code. The Contractor shall be responsible for the correct location, elevation, and orientation for all poles and pedestals installed on the foundations.

Excavation for foundations shall be made by an earth auger to specified dimensions according to 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 Engineer's approval. When subsurface obstructions are encountered, the Contractor may remove the obstructions, 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 fifty percent. The Contractor shall perform all necessary dewatering of the excavation.

Foundation concrete Work shall conform to the requirements of Item 511. The concrete shall be placed against undisturbed soil or compacted embankment. The top of the foundation shall be formed to a nominal depth of 6 inches below the groundline. The concrete foundation, including formed top, shall be placed in one continuous concrete pour.

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.

Remove forms and templates once the concrete has hardened sufficiently so as not to be susceptible to damage. Remove bracing for embedded supports after seven Days. After fourteen Days, load embedded supports, and erect and load supports on anchor base foundations. The Contractor may erect and load supports after seven 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.

632.15 Signal Support. Supports with mast arms shall be furnished with the required pole and arm length, anchor bolt circle diameter, and anchor bolt size.

Combination signal supports with light pole extension shall provide for the attachment of a luminaire bracket arm.

Support designs not specifically detailed on the Plans shall be demonstrated, to the satisfaction of the Engineer, as being structurally equivalent to the specified design.

Individual anchor bolt covers or cover bases shall be furnished for poles erected in Sidewalks, traffic islands, curbed areas, and seeded areas of urban character as defined in 659.09, or when directed by the Engineer. Concrete grouting shall not be used in the space between the foundation surface and support base.

632.16 Strain Pole. Strain poles for the attachment of messenger wire shall be anchor base type unless the type for concrete embedment is specified.

Combination strain poles with light pole extension shall provide for the attachment of a luminaire bracket arm.

Anchor base type poles shall be adjusted and embedded type poles shall be set with the initial rake so that under messenger wire tensioning as per 632.22 the poles shall assume an essentially vertical position.

Individual anchor bolt covers or cover bases shall be provided under conditions as specified by 632.15.

632.17 Wood Pole. Wood poles shall be set in holes excavated by an earth auger to a minimum depth of 6 feet. Auger diameter shall be approximately 4 inches greater than the pole butt. Pole shall be held with initial rake, up to a maximum of 12 inches, while backfill is tamped into place, so that under messenger wire tensioning conforming to 632.22, the poles will assume an essentially vertical position. Backfill shall be no greater than 1 inch in size and thoroughly tamped in lifts not exceeding 6 inches, to the satisfaction of the Engineer. When concrete embedment is specified, poles shall be braced until the concrete has set.

Field holes bored for the attachment of messenger or guy wire shall be liberally coated with an approved creosote base paint and fitted with 5/8 inch thimble-eye through-bolts and 3 inch washers. Ground wire furnished as part of another work item shall be securely attached and protected with a wood or plastic molding for a distance of 10 feet above the groundline.

632.18 Down Guy Assembly. Guy assemblies shall be installed and tensioned before erection of signals such that they will resist the major portion of the horizontal loading caused by loading of the messenger wire.

632.19 Pedestal. Pedestals for the support of traffic control Equipment shall have a cast or plate steel base, unless a transformer type base is specified.

632.20 Conduit Riser. Risers shall be attached to poles to provide a wiring raceway and shall include a weatherhead, Conduit, necessary fittings, and pole attachment clamps. Risers shall be attached to poles by clamps spaced at intervals not exceeding 5 feet. Paint Conduit risers mounted on painted poles to match the poles.

632.21 Cable Support Assembly. Cable support assemblies shall be used 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. When required, a length of messenger wire forming a sling with ends formed of lapped wire, thimbles, and clamps shall be a part of the assembly.

632.22 Messenger Wire. Messenger wire with accessories shall be arranged between two or more poles to provide support and attachment for traffic control Equipment. Accessories used with messenger wire shall include bullrings, thimbles, preformed guy grip dead ends, and three bolt clamps. Strain insulators shall be inserted in the messenger wire near each strain pole. Bullrings shall be furnished at messenger wire network corners. Thimbles shall be used for attaching messenger wire to the shackles of strain pole clamps and bullrings.

The length of the messenger wire shall be adjusted under the load of traffic control Equipment so the sag at the lowest point shall not be greater than five percent or less than three percent of the span. Signal cable shall be attached 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. Interconnect cable shall be attached with preformed lashing rod or spinning wire.

632.23 Cable and Wire. Cable at traffic signal Equipment weatherhead entrance fittings or splice enclosures shall be fashioned into a drip loop that extends at least 6 inches below the entrance and shall not chafe on the Equipment. Cable installed in strain poles and signal supports with cable support assemblies shall be supported according to 632.21.

Splices shall not be permitted 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.

Permitted splices in aerial installations shall be accomplished in weather tight splice enclosures. Permitted splices in underground installations shall be accomplished in pull boxes or poles where the splice is encapsulated with poured waterproof epoxy insulation according to 725.15.

Signal cable shall be installed between signal heads and controller cabinets, and interconnect cable installed between controller cabinets of different intersections. Signal and interconnect cable routing may be by aerial installation supported by messenger wire or within underground Conduit. When so specified, interconnect cable shall be of the aerial self-supporting integral messenger type with a figure “8” cross-section and shall include pole clamps and splice enclosures. The supporting messenger wire of interconnect cable shall be grounded.

Loop detector wire shall consist of detector wire inserted into flexible plastic tubing. The tubing shall encase the wire continuously from the splice at the lead-in cable, through the entire loop turns, and back to the splice. Loop detector wire shall be installed in sawn Roadway slots forming loops according to 632.11. The number of turns of wire installed for each loop shall be as required and the wire shall be pushed carefully into the slots with a blunt tool to avoid damaging the tubing. The wire shall be run continuously around the loop perimeter and through a slot leading to the pavement edge and by underground Conduit to a Roadway pull box or pole with 5 feet at each end for slack and splice. Wires and tubing installed in the Conduit to the splice with lead-in cable shall be twisted uniformly at three to five turns per foot. The loop ends shall be spliced to a lead-in cable, which is connected to the controller cabinet. The wires shall be joined 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 725.15. The tubing ends shall be extended 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, the leads from the probes to the specified lead-in cable shall be spliced by the same method. Lead-in cable shall be routed within underground Conduit or by aerial installation supported by messenger wire.

Power cable shall be installed from the power supply source to the controller cabinet. When multi-conductor power cable is specified, multiple single conductors may be substituted.

Service cable shall be installed aerially from a remote power source to the vicinity of the controller cabinet with the support cable functioning as the electrical neutral. Connections used with aluminum power or service cable shall be of an approved type for aluminum to aluminum or aluminum to copper connections, and insulated with an approved vinyl mastic pad.

632.24 Power Service. The Contractor shall furnish and install all Equipment necessary to provide complete electrical service to each signal installation as shown on the Plans.

Power service shall consist of Equipment to provide a pole attached wiring raceway and disconnect switch for use with power cable routed from the service entrance to the controller cabinet. The power service installation shall include a weatherhead, Conduit and fittings, a disconnect switch with enclosure, meter base and attachment clamps.

The Conduit riser shall terminate at an electric meter base, or termination shall be at the disconnect switch enclosure. The Conduit shall be bent away from the pole at the top and bottom of the riser to allow the Conduit to

enter straight into the enclosure or meter base hub, and to provide space for the weatherhead when the riser is pulled tight against the pole. Watertight Conduit connections shall be furnished between the meter base and enclosure by using Conduit hubs listed on the enclosure UL label.

From the switch enclosure, a connection may be made to a controller cabinet, a pull box, an underground Conduit, or a Conduit riser. The switch enclosure neutral bar shall be grounded directly to the pole grounding lug.

Conduit risers mounted on painted poles shall be painted to match the poles.

632.25 Covering of Vehicular and Pedestrian Signal Heads. Vehicular signal heads shall be covered when erected at intersections where traffic is maintained before energizing the signals. Pedestrian signal heads shall be covered when specified in the Plans. The covering material shall be a sturdy opaque material and the proposed method of covering and cover attachment shall be approved by the Engineer. Covers shall be maintained by the Contractor and shall be removed and disposed of when directed by the Engineer.

632.26 Removal of Traffic Signal Installation. Removal shall include signal heads, cable, messenger wire, strain poles, cabinet, controller, or other incidental items required by the Engineer. Support foundations shall be removed to at least 1 foot below Subgrade or finished groundline. The Contractor shall backfill, restore surfaces, and dispose of surplus material according to 603.09. Removed items shall be stored on the Project for salvage by the City or reuse removed items as part of a new installation on the Project under another item of Work. All items not designated for salvage or reuse shall be disposed of by the Contractor. As specified in 614.03, signals shall not be removed until a new signal system or a temporary traffic control method approved by the Engineer is in operation. Equipment to be stored shall be suitably protected.

632.27 Reuse of Traffic Signal Equipment. Specified traffic Equipment removed from existing signal installations within the Project, shall be reinstalled or reerected. Equipment to be reused shall be cleaned and restored to an operating condition, and signals shall be relamped with the proper type and size lamp. The Contractor shall provide all additional hardware and incidentals necessary to allow reuse of the Equipment.

632.28 Testing.

(a) General. 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 by the Engineer, or alternate certification approved by the Engineer.

(b) Ground Test. Each ground rod shall be measured for earth resistance according to 625.19, except that measurements are not necessary immediately after installation.

(c) Short-Circuit Test**.** Prior to the performance of any cable insulation tests or performance test, a short-circuit test shall be performed with a volt-ohmmeter or other approved instrument. Short-circuit tests shall be conducted with electrical loads, power sources, Equipment grounds, and earth grounds disconnected. Signal cable routed to signal heads may be tested with connections made to lamp sockets without lamps installed. Each conductor shall be measured against every other conductor and ground to ensure that no short-circuits, cross-circuits, or other improper connections exist. Continuity shall not exist between any conductor and another conductor including ground.

(d) Circuit Continuity Test. Each circuit branch shall be temporarily jumpered 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. Lead-in cable for loop detector wire shall be tested before and after the cable is spliced to the loop wire. As an alternative, circuit continuity testing of signal head cable may be done by applying 120 volts to each outgoing circuit and observing that only the proper lamps are lighted.

(e) Cable Insulation Test. The insulation resistance measured to ground shall be not less than ten megohms for each conductor of cable or wire terminating at the controller cabinet. Insulation testing shall be performed with all conductors disconnected from their points on the terminal blocks. Insulation resistance shall be measured for the wire of Roadway loops after the embedding of the wire with sealant in slots. When testing signal wire attached to a span wire support system, a temporary jumper on the span wire shall be used at strain insulators. A list of the resistance readings for each conductor shall be included in the test results. After completing the cable insulation test, the Contractor shall connect all cabinet wiring according to the wiring diagram. The Contractor shall demonstrate to the satisfaction of the Engineer that all circuits are continuous and operating correctly with freedom from shorts, crosses, and unintentional grounds.

(f) Functional Test. Before the ten Day performance test begins, the Contractor shall make the 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 are 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 seven Days before the performance test begins, the Contractor shall notify the Engineer of the starting date. Prior to acceptance, the Contractor shall operate the traffic control system continuously for ten consecutive Days without major malfunction or failure. Minor failures such as lamps, a single detector unit, or an individual signal head, etc., shall be immediately replaced or repaired and shall not cause restart of the test. Major malfunctions or failures such as master or local controller, interconnect Equipment, etc., shall cause termination of the test and, after replacement or repair, the beginning of a new ten Day test. Items which have been repaired or which are replacements shall be monitored for a ten Day period to provide assurance of their reliability. The Contractor shall record, for inclusion in the test result, the method and date of correction of each fault, and the beginning and end of the test.

632.29 Method of Measurement. Measurement will be made for specific items, furnished and in place, complete and accepted, in accordance with the following. Any items of labor, Materials, or Equipment required but not shown as separate payment items shall be furnished and installed as incidental to the Contract.

Vehicular Signal Head and Pedestrian Signal Head will be measured by the number of complete units, and will include all support or mounting hardware, disconnect hangers, closure caps, dimmers, and lamps as required. Optically programmed heads shall include programming. For programming purposes, 8 inch programmed heads shall include one extender tool per Project.

Pedestrian Pushbuttons will be measured by the number of individual units, and will include pedestrian pushbutton signs.

Loop Detector Units and Magnetometer Detector Units will be measured by the number of individual units, adjusted and tuned, and will include a wiring harness. If multi-channel detector units are used, each channel will be measured as an individual detector unit up to the number of units specified.

Magnetometer Sensor Probes will be measured by the number of individual probes, and will include pavement cutting, probe and lead installation, and application of sealant.

Detector Loops will be measured by the number of complete 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 or pole.

Strain Pole Foundations, Signal Support Foundations, and Pedestal Foundations will be measured 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.

Signal Supports, Combination Signal Supports, Strain Poles, Combination Strain Poles, Strain Poles Embedded, Combination Strain Poles Embedded, Wood Poles, and Pedestals will be measured by the number of complete units each, and will include pole arms, weatherheads and blind half couplings, anchor bolts and Conduit ells furnished for foundations, and required individual anchor bolt covers or cover bases.

Down Guys will be measured 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.

Conduit Risers will be measured by the number of complete units, and will include weatherhead, Conduit, fittings, clamps, and hardware.

Messenger Wire will be measured by the number of feet in place, and will include all necessary accessories such as, grips, thimbles, clamps, bullrings, and lashing rod. Measurement will be from pole center to pole center, or pole center to bullring, or bullring to bullring. The measurement will not include any

length of messenger wire for attachment to poles, or bullrings by bending, lapping, or wrapping.

Signal Cable, Interconnect Cable, Loop Detector Lead-In Cable, Magnetometer Lead-In Cable, Power Cable, and Service Cable will be measured by the number of feet 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. Measurement will be (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 measurement will be the required length of multi-conductor cable.

Power Service will be measured by the number of complete units, and will include weatherhead, Conduit, fittings, clamps, and other necessary hardware, installation of meter base, ground wire connection, and disconnect switch with enclosure.

Covering of Vehicular Signal Head and Covering of Pedestrian Signal Head will be measured by the number of individual signal heads covered, and will include Materials and labor to erect, maintain, and remove the covering.

Removal of Traffic Signal Installation will be measured by the number of installations removed, and will include storage when required.

Removal of (Item) and (Storage or Reerection) will be measured 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.

Reuse of (Item) will be measured by the number of traffic signal Equipment items reused, and will include cleaning, restoring, and relamping.

632.30 Basis of Payment. Payment for accepted quantities of traffic signal Equipment items as provided above will be made at the Contract Unit Price. Payment shall be full compensation for all labor, Materials, tools, Equipment, and other incidentals necessary for each item furnished, in place, all connections made and wiring completed, tested, and accepted.

The costs to arrange service by the supply agency are included under Power Cable.

The cost 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 will pay for accepted quantities at the Contract prices as follows:

Item	Unit	Description
632	Each	Vehicular signal head, (LED), ____-section ____ inch lens,____-way
632	Each	Vehicular signal head, optically programmed, ____-section, ____ inch lens, ____-way
632	Each	Pedestrian signal head, (LED), Type ____
632	Each	Pedestrian pushbutton
632	Each	Loop detector unit
632	Each	Detector loop
632	Each	Magnetometer detector unit
632	Each	Magnetometer sensor probe
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 pole embedded, Type TC-____, Design ____
632	Each	Wood pole, Class ____, (Length) ____ feet
632	Each	Down guy
632	Each	Pedestal, (length) ____ feet
632	Each	Pedestal, (length) ____ feet, transformer base
632	Each	Conduit riser, ____ inch dia.
632	Linear Foot	Messenger wire, (no.) strand ____ inch dia., with accessories
632	Linear Foot	Signal cable, ____-conductor No. ____ AWG
632	Linear Foot	Interconnect cable, ____-conductor no. ____ AWG
632	Linear Foot	Interconnect cable, integral messenger wire type conductor no. ____ AWG
632	Linear Foot	Loop detector lead-in cable
632	Linear Foot	Magnetometer lead-in cable
632	Linear Foot	Power cable, ____-conductor no. ____ AWG
632	Linear Foot	Service cable, ____-conductor no. ____ AWG
632	Each	Power service
632	Each	Covering of vehicular signal head
632	Each	Covering of pedestrian signal head
632	Each	Removal of traffic signal installation
632	Each	Removal of (item) and (storage or reerection)
632	Each	Reuse of (item)

ITEM 633 TRAFFIC SIGNAL CONTROLLERS

633.01 Description
633.02 Contractor Personnel Requirements
633.03 Materials and Equipment
633.04 Working Drawings
633.05 General
633.06 Testing and Prequalifications
633.07 Controllers
633.08 Cabinets
633.09 Cabinet Riser
633.10 Foundations
633.11 Controller Work Pad
633.12 Flasher Controller
633.13 Method of Measurement
633.14 Basis of Payment

633.01 Description. This Work shall consist 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. The Contractor shall have a foreman assigned to each crew performing traffic signal construction for a Project. A foreman shall be present at all times when Work is performed by the crew. Each foreman shall be an International Municipal Signal Association (IMSA) level one certified technician.

All controller Work as defined in items (1) through (4) shall be performed by an IMSA level two certified technician: (1) back panel wiring terminations; (2) programming; (3) turn on; and, (4) troubleshooting.

The Contractor shall present to the Engineer, prior to the commencement of Work, the required IMSA level certification papers for all signal technicians working on a Project.

633.03 Materials and Equipment. Materials and Equipment shall be new, of first quality, of current design, and free from defects.

Electrical parts, wire, switches, and other elements of the installation shall be capable of carrying the required current without excessive heating or drop of potential.

Major items or assemblies of Equipment shall bear a nameplate, indelible marking, or brand that identifies the type, model, catalog number, and manufacturer. Equipment provided shall conform to the types, models, and systems specified.

Material and Equipment shall conform to the following:

Concrete, Class D	499, 511
Conduit	725.04, 725.05
Controller unit	733.02
Cabinet and auxiliary Equipment	733.03
Cabinet riser	733.04
Flasher controller	733.05

633.04 Working Drawings. The requirements in 625.04 for Working Drawings shall apply.

633.05 General. Major items of traffic signal control Equipment which are used in combination shall be compatible, interchangeable, and, whenever feasible, provided by the same manufacturer or supplier.

Controller cabinets shall be shop pre-wired according to 632.05.

Before starting installation, the Contractor shall 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. The Contractor shall furnish one additional copy of the cabinet wiring diagrams in a clear plastic pouch fastened to the inside of the controller door. Before beginning the ten Day performance test, the Contractor shall replace or modify these documents as necessary to reflect current conditions. Upon completion of the Work and before its acceptance, the Contractor shall replace or modify the documents as necessary.

The Contractor shall transfer manufacturers' guaranties on all installed traffic signal control Equipment to the City upon completion and acceptance of the Project.

If required by the Plans to install Equipment furnished by others, the Contractor shall store and protect the Equipment upon receipt.

633.06 Testing and Prequalification. For all traffic control Equipment, the Contractor shall perform functional tests and a ten Day performance test according to 632.28. Conflict monitor logs shall not be cleared

during the ten Day test. The logs shall note power-up to start the test and all events until the test is complete. The Contractor shall restart the test upon correcting a noted event. The Contractor shall notify the Engineer at least three Days before beginning the ten Day performance test. The following testing and prequalification requirements shall be met:

(a) The Contractor shall furnish a certified test report indicating compliance to all requirements of NEMA Standards Publication TS-1 or TS-2 as applicable.

(b) The Contractor shall 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.

(c) The Laboratory shall provide City representatives access to those parts of the Laboratory where testing was done.

(d) Upon request, the Contractor shall furnish a copy of the actual test data results for review and analysis.

633.07 Controllers. The Contractor shall install controller units, consisting of the timing unit, software, and signal timing, into the specified type of pre-wired cabinet.

The Contractor shall program controller units as shown on the Plans unless otherwise directed by the Engineer. If the plan timing data or supplemental timing data supplied by the Engineer does not exactly fulfill the timing requirements of the installed Equipment, the Contractor shall notify, in writing, the Engineer of the problem and identify the discrepancies. The Engineer will respond to the Contractor within two weeks. After programming, the Contractor shall 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, the Contractor shall 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. The Contractor shall ensure that the controller unit software provides coordination capability to allow associated controllers to be operated within the progressive traffic system.

633.08 Cabinets. Cabinets shall be mounted by attaching to pedestal or pole or by installing on a concrete foundation. Foundation mounted cabinets shall be arranged so that control Equipment, terminal blocks, or shelves are no

closer than 6 inches to the top of the foundation. Pole or pedestal mounted controller cabinets shall be mounted at a height that allows convenient access to all controller components by service personnel.

Field connections shall be made for the conductors of signal cable, power cable, interconnect cable, and detector lead-in cable. Conductors shall be connected so the outgoing traffic signal circuits are of the same polarity as the line side of the power supply. The traffic signal circuit common return shall use the same polarity as the grounded side of the power supply. The grounded side of the power supply shall be grounded to the cabinet in an approved manner. All field wiring shall be neatly arranged and routed to the appropriate terminal blocks. Field wiring shall be identified according to 725.02 except tags shall be marked with either indelible pen or embossed letters.

Except for power wiring, field wiring entering the cabinet shall be fit with spade terminals to ensure a good connection. Incoming power wiring may use either spade terminals or connection of 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, the Conduit entering the cabinet shall be sealed 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, the joint between the controller cabinet and the foundation shall be sealed with a quality, clear silicon caulk.

When future phasing configurations are shown on the Plans, a cabinet and hardware that will accommodate the future operation through only the future addition of load switches and detector units shall be furnished.

633.09 Cabinet Riser. Cabinet risers provide an extension of the cabinet between the ground mounted cabinet and the foundation. The riser shall be bolted to the foundation, and the cabinet bolted to the riser.

Cabinet risers shall be a type (size and shape) compatible with the type of controller cabinets specified for the Project.

The joints between the controller cabinet and cabinet riser, and between the cabinet riser and foundation shall be sealed with a quality, clear silicon caulk.

633.10 Foundations. Foundations for controller cabinets shall be constructed according to 632.14, except that excavation by earth auger is not required and the foundation does not require reinforcing steel. Anchor bolts,

Conduit ells, and similar appurtenances shall be held in the proper position until the concrete has set.

633.11 Controller Work Pad. Controller work pads shall be constructed according to 608.03, except that transverse joints are not required.

633.12 Flasher Controller. A flasher controller with cabinet and mounting hardware shall be furnished and installed when indicated. The flasher controller shall be for the operation of flashing beacons.

633.13 Method of Measurement. Controller Unit, Type ___, with Cabinet Type ___ will be measured by the number of each complete unit, and will include controller unit with software, all required auxiliary Equipment, loop detector units, and a pre-wired cabinet, with all items completely wired and tested. Ground mounted cabinets shall include anchor bolts and Conduit ells for installation in the foundation. Pole mounted cabinets shall include pole mounting hardware.

Controller Unit, Type ___ will be measured by the number of each controller timing unit with software, and will include any signal timing programming or installation. Controller Unit, Type ___, Furnish Only will be measured by the number of each controller timing unit with software, and will exclude any signal timing programming or installation.

Cabinet, Type ___ will be measured by the number of each complete pre-wired 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 shall include anchor bolts and Conduit ells for installation in the foundation. Pole mounted cabinets shall include pole mounting hardware. Cabinet, Type ___, Furnish Only will be measured by the number of each complete pre-wired cabinet, and will include pole mounting hardware and anchor bolts, but will exclude installation, controller unit, and detector units.

Cabinet Risers will be measured by the number of each unit, and will include Materials, mounting hardware, and installation.

Cabinet Foundations and Controller work pads will be measured by the number of each complete unit, in place, complete and accepted, and will include excavation, concrete, backfilling, and disposal of surplus excavation.

Flasher Controllers will be measured by the number of each complete flasher assembly with cabinet installed and tested.

633.14 Basis of Payment. Payment for accepted quantities of traffic signal controller items as provided above will be made at the Contract Unit Price. Payment shall be full compensation for all labor, Materials, tools, Equipment, and other incidentals necessary for each item furnished, in place, all connections made and wiring completed, tested, and accepted.

The City 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
633	Each	Controller Work Pad
633	Each	Flasher Controller

640 PAVEMENT MARKING

ITEM 641 PAVEMENT MARKING GENERAL

641.01 Description
641.02 Materials
641.03 General
641.04 Equipment
641.05 Pavement Preparation
641.06 Layout and Premarking
641.07 Line Placement Tolerance
641.08 Marking Types
641.09 Removal of Pavement Markings
641.10 Deduction for Deficiency
641.11 Method of Measurement
641.12 Basis of Payment

641.01 Description. This specification includes general requirements for various kinds of retroreflective pavement markings. Deviations from these general requirements are covered in the specific requirements for each marking type.

All pavement markings shall be placed according to the OMUTCD.

641.02 Materials. Marking Materials shall conform to Item 740.

A material safety data sheet (MSDS) for each material, including resin, catalyst, primer, adhesive, activator, glass beads, and cleaning solvent, to be used on the Project shall be furnished by the Contractor to the Engineer prior to material delivery. Workers shall be informed of the location of all MSDS and shall be allowed an opportunity to review them.

641.03 General. Lines shall be applied as solid, broken, or dotted lines, either singly or in combination, as shown on the Plans. Broken lines shall be applied in a 40 foot cycle consisting of a 10 foot dash and a 30 foot gap between broken lines, unless otherwise shown on the Plans. The Contractor shall use an accurate striping mechanism which is capable of being easily adjusted to retrace existing broken markings or to apply new Materials at the correct spacing. Broken lines that are to be applied over plainly visible existing broken lines shall begin within 6 inches of the beginning of the existing broken line, 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 for line extensions, unless otherwise shown on the Plans.

Gaps not marked as a result of template use for spray-applied auxiliary markings shall be filled with marking material after the template removal. If applying extruded thermoplastic, small gaps in arrows or letters resulting from template use may remain unfilled.

Pavement markings shall be free of uneven edges, overspray, or other readily visible defects which detract from the appearance or function of the pavement markings.

Lines shall be sharp, well defined, and uniformly retroreflective. The width of line applied shall be the width specified within 1/4 inch. Fuzzy lines, excessive overspray, or non-uniform application are unacceptable. The Engineer will inspect lines at night to verify proper retroreflectivity. Pavement markings which are improperly applied, located, or reflectorized shall be corrected. Lines applied with insufficient material quantities shall be reapplied according to 641.10. Improperly located lines shall be removed in accordance to 641.09; new lines shall then be applied in the correct locations at the Contractor's expense.

Any lines applied with non-specification Materials shall be reapplied.

Methods and Equipment used for pavement preparation, marking, and marking removal shall be subject to the approval of the Engineer. Glass beads shall be kept dry during storage and prior to use.

The Contractor shall furnish to the Engineer at least three Days in advance of installation current copies of the manufacturer's instructions and recommendations for application of any marking material, including primer, activator, catalyst, and adhesive, shown on the Plans. Other construction Work, such as Shoulder paving, seeding, and mulching shall be scheduled and performed in a manner to avoid damage to applied pavement markings.

Pavement marking Materials shall not be applied to the reflector of a plowable raised pavement marker. The Contractor shall interrupt the application of the pavement marking line at each raised pavement marker where marking material would otherwise be applied to the marker's prismatic reflector. The maximum gap in the marked line at each marker shall be 18 inches. The Contractor shall remove pavement marking material applied to a prismatic reflector surface, or replace the reflector that same workday. If material must be removed from the reflector, the reflector's brightness shall be restored to its prior condition.

641.04 Equipment. The Contractor shall be responsible for measurement of the Work in accordance with the following requirements. The

Contractor's pavement marking Equipment shall be equipped with an odometer graduated to 0.01 mile. The Engineer will determine the degree of accuracy of the Contractor's odometer and establish an adjustment factor as may be required to accurately determine the pay item quantities. The Engineer will periodically check the odometer operation to assure maintenance of accurate measurements.

Failure of the odometer to function properly shall be cause to stop the Work until the odometer is made to function properly. On short Projects, the Engineer may approve alternate methods to accurately measure the length of various types of markings applied. When measuring lane, edge and center line marking, the odometer shall be started at the first marked line and remain in operation until the end of section being marked, where it shall be shut off and the reading of the odometer recorded.

Electrical foot counters shall be provided and installed on the striper. The counters shall individually tabulate the amount of footage applied by each striping gun whether solid or dashed. The counters shall be six digit type with a reset feature.

641.05 Pavement Preparation. The Contractor shall clean all visible loose or foreign material from the surface to be marked. The pavement marking Equipment shall be equipped with an air jet to remove all debris from the pavement in advance of the applicator gun. The air jet shall operate when marking material is being applied and be synchronized with marking material application. The Contractor shall power broom clean all surfaces where gore markings or edge lines are to be applied. When required by the Engineer, other surfaces shall also be power broom cleaned. Marking shall not be applied to portland cement concrete until the concrete in the areas to be marked is clean of membrane curing material and is dry.

641.06 Layout and Premarking. The Contractor shall lay out the locations of all lines, words and other symbols to assure their proper placement. The layout and premarking lines shall be approved by the Engineer before marking operations are started. When applying longitudinal or transverse lines, the Contractor shall use existing lines, construction joints or premarking to guide this 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. When existing markings are to be retraced, it shall be the responsibility of the Contractor to verify any adjustment in the location with the Engineer.

"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 1 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. Premarking for auxiliary markings shall be located from the Plans or schematic forms provided by the Engineer.

641.07 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. Improperly located lines shall be removed according to 641.09 and new lines shall be applied in the correct locations.

641.08 Marking Types. Marking Materials shall be applied at the rate or thickness specified in 642.03, 644.03, or 646.03 and shall be uniformly retroreflective. Pavement markings consist of the following types:

(a) Edge Lines. Edge lines shall be continuous stripes, 4 inches in width. Center of stripe shall be located a minimum of 6 inches from the edge of the pavement.

(b) Lane Lines. Lane lines shall be 4 inch wide, white stripes between contiguous lanes of pavement carrying traffic in the same direction. They shall be broken lines unless specified solid. 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. Lane lines shall not be placed through intersections.

(c) Center Lines. Center lines shall be single or double yellow 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 left-turn island. Each stripe shall be 4 inches wide, solid or broken as specified.

(d) Channelizing Lines. Channelizing lines shall be continuous white stripes 8 inches wide.

(e) Stop and Crosswalk Lines. Stop lines shall be solid white stripes 24 inches wide. Crosswalk lines shall be solid white stripes 6 inches wide.

(f) Transverse/Diagonal Lines. Transverse/diagonal lines shall be solid stripes 24 inches wide, of the color specified, and placed at an angle to the direction of travel.

(g) Curb and Island Marking. Exposed surfaces and curbs and paved islands shall be prepared in accordance with 641.05. In addition, the Contractor shall remove and dispose of all visible loose or foreign material, including vegetation, on and immediately contiguous to surfaces to be marked.

(h) Symbol Markings. Railroad, school and handicap symbol markings shall be white. The railroad symbol marking shall include the 16 inch crossbuck, two 72 inch "R"s, two 24 inch transverse lines and a stop line. The school symbol marking shall include the word "SCHOOL" and two 16 inch transverse lines.

(i) Parking Lot Stall Marking. Parking lot stall marking lines shall be continuous 4 inch wide white stripes.

(j) Lane Arrows. Lane arrows shall be white markings.

(k) Words on Pavement. Words on pavement shall be white markings.

(l) Dotted lines. Dotted lines shall be markings of the width and color specified.

The term long lines, when used in Items 642 through 646 includes edge lines, lane lines, center lines, and channelizing lines over 200 feet long. The term auxiliary markings, when used in Items 642 through 646 includes channelizing lines 200 feet or shorter, stop lines, crosswalk lines, transverse lines, diagonal lines, curb markings, island markings, symbol markings, parking lot stall markings, lane arrows, and dotted lines.

641.09 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, or other methods, with the approval of the Engineer. 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, unless approved by the Engineer prior to use.

641.10 Deduction for Deficiency. The amount of marking material (including resin, catalyst, primer, adhesive or activator) and glass beads, applied per unit of measurement will be computed each Day by the Engineer. The Contract Unit Price shall be reduced in direct proportion to the percent of deficiency of marking Materials or glass beads as specified in the application subsection of each pavement marking material up to twenty percent for each material deficient; only the greater deficiency shall be used to compute the deduction.

If the deficiency of any material is twenty percent or more, the Work shall be considered unsatisfactory and shall be corrected according to Item 642, Item 644 or Item 646 at the expense of the Contractor, including all labor, Equipment, and material requirements. Replaced lines shall be retraced at the full thickness specified by Item 642 and Item 646. Unsatisfactory thermoplastic lines shall be replaced to meet the requirements of Item 644 or a minimum 30 mils additional material shall be applied to achieve 644.04 application thickness. Material applied without written approval of the Engineer outside the temperature or application speed requirements will be considered unsatisfactory and shall be replaced per above. All exceptions granted by the Engineer, shall be documented.

All retraced unsatisfactory lines shall include glass beads per Item 642, Item 644 and Item 646.

641.11 Method of Measurement. Pavement marking will be measured complete in place in the units designated. Line quantities will be the length of completed marking, including the gaps, intersections, and other sections of pavement not normally marked. Removal of pavement markings will be in the units designated.

641.12 Basis of Payment. All Work performed and measured as prescribed above will be paid for as provided in the respective items for each type.

Payment will not include costs associated with correcting improperly located lines, replacing reflectors coated with pavement marking material, or replacing unsatisfactory pavement markings.

The Contractor shall not be paid for lines placed using non-specification Materials and lines determined to be non-specification through field measurement.

ITEM 642 TRAFFIC PAINT

642.01 Description
642.02 Materials
642.03 Equipment
642.04 Application
642.05 Basis of Payment

642.01 Description. This Work shall consist of furnishing and applying water-based traffic paint in accordance with Item 641, 740.01, 740.02, 740.09 and the additional requirements specified below.

642.02 Materials. Materials shall be furnished conforming to:

Traffic Paint	740.02
Glass Beads, Type A	740.09

The Engineer may obtain random samples from the application Equipment. The Contractor shall furnish the manufacturer's identification information for the sampled liquid Materials. The Engineer may test the quality assurance sample for conformance to the manufacturer's production ranges. The Contractor shall re-apply, at the Contractor's expense, any markings applied using Materials not meeting the manufacturer's production ranges. All other untested batches shall be considered not approved and will either require testing or re-application by the Contractor.

Paints that have exceeded the manufacturer's shelf life shall not be applied. Glass beads shall not be wet.

642.03 Equipment. Equipment for applying the traffic paint shall be capable of applying the material as recommended by the manufacturer and applying glass beads at the time of line placement. The Contractor shall provide a calibrated measuring device acceptable to the Engineer to measure the traffic paint in the striper tanks.

All striping Equipment shall be equipped with measuring devices conforming to 641.04.

Written documentation for the Equipment's operational capabilities from the Equipment manufacturer shall be furnished to the Engineer.

The application Equipment, pump, paint guns and bead applicators shall be capable of applying the minimum wet millage and pounds of beads at no more

than 10 miles per hour. The Equipment shall not be operated above 10 miles per hour without documenting the Equipment's capability to operate at higher speed.

642.04 Application. Pavement markings shall be applied only when the surface is clean and dry in accordance with the paint manufacturer's written application instructions.

The paint shall be kept thoroughly mixed during application.

20 mil thick traffic paint shall be applied at the following rates:

	20 mil Thickness Gallons per Mile of Line Width of Line (inches)				
	4	6	8	12	24
Solid Line	22	33	44	66	132
Broken Line	5.5	8.25	11	16.5	33
Dotted Line	7.15	10.75	14.3	21.45	42.9
Areas, Symbols, Words	1.33 gallons per 100 square feet				

Diluting the paint shall not be permitted. However, the Contractor is permitted to add spent traffic paint solvents, generated during performance of this Work, to virgin traffic paint. The maximum ratio of addition shall be 1:50 of spent traffic paint solvents to virgin paint. The maximum concentration of spent traffic paint solvents in the striping Equipment tanks shall be two percent. Spent solvents shall be added during the loading of the striping Equipment.

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 12 pounds of glass beads per gallon of traffic paint applied. Glass beads shall be applied in a manner that provides uniformly retroreflective lines.

The temperature of fast dry paint at the discharge point shall be in the range recommended by the paint manufacturer.

Markings found to be more than twenty percent deficient shall be reapplied at the application rates specified in 642.04.

Material applied without written approval of the Engineer outside the temperature or application speed requirements shall be considered unsatisfactory and shall be replaced per 641.10 and 642.04.

642.05 Basis of Payment. Payment for accepted quantities in place will be made at the Contract prices, or prices adjusted according to 641.10, measured according to 641.11, with the provisions specified in 641.12, and as follows:

Item	Unit	Description
642	Foot	Edge Line
642	Foot	Lane Line
642	Foot	Center Line
642	Foot	Channelizing Line
642	Foot	Stop Line
642	Foot	Crosswalk Line
642	Foot	Transverse/Diagonal Line
642	Foot	Curb Marking
642	Square Foot	Island Marking
642	Each	Handicap Symbol Marking
642	Each	Railroad Symbol Marking
642	Each	School Symbol Marking,__ inch
642	Foot	Parking Lot Stall Marking
642	Each	Lane Arrow
642	Each	Word on Pavement, ___ inch
642	Foot	Dotted Line, ___ inch
642	Foot or Square Foot or Each	Removal of Pavement Marking

ITEM 644 THERMOPLASTIC PAVEMENT MARKING

644.01 Description
644.02 Materials
644.03 Equipment
644.04 Application
644.05 Layout and Premarking
644.06 Basis of Payment

644.01 Description. This Work shall consist of furnishing and applying screed extruded thermoplastic pavement markings in accordance with Item 641, 740.01, 740.04, 740.09 and the additional requirements specified below.

644.02 Materials. Materials shall be furnished conforming to:

Thermoplastic pavement marking	740.04
Glass Beads, Type C	740.09

The Engineer may obtain random samples from the application Equipment. The Contractor shall furnish the manufacturer's identification information for the sampled liquid Materials. The Engineer may test the quality assurance sample for conformance to the manufacturer's production ranges. The Contractor shall re-apply, at the Contractor's expense, any markings applied using Materials not meeting the manufacturer's production ranges. All other untested batches shall be considered not approved and will either require testing or re-application by the Contractor.

Materials that have exceeded the manufacturer's shelf life shall not be applied. Glass beads shall not be wet.

644.03 Equipment. All striping Equipment shall be equipped with measuring devices conforming to 641.04.

Application Equipment shall include a kettle for melting the thermoplastic and maintaining it at the proper temperature. The kettle shall have a thermostat to control the temperature of the melted thermoplastic and to prevent overheating. The molten thermoplastic shall be continuously mixed and agitated. The parts of the Equipment which convey the thermoplastic from the kettle to the application point shall maintain the required temperature of the thermoplastic. Thermometers shall be furnished which measure the temperature of the kettle contents and the material temperature in close proximity to the point of application.

The Contractor shall furnish documentation that the application Equipment, pump, extruding shoes and bead applicators are capable of applying the minimum millage and pounds of beads at 10 miles per hour. The Equipment shall not be operated above 10 miles per hour without documenting the Equipment's capability to operate at a higher speed.

The application Equipment shall apply lines with a square end and be capable of applying dashed lines.

If applying surface-applied glass beads, an automatic bead dispenser shall be attached to the Equipment so that the beads are immediately and uniformly dispensed over the marking surface. The bead dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

The applicator portion of the Equipment shall include a shoe that rides on the pavement and extrudes the thermoplastic. Application Equipment shall apply screed extruded markings (no ribbon application) that consists of dies of varying widths to produce different widths of lines. Pans, aprons, or similar devices that the die overruns shall not be used. Spray thermoplastic Equipment is permissible for 30 mil application.

The Equipment shall provide uniformity in the thickness and width of lines. The Equipment shall form lines 12 inches wide or less by one application pass, and lines wider than 12 inches by no more than two passes. Individual passes shall not overlap or be separated by a gap greater than 1/4 inch.

644.04 Application. When thermoplastic markings are applied to pavements less than six months old, both the pavement surface and the ambient air temperature at the time of material application shall be not less than 50°F and rising. However, when thermoplastic markings are applied to pavements that are older than one year, both the pavement surface and the ambient air temperature at the time of material application shall not be less than 70°F and rising. The temperature of thermoplastic material at the point of application shall be at least 400°F and not more than 440°F. Before any application, the pavement surface temperature, dew point and temperature of the thermoplastic at the point of application shall be documented. Testing devices shall be accurate and operational.

Thermoplastic material shall be applied at a thickness of 125 mils.

Thermoplastic shall be applied at the following rates:

	Pounds per Mile of Line Width of Line (inches)			
	4	8	12	24
Solid Line	2340	4680	7020	14040
Broken Line	585	1170	1755	3510
Dotted Line	780	1560	2340	4680
Areas, Symbols, Words	133 pounds per 100 square feet			

Glass beads shall be mechanically dispensed uniformly at a rate of 8 pounds of beads for each 100 square feet of thermoplastic surface area. Hand beading shall not be permitted, except to arrows, letters and to complete the end of a line. Hand applied beads shall be uniformly dispensed over the marking surface at a rate of not less than 8 pounds of beads for each 100 square feet of thermoplastic surface area. Small gaps in arrows or letters resulting from template use may remain unfilled.

If required, primer shall be furnished with the marking material, and shall be applied in accordance with the manufacturer's recommendations. Primer shall be used except on new asphalt pavement.

Spray application of thermoplastic shall not be permitted.

Markings found to be more than twenty percent deficient shall be reapplied at the application rates specified in 644.04 as a new application or a minimum 30 mils additional material with glass beads shall be applied as specified above to achieve 644.04 application thickness.

Material applied without written approval of the Engineer outside the temperature or application speed requirements shall be considered unsatisfactory and will be replaced per 641.10 and 644.05(b).

644.05 Layout and Premarking

(a) Initial Thermoplastic Installation. In addition to 641.06, auxiliary markings shall only be placed on new pavement. Initial thermoplastic markings may be placed over work zone traffic paint markings.

(b) Subsequent Thermoplastic Installation (Repair or Refurbishing). In addition to 641.06, markings shall be placed over existing thermoplastic markings, or portions thereof. Prior to installation of new thermoplastic markings, the existing thermoplastic markings shall be removed by grinding so that the final combined thickness of the old and new thermoplastic markings shall be 130 mils and a clean, intact substrate is present. Removal of existing thermoplastic

markings shall be at the Contract Unit Price for Item 644 Removal of Pavement Marking.

644.06 Basis of Payment. Payment for accepted quantities complete in place will be made at Contract prices, or prices adjusted in accordance with 641.10, measured according to 641.11, with the provisions specified in 641.12, and as follows:

Item	Unit	Description
644	Foot	Edge Line
644	Foot	Lane Line
644	Foot	Center Line
644	Foot	Channelizing Line
644	Foot	Stop Line
644	Foot	Crosswalk Line
644	Foot	Transverse/Diagonal Line
644	Each	Handicap Symbol Marking
644	Each	Railroad Symbol Marking, ___ inch
644	Each	School Symbol Marking, ___ inch
644	Foot	Parking Lot Stall Marking
644	Each	Lane Arrow
644	Each	Word on Pavement, ___ inch
644	Foot	Dotted Line, ___ inch
644	Foot or Square Foot or Each	Removal of Pavement Marking

ITEM 646 EPOXY PAVEMENT MARKING

646.01 Description
646.02 Materials
646.03 Equipment
646.04 Cleaning And Surface Preparation
646.05 Application
646.06 Method of Measurement
646.07 Basis of Payment

646.01 Description. This Work shall consist of furnishing and applying epoxy pavement markings in accordance with Item 641, 740.01, 740.07, 740.09 and the additional requirements specified below.

The epoxy material shall be stored and handled according to all the applicable EPA and local environmental regulations and the manufacturer's recommendations.

646.02 Materials. Materials shall be furnished conforming to:

Epoxy pavement marking	740.07
Glass Beads, Type D	740.09

The Engineer may obtain random samples from the application Equipment. The Contractor shall furnish the manufacturer's identification information for the sampled liquid Materials. The Engineer may test the quality assurance sample for conformance to the manufacturer's production ranges. The Contractor shall re-apply, at the Contractor's expense, any markings applied using Materials not meeting the manufacturer's production ranges. All other untested batches shall be considered not approved and will either require testing or re-application by the Contractor.

Any Materials that have exceeded the manufacturer's shelf life shall not be applied. Glass beads shall not be wet.

646.03 Equipment.

General. Before any application, the Contractor shall test and record the pavement surface temperature, air temperature and record the temperature of the epoxy at the point of application. The temperatures shall be retested and recorded every four hours of operation. The testing devices shall be accurate and operational.

All striping Equipment shall be equipped with measuring devices conforming to 641.04.

Written documentation for the Equipment's operational capabilities from the Equipment manufacturer shall be furnished to the Engineer.

The application Equipment, pump, paint guns and bead applicators shall be capable of applying the minimum wet millage and pounds of beads at no more than 10 miles per hour. The Equipment shall not be operated above 10 miles per hour without documenting the Equipment's capability to operate at higher speed.

(a) Epoxy pavement marking Equipment shall have the following capabilities and features:

(1) Capable of mixing the epoxy components in proportions recommended by the manufacturer and applying glass beads simultaneously with line placement.
(2) Capable of applying epoxy at the specified thickness, width, and pattern.
(3) Individual material reservoirs, or space, for the storage of Part A and Part B of the epoxy.
(4) Heating Equipment of sufficient capacity to maintain the epoxy components at the manufacturer's recommended temperature, and to produce the required amount of heat at the mixing head and gun tip and maintain those temperatures with the tolerances recommended by the epoxy manufacturer for the spray application.
(5) Adequate individual tanks for the storage and dispensing of Size I and Size II glass beads.
(6) Individual dispensers for the simultaneous application of Size I and Size II glass beads at a rate up to 20 pounds per gallon.
(7) Individual metering devices on the proportioning pumps (one indicator per pump) and stroke counters to monitor gallon usage. These devices shall be clearly visible.
(8) All the necessary spray Equipment mixers, compressors, and other appurtenances to allow for the placement of reflectorized pavement marking systems in a simultaneous sequence of operations.
(9) A minimum 24 inch long static mixer unit or an equivalent system that produces properly mixed material.
(10) A completely enclosed flush and purge system to clean the lines and the guns without expelling any of the solution into the environment.

(b) Long Line Equipment. Long line epoxy markings shall be applied with a striper that is:

(1) Truck-mounted and self-contained.

(2) Designed to spray the epoxy and glass beads in continuous and skip line.
(3) Maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

(c) Auxiliary Marking Equipment. Auxiliary markings shall be applied using a striper equipped with accessories for applying auxiliary markings or using a portable applicator approved by the Engineer.

646.04 Cleaning and Surface Preparation.

(a) General. Before applying epoxy, the Contractor shall clean and prepare the pavement surface in the following sequence:

(1) Remove all debris, oil, and any other contaminants that may hinder the adhesion of the epoxy to the pavement.
(2) Use a power-broom to clean the pavement.
(3) Remove residue and debris with blasts of compressed air.
(4) Follow any additional manufacturer's recommendations for surface preparation.

The Contractor shall perform these operations in such a manner that the finished pavement surface is not damaged or unnecessarily scarred or left in a pattern that will mislead or misdirect the motorist and that minimizes airborne dust. Damage to transverse and longitudinal joint sealers shall be avoided.

(b) Asphalt Concrete Pavements. In addition to the requirements of 646.04(a), the following shall apply.

Polymer modified asphalt-concrete pavement shall be in place forty-eight hours before preparing it for epoxy pavement markings.

For any other type of modified asphalt or for open graded friction course asphalts, the Contractor shall follow the manufacturer's recommendation surface preparation recommendations and furnish the Engineer copies of the manufacturer's recommendations.

The Contractor shall lightly abrade any new asphalt concrete pavement containing SBS, SBR latex or SMA latex polymer modifiers without scarring the area between the broken lines to the manufacturer's recommendations to remove polymer surface film to assure proper bonding. In no case shall the removal of the polymer surface film be less than that required for the epoxy to properly bond and adhere.

(c) Portland Cement Concrete Pavements. On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of thirty Days after the placement of concrete, unless otherwise directed by the Engineer. In addition to the requirements of 646.04(a), the following shall apply.

All curing compound and laitance shall be removed from the concrete surface and in any textured pavement valleys.

The profiles of the peaks of textured pavement shall be rounded and sharp edges and irregularities removed.

Acceptable removal methods are:

(1) Sand blasting with containment.
(2) Lightly abrading the surface without scarring the surrounding surface with approval of the Engineer.
(3) Blast track cleaning.
(4) High-pressure water blasting (greater than 5000 pounds per square inch) with or without abrasives and with sufficient time to allow the pavement to dry before applying epoxy markings.
(5) Other methods approved by the Engineer.

The Contractor shall contain and dispose of all the removal debris.

(d) Removal of Existing Markings. Pavement markings shall be removed to the extent that ninety-five to one hundred percent of the existing marking is removed. Removal operations shall be conducted in such a manner that no more than moderate color and/or surface texture change results on the surrounding pavement surface.

(e) Preparation Area.

(1) Lines. An area shall be prepared that is the width of the new pavement marking, or existing line, plus 1 inch on each side and the length of broken lines plus 12 inches on each end.
(2) Arrows, Letters, and Symbols. When cleaning for letters and symbols, the Contractor shall prepare an area that is sufficiently large to accommodate the new marking, or to remove the existing marking.

646.05 Application. Epoxy marking material shall be applied only when the surface is clean and dry and when the pavement and air temperature are above 50°F. The Contractor shall transfer the entire contents of each material container to the striper tanks. The material shall be thoroughly mixed at all times during application. Before any application, the Contractor shall test and record

the pavement surface temperature and air temperature and retested every four hours of operation. The testing devices shall be accurate and operational.

Epoxy marking material shall be applied uniformly to the surface to be marked at the rate specified below. To achieve this rate the thickness of the applied epoxy shall be 20 mils.

	Gallons per Mile of Line Width of Line (inches)				
	4	6	8	12	24
Solid Line	22	33	44	66	132
Broken Line	5.5	8.25	11	16.5	33
Dotted Line	7.15	10.75	14.3	21.45	42.9
Areas, Symbols, Words	1.33 gallons per 100 square feet				

On new surface or open graded asphalts the above rate shall be increased twenty-five percent to achieve the required thickness of 25 mils.

Diluting the epoxy material shall not be permitted.

Glass beads shall be applied to the uncured epoxy material in sufficient quantity so that the beads completely fill the epoxy film from the film-pavement interface to the top surface of the film to the extent that there are loose beads on the surface of the uncured line. The rate of application shall not be less than 25 pounds of glass beads per gallon of epoxy material applied. Beads shall be applied in a manner that provides uniformly retroreflective lines. Glass beads shall be dropped on the epoxy in a double-drop system with the large gradation (Size I) first and the regular gradation (Size II) second in the same pass of the Equipment. The beads shall be applied in equal amount by weight.

If the epoxy marking does not dry to a no-tracking condition consistently or shows cyclical soft spots, the Contractor shall cease marking application until the problem is corrected.

Markings found to be more than twenty percent deficient shall be reapplied at the application rates specified in 646.05

Material applied without written approval of the Engineer outside the temperature or application speed requirements shall be considered unsatisfactory and will be replaced per 641.10 and 646.05.

646.06 Method of Measurement. In addition to the requirements of 641.11, the following shall apply:

(a) The Contractor must submit certified documents from the manufacturer listing of the amount of epoxy (in gallons) and glass beads (in pounds) shipped for the particular Project.

(b) In the field the Contractor shall furnish stroke counters mounted on the dispensing pumps. Stroke counter readings must be taken at the beginning and end of each Day by the Engineer. The stroke counter shall be turned off while re-circulating the epoxy material. Using the "dipping the tank" method is not sufficient.

(c) The rate of application of Materials shall be verified by comparing the amount of Materials used with the computed amount needed for each section. Where short sections are involved and it is not practical or feasible to determine the quantities used on each and every short section, such sections may, by agreement between the Engineer and Contractor, be grouped together to verify the quantities used.

646.07 Basis of Payment. The cost of cleaning and surface preparation according to 646.04 is included in the unit Bid cost for the various pavement markings.

Payment for accepted quantities complete in place will be made at Contract prices, or prices adjusted in accordance with 641.10, measured according to 641.11, with the provisions specified in 641.12, and as follows:

Item	Unit	Description
646	Foot	Edge Line
646	Foot	Lane Line
646	Foot	Center Line
646	Foot	Channelizing Line
646	Foot	Stop Line
646	Foot	Crosswalk Line
646	Foot	Transverse/Diagonal Line
646	Foot	Curb Marking
646	Square Foot	Island Marking
646	Each	Handicap Symbol Marking
646	Each	Railroad Symbol Marking, ___ inch
646	Each	School Symbol Marking, ___ inch
646	Foot	Parking Lot Stall Marking
646	Each	Lane Arrow
646	Each	Word on Pavement, ___ inch
646	Foot	Dotted Line, ___ inch
646	Foot or Square Foot or Each	Removal of Pavement Marking

ITEM 651 TOPSOIL STOCKPILED

651.01 Description
651.02 Stripping and Lifting
651.03 Method of Measurement
651.04 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 Stripping and Lifting. The Contractor shall mow or otherwise remove all heavy grass, weeds or other vegetation over the areas before stripping. The 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 beginning of regular excavation or embankment Work in the area. 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.

651.03 Method of Measurement. Measurement shall be the number of cubic yards of topsoil measured in the original place, acceptably stripped and stored in stockpiles as herein prescribed.

651.04 Basis of Payment. Payment for accepted quantities will be made at Contract price for:

Item	Unit	Description
651	Cubic yard	Topsoil stockpiled

ITEM 652 PLACING STOCKPILED TOPSOIL

652.01 Description
652.03 Preparation of Subgrade
652.04 Placing and Spreading Topsoil
652.05 Method of Measurement
652.06 Basis of Payment

652.01 Description. This item shall consist of hauling and spreading topsoil from stockpiles and preparing the Subgrade.

652.03 Preparation of Subgrade. Preparation of Subgrade shall be performed in accordance with 653.04.

652.04 Placing and Spreading Topsoil. Topsoil shall be placed and spread in accordance with 653.05. Topsoil shall be run through a 1/2 inch screen, with roots and rocks removed.

652.05 Method of Measurement. Measurement of placing stockpiled topsoil shall be the number of cubic yards measured in place for the thickness specified on the Contract Plans or in the Proposal.

652.06 Basis of Payment. Payment for accepted quantities will be made at Contract price for:

Item	Unit	Description
652	Cubic yard	Placing stockpiled topsoil

ITEM 653 TOPSOIL FURNISHED AND PLACED

653.01 Description
653.02 Topsoil
653.03 Stripping Topsoil
653.04 Preparation of Subgrade
653.05 Placing and Spreading Topsoil
653.06 Method of Measurement
653.07 Basis of Payment

653.01 Description. This item shall consist of furnishing and spreading topsoil and preparing the Subgrade.

653.02 Topsoil. The material shall be screened to consist of loose, friable, loamy topsoil without admixture of subsoil, rocks, or foreign material. For topsoil to be considered loamy, that fraction passing the No. 10 sieve shall contain not more the forty percent clay.

Acceptable topsoil shall contain not less than five percent or more than twenty percent organic matter as determined by loss on ignition of samples oven dried to constant weight at 212°F. Topsoil shall be free of grass, brush, and roots.

653.03 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. The City reserves the right to reject any material found to be unacceptable either at the excavation site or at the delivery site.

653.04 Preparation of Subgrade. The Contractor shall complete all subgrading within the areas to be covered with topsoil under this item necessary to bring the surface of the proposed Subgrade to the lines indicated on the Plans, and parallel to the proposed finished grade. These areas are to be free from rock or other foreign material of 1 inch or greater in any dimension. The surface of the Subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a depth of 1 inch.

653.05 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. As directed by the Engineer, the Contractor may be required to compact topsoil by rolling.

653.06 Method of Measurement. Measurement shall be the number of cubic yards measured in place, after compaction, for the thickness specified on the Contract Plans or in the Proposal. When specifically stated on the Contract Plans or in the Proposal, measurement shall be the number of cubic yards measured by volume in carrier at the work site. Measurement may be determined by slips, provided a slip for each load is signed by the Contractor and turned into the Engineer each Day. If the quantity shown on the slips is measured by weight, 2,700 pounds of topsoil base shall be equal to 1 cubic yard.

653.07 Basis of Payment. Payment for accepted quantities will be made at Contract price for:

Item	Unit	Description
653	Cubic yard	Topsoil furnished and placed

ITEM 659 SEEDING AND MULCHING

659.01 Description
651.03 Commercial Fertilizer
651.04 Seeds
659.05 Inoculating Bacteria
659.06 Mulching Materials
659.07 Inoculating Legumes
659.08 Fertilizing
659.09 Seeding and Mulching
659.10 Method of Measurement
659.11 Basis of Payment

659.01 Description. This item shall consist of furnishing all seed, commercial fertilizer, and mulching material and placing and incorporating same as specified.

The areas to be seeded and paid for under this item shall include all areas designated by the Engineer and as described on the Plans. All areas outside of specified limits where the vegetative growth has been injuriously disturbed or destroyed by the Contractor shall be restored and seeded in accordance with these Specifications by the Contractor at the Contractor's expense.

Commercial fertilizers shall be obtained by the Contractor from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Ohio, Department of Agriculture.

659.03 Commercial Fertilizer. Commercial fertilizer shall be 12-12-12 unless otherwise specified. The commercial fertilizer with the composition indicated shall analyze in the following order: twelve percent total available nitrogen; twelve percent available phosphoric acid; twelve percent available potash.

659.04 Seeds. All seeds shall be not less than ninety-five percent pure and have not less than eighty-seven percent germination.

All seeds proposed to be used under this item shall be approved by the State of Ohio, Department of Agriculture, Division of Plant Industry, and shall meet the requirements of these Specifications.

The City reserves the right to test, reject or approve all seed after delivery on the Project.

All seeds are to be furnished in separate varieties, separately packaged or bagged, and shall be labeled, tagged or marked in accordance with 907.03, ORC.

659.05 Inoculating Bacteria. The inoculant for treating leguminous seeds shall be a pure culture of nitrogen-fixing bacteria selected for maximum vitality, not more than one year old. All cultures shall be subject to the approval of the Engineer.

659.06 Mulching Material. Materials used for mulching shall be straw or other Materials as may be processed or manufactured for this purpose. They shall be free of weed seed and such foreign Materials as may detract from their effectiveness as mulch or injurious to desired plant growth.

659.07 Inoculating Legumes. All leguminous seeds shall be inoculated or treated with the proper amount of approved culture mixed with sufficient water to thoroughly wet the seed with the solution. When seed is sown hydraulically, four times the amount of inoculant required above shall be placed directly into the slurry and thoroughly mixed immediately before seeding. Seed shall be sown within twenty-four hours after treatment with the inoculant.

659.08 Fertilizing. The standard application of fertilizer shall be at the rate of 10 pounds per 1,000 square feet for the analysis specified. Another analysis, in the same ratio, may be used by varying the application rate to produce the same values specified. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed or raked into the soil to a depth of not less than 1 inch.

If the seed bed becomes compacted prior to seeding, it shall be redisked or loosened to a friable condition before seeding. If the fertilizer has been washed or otherwise lost from the seed bed, the areas so depleted shall be retreated as directed by the Engineer at no cost to the Project.

659.09 Seeding and Mulching. All areas to be seeded shall be free of rock and other foreign material 1 inch or greater in any dimensions and shall be satisfactorily shaped and finished as provided in 203. Hand raking will be required for areas if machines do not provide results equivalent to hand raking. Payment for the Work necessary for proper preparation of the seed bed shall be included in this item.

The seed shall be thoroughly mixed and then evenly sown over the prepared areas at the rate of 6 pounds per 1,000 square feet. Seed shall be sown dry or hydraulically.

Areas to be seeded shall be seeded with the following mixtures: (Percentages are by weight).

(a) Lawn Mixture. For use in areas in front of residences, commercial properties, etc.

40 percent Kentucky Bluegrass (Poa pratensis)
40 percent Creeping Red Fescue (Festuca rubra)
20 percent Perennial Ryegrass (Lolium perenne)

(b) Roadway Mixture. For use on thoroughfare roads, in medians, etc.

30 percent Kentucky Bluegrass (Poa pratensis)
40 percent Kentucky 31 Fescue (Festuca arundinacea var. KY 31)
30 percent Perennial Ryegrass (Lolium perenne)

(c) Crown Vetch Mixture. For use on slopes greater than 3 to 1.

30 percent Crown Vetch (Coronilla varia)
60 percent perennial ryegrass (Lolium perenne)
10 percent Annual Ryegrass (Lolium multiflorum)

Immediately after sowing, the area shall be raked, dragged or otherwise treated so as to cover the seed to a depth of approximately 1/4 inch.

The operation of seed sowing shall not be performed when the ground is frozen or muddy, or when soil or weather conditions would prevent the proper soil preparation and subsequent operations as specified.

When mulching is specified, it shall be applied within forty-eight hours after any given area is seeded. Vegetative mulching material conforming to 659.06 shall be evenly placed over the seeded areas indicated to be mulched at the rate of approximately 2 tons per acre when seeding is performed between the dates of March 15 and October 15, and at the approximate rate of 3 tons per acre when seeding is performed between the dates of October 15 and March 15 of the succeeding year. Mulching Materials shall be kept in place with asphalt emulsion applied at a minimum rate of 60 gallons per ton of mulch specified per acre or by methods as are approved or may be otherwise required to prevent displacement of material. Asphalt emulsion for vegetative mulch shall conform to 702.04, SS-1. Emulsion shall be nontoxic to plants and shall be so prepared that it will not change in transportation or storage. Mulching which is displaced shall be replaced at once but only after the seeding or other Work which preceded the

mulching and which Work was damaged as a result of displacement of mulching material has been acceptably repaired.

The Contractor shall maintain all seeded and mulched areas until Final Inspection or until a 2 inch minimum growth of grass has been attained, whichever date is later. Maintenance shall also include watering, providing protection for traffic by approved warning signs or barricades, and repairing any areas damaged following the seeding or mulching operation due to wind, water, fire or other causes. Such damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding and shall then be refertilized, reseeded and remulched as directed by the Engineer. Mowing of excess growth shall be performed when and as directed by the Engineer, and will be included in the cost of this item.

659.10 Method of Measurement. Commercial fertilizer, seeding, and mulching shall be paid as the actual number of square yards of the area treated in accordance with these Specifications.

659.11 Basis of Payment. Payment for accepted quantities will be made at Contract prices for:

Item	Unit	Description
659	Square yard	Commercial fertilizer
659	Square yard	Seeding and mulching

ITEM 660 SODDING

660.01 Description
660.02 Sod
660.03 Lifting Sod
660.04 Preparation of Areas to be Sodded
660.05 Placing Sod
660.06 Placing Sod on Slopes
660.07 Placing Sod in Ditches
660.08 Watering
660.09 Method of Measurement
660.10 Basis of Payment

660.01 Description. This item shall consist of furnishing, hauling, excavating for and preparing the bed, and placing sod on areas specified or directed by the Engineer.

660.02 Sod. The sod shall be well-rooted Kentucky Blue Grass (Poa pratensis) or Canadian Blue Grass (Poa compressa) containing a growth of not more than thirty percent of other grasses and clovers, and free from all noxious weeds such as wild thistles, quack grass, etc., and reasonably free from dandelions, crab grass, etc.

All sod shall be certified that it complies with 660.02. A certificate shall accompany each shipment and furnish the following additional information from the sod supplier:

The name of the producer
The amount of sod shipped in square yards
The location of the sod field
The location of the job site
The date the sod was cut
The thickness at which the sod was cut

660.03 Lifting Sod. The sod shall be recently mowed to a length of between 2 and 3 inches and shall be cut below the root line but in no case shall it be less than 1 1/2 inches in thickness. It shall be cut into strips of not less than 3 feet and not over 6 feet in length with a uniform width of not over 24 inches. The sod shall have a minimum of two years growth prior to cutting.

The Contractor will notify the Engineer a reasonable length of time in advance of any sod lifting to permit the Engineer to inspect the sod before lifting. Sod will be accepted only from areas approved by the Engineer.

Sod shall be delivered to the job within twenty-four hours after being cut and shall be installed within thirty-six hours after being cut.

During wet weather the sod shall be allowed to dry sufficiently to prevent tearing during handling and placing, and during dry weather it shall be watered before lifting to insure its vitality and to prevent the loss of the soil in handling.

660.04 Preparation of Areas to be Sodded. Before the sod is placed, the sod bed will have been excavated to such a depth that when the sod is in place the top of the sod will be flush with the surrounding grade and in accordance with the typical cross section. When specified under Item 659, commercial fertilizer shall be applied and incorporated in the areas to be sodded at the rate specified in 659.08 to a depth of not less than 1 inch, and not more than forty-eight hours before the sod is placed. Immediately prior to the placing of the sod, the area shall be raked, or otherwise brought to an even surface forming a proper sod bed, and if dry, the sod bed shall be thoroughly watered previous to placing of the sod.

660.05 Placing Sod. No sod shall be placed when the temperature is below 32°F. No frozen sod shall be placed nor shall any sod be placed upon frozen soil.

Sod shall be lifted from trucks or storage piles and placed by hand with close joints and no overlapping. All gaps between sections of sod and openings at angles shall be plugged with sod. After laying, the sod shall be watered thoroughly and then tamped with approved sod tampers sufficiently to bring the sod into close contact with the sod bed and insure tight joints between the sections or strips. Upon the completion of the above Work, the surface of the sodded areas shall coincide with the finished grade.

If excessive weeds appear in the newly laid sod prior to the expiration of the one year maintenance Guarantee, the Contractor shall spray the affected areas with a commercial weed killer at no cost to the City.

660.06 Placing Sod on Slopes. On slopes 2 to 1 and steeper, sod shall be laid with the long edges of the strip parallel to the contour starting at the bottom of the slope. Successive strips shall be neatly matched and all joints staggered or broken.

Each strip or section of sod placed on slopes 2 to 1 and steeper and which are 6 feet or over in height, measured on the slope, shall be staked securely with at least two stakes not more than 2 feet apart with the flat side against the slope. Stakes shall be wood and shall be at least 1/2 x 3/4 x 12 inches, driven flush with the top of the sod.

Sod laid on slopes shall be watered thoroughly, and then tamped or pressed to bring the sod into close contact with the sod bed and insure tight joints between the sections or strips.

660.07 Placing Sod in Ditches. Sod shall be placed in ditches with successive strips neatly matched and transverse joints staggered. The sod shall be staked securely with stakes placed at a maximum distance of 2 feet and stakes in adjacent rows staggered.

Stakes shall be wood and may vary in size from 1/2 x 3/4 x 12 inches to 1 x 1 x 24 inches as required to hold the sod in place. Stakes shall be driven flush with the top of the sod.

660.08 Watering. The Contractor shall keep all sodded areas, including the Subgrade, thoroughly moist until the newly laid sod is firmly established as indicated by at least 1 inch of new growth developed after the sod is laid.

660.09 Method of Measurement. Measurement of sodding shall be the actual number of square feet of area sodded, completed and accepted.

660.10 Basis of Payment. Payment for accepted quantities will be made at Contract price for:

Item	Unit	Description
660	Square feet	Sodding

ITEM 661 PLANTING TREES AND SHRUBS

661.01 Description
661.02 Plant Materials
661.03 Labeling
661.04 Inspection
661.05 Location And Source Of Supply
661.06 Scheduling
661.07 Transportation, Storage And Handling
661.08 Layout Of Plant Materials
661.09 Planting Holes
661.10 Planting Beds
661.11 Backfill Mixture
661.12 Planting
661.13 Mulching
661.14 Pruning
661.15 Wrapping
661.16 Bracing
661.17 Maintenance
661.18 Removal Of Stakes And Bracing
661.19 Method Of Measurement
661.20 Basis Of Payment

661.01 Description. This Work shall consist of furnishing and planting trees and shrubs, and other related Materials, in arrangements and locations, as directed by the Engineer, including excavation, preparing pocket holes, and furnishing and placing backfill and mulch.

661.02 Plant Materials. Plant Materials shall include all trees, shrubs, and plants required for the Project. All plant material shall conform to the current edition of the American Standard for Nursery Stock, as published by the American Nursery and Landscape Association.

All plants shall be healthy representatives, typical of their species or variety, and shall exhibit a normal habit of growth. All plants shall be hardy under climatic conditions and grown in the same hardiness zone or colder, as the one in which the Project is located.

Topsoil shall be in accordance with Item 653.

Mulch shall be in accordance with Item 659.

661.03 Labeling. Legible labels must be attached to all specimens, or boxes, bundles, and other containers, indicating detailed information covering the botanical genus and the species name, the common name, the size or age of each species or variety and the quantity contained in the individual bundles, boxes, and bales.

661.04 Inspection. The Engineer will inspect all plant Materials on the Project before use or planting. All plants shall be healthy, vigorous and free from harmful defects, decay, disfigured stems and roots, plant diseases and insect pests.

Final Acceptance of all plant Materials will be given only after the Materials are planted and have met all the requirements prescribed within.

661.05 Location and Source of Supply. The Contractor shall supply the Engineer with complete and detailed information concerning the source of supply for each item of required plant material prior to construction.

661.06 Scheduling. The Contractor shall dig and plant all deciduous plants, and plant replacement plants, between September 15th and June 1st.

661.07 Transportation, Storage and Handling. The Contractor shall transport all plants from nursery sources to the Project site with the entire load completely covered for protection from drying winds.

The Contractor shall thoroughly water all plants that cannot be immediately planted so as to keep the roots continually moist, with exposed roots covered with moist soil. Plants that are not adequately protected during transportation and storage may be rejected. All plant Materials shall be handled by the root ball or container.

All trees heeled in or stored shall be properly maintained by the Contractor until planted. The ball of soil and roots of balled and burlapped trees, that are not immediately planted after delivery and inspection, shall be adequately protected by topsoil covering until removed for planting, in a manner appropriate to the conditions and satisfactory to the Engineer.

Temporary storage of plant material shall be at the entire risk of the Contractor, including maintenance of same.

661.08 Layout of Plant Materials. Before digging, the Contractor shall use suitable staking to lay out the locations of all planting holes and beds. These locations shall be approved by the Engineer prior to digging.

661.09 Planting Holes. The Contractor shall dig planting holes in shapes having vertical sides and flat bottoms. When trees and shrubs are to be set at grade, the planting holes shall have a diameter 18 inches greater that the root ball. Depth of planting shall be in accordance with 661.12. Planting holes for perennial plants shall be dug to a minimum depth and diameter of 6 inches.

661.10 Planting Beds. One month prior to cultivation, the Contractor shall treat all planting beds that are to be developed in areas of existing turf, with pre-emergent and post-emergent type herbicides. A State-licensed pesticide applicator shall apply the herbicide according to the manufacturer's instructions.

661.11 Backfill Mixture. For all plantings, backfill mix shall consist of the following:

(a) One part excavated soil.

(b) One part sphagnum peat moss, shredded pine bark, or EPA rated Class IV compost.

(c) One part sand.

(d) A slow release commercial fertilizer (0-20-20 Or Equal) added at a rate of 5 pounds per cubic yard to the backfill mix.

Backfill mix shall not be used in a frozen or muddy condition. It shall be mixed at the Project site.

661.12 Planting. Plants in planting holes shall be set at a level such that the top of the root structure is 1 inch above the surrounding soil. Each plant shall be set in the center of the planting hole, plumb, and straight.

Trees to be planted shall be the species, variety and size specified. The operation of the actual planting shall not be performed between the dates of June 1 and October 1 nor at any time when the temperature is below 32°F, except by specific permission of the Engineer. The Engineer shall also approve the location of each individual tree taking into consideration its size and shape, in order that the best possible arrangement will result.

If the Engineer determines that existing soils are compacted or poorly drained, the Contractor shall set trees and shrubs with half of the root structure above the existing soil level. Backfill mix shall be added around the root structure so that the edges of the root structure are covered by a minimum of 12 inches.

The Contractor shall remove all twine, bags, roping, and rot-proof burlap before backfilling the planting hole. The top one-third of the wire shall be removed from root balls having wire baskets.

The Contractor shall backfill the planting hole gradually with backfill mix, and settled with water to the top of the root structure, avoiding fill around the trunks or stems. Balled and burlapped, or containerized stock shall be set as specified. The Contractor shall buildup backfill on the lower side of slopes to catch and hold water.

661.13 Mulching. The backfill mix shall be smoothed and shaped to form a shallow basin slightly larger than the planting hole. A 4 inch layer of finely shredded hardwood bark of uniform texture and size, aged at least one year, shall be applied within twenty-four hours of any planting. The Contractor shall rake and smooth the entire area of the planting beds and shall water thoroughly.

After mulching, a slow release commercial fertilizer (12-12-12 Or Equal) shall be added, in granular form, to the top of the mulch at a rate of 5 pounds per 100 square feet. Fertilizer shall not come in contact with the stems, trunk, branches, or leaves of the plants.

661.14 Pruning. To balance the loss of roots after planting, branches of deciduous plants shall be pruned to preserve the natural characteristics of the species, following standard horticultural practices. Broken, damaged, and unsymmetrical branches and other growth shall be removed to ensure healthy and symmetrical growth of new wood. The central leader of the trees shall not be trimmed.

The ends of all broken and damaged roots of 1/4 inch diameter or larger of trees shall be pruned with a clean cut removing no more than the injured portion. All cuts and wounds, except ends of small terminal and side branches, shall be painted with paint or tree wound dressing immediately after the pruning. A sample tree of each species, variety, and size shall be acceptably pruned, the sample to be a guide for subsequent pruning.

661.15 Wrapping. The Contractor shall wrap all single deciduous tree trunks of 1 inch caliper and larger, within forty-eight hours after planting, using a double-layered, bituminous-cemented, waterproof, crinkled paper. Before wrapping, trees shall be inspected for insect infestation and any necessary

corrective measures shall be taken. The trunk shall be wrapped neatly and snugly to the height of the first branches, starting at the ground, and shall be attached securely. With each turn of the wrapping, the Contractor shall overlap the previous turn by half the width of the paper. Flowering trees and others with multiple branching close to the ground shall be wrapped as directed by the Engineer. The same kind of wrapping material shall be used throughout the Project.

661.16 Bracing. All deciduous shade and flowering trees shall be braced immediately after planting. Unless otherwise specified, trees of 2 inch diameter or less and other trees less than 8 feet in height shall have a support stake driven into the ground to a depth of 18 inches below the elevation of the bottom of the planting hole or until so anchored as to give adequate support. These stakes shall extend upward to within approximately 4 inches of the lowest main branches; however, a uniform height of stake above the ground level shall prevail for near like sizes throughout the Project. Low-headed trees may be braced as shown on the Plans.

Trees over two inches in diameter, and other trees 8 feet or more in height, shall be braced with two stakes as prescribed above.

Balled and burlapped trees shall be braced carefully so as not to injure the earth ball.

When specified, evergreens and specimen trees shall be braced by the tripod method as follows:

Three wires shall be used, the upper ends encircling the tree trunk just above the lowest main branches of deciduous trees, and at a point above the ground line of not less than 2/3 the height of evergreen trees. The lower ends shall be staked to the ground equidistant apart and all at the same distance outward from the tree being approximately equal to 3/4 of the vertical distance between the ground line and the point of fastening. The anchor stakes shall be notched to prevent the wire from slipping and shall be driven into the ground 18 inches, and extend above the ground 3 inches.

Hose shall be used to enclose the wires where they encircle the tree and it shall be of sufficient length to clear the trunk 6 inches at the ends.

661.17 Maintenance. The Contractor shall, during the life of the Contract, properly care for all plantings furnished, planted or stored, performing such watering, weeding, cultivating or other ordinary maintenance Work as shall be necessary to keep the stock in a live healthy condition. Trees which have died back into the crown or beyond a normal pruning line within one year after the

date of acceptance of Work shall be replaced by the Contractor at no additional expense to the City.

661.18 Removal of Stakes and Wrapping. The Contractor shall remove all stakes, guy wires, and wrapping material from all plants just before the Final Inspection, with the exception of the replacement plantings that have not been in place for a full growing season, and shall dispose all Materials in a suitable manner.

661.19 Method of Measurement. Plantings of each species and size will be paid for as the number completed and accepted, in place.

661.20 Basis of Payment. Payment for accepted quantities will be made at the Contract price for:

Item	Unit	Description
661	Each	Shrub, Type_____, Size
661	Each	Tree, Type_____, Size

ITEM 667 JUTE MATTING

667.01 Description.
667.02 Materials.
667.03 Construction.
667.04 Maintenance.
667.05 Method of Measurement.
667.06 Basis of Payment.

667.01 Description. This Work shall consist of furnishing, placing and maintaining jute matting in seeded areas as shown on the Plans and as directed by the Engineer.

667.02 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 1 inch
Warp ends per width-81 plus or minus three
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 No. 11 gauge 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 1 inch steel staple, at least nine gauge with points approximately 1 inch apart, will be used as may be required by the Engineer.

667.03 Construction. The jute matting shall be placed immediately after seeding operations have been completed in the specified areas, and prior to placing mulching material.

After the soil has been properly shaped, limed if specified on the Plans, fertilized and seeded, the matting shall be laid out flat, parallel to the flow of water. Where more than one strip is required to cover the given area, the strips shall overlap at least 4 inches. Ends shall overlap at least 6 inches with the upgrade section on top. The up-slope end of each strip of matting shall be buried in 6 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 6 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 and be in contact with the soil at all points. It shall be pressed into the soil with a light lawn roller or by other methods approved by the Engineer.

The 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 3 feet apart in each row. All ends of the matting and all check slots shall be stapled across their width, with staples spaced not more than 6 inches apart.

After the installation operations described above have been completed, the area covered by the matting shall be overseeded with Kentucky 31 Fescue (Festuca arundinacea var. Ky. 31) at the rate of 1 pound per 1,000 square feet. Mulch shall be placed on the matting in accordance with 659.

667.04 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.

667.05 Method of Measurement. The yardage of jute matting shall be the number of square yards (ground surface area) of jute matting placed in accordance with these Specifications, completed and accepted.

667.06 Basis of Payment. Payment for accepted quantities placed, will be made at Contract prices for:

Item	Unit	Description
667	Square yard	Jute matting

The liming, fertilizing, and seeding and protecting (except overseeding) required on the area covered by the jute matting will be paid for under Item 659.

ITEM 668 SEEDING AND EXCELSIOR MATTING

668.01 Description.
668.02 Material.
668.03 Construction.
668.04 Maintenance.
668.05 Method of Measurement.
668.06 Basis 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 Material. Excelsior matting shall consist of a machine-produced mat of wood excelsior, eighty percent of which is at least 8 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 3 inch by 1 inch weave, twisted kraft paper yarn having a high wet strength, or biodegradable plastic, and entwined with the excelsior for maximum strength and ease of handling.

The matting may be 24, 36, or 48 inches in width, plus or minus 1 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 667.02.

668.03 Construction. Within forty-eight hours after the area has been fertilized, and limed if specified, it shall be seeded with the mixture and at the rate as specified in 659.09.

Within forty-eight hours after the specific area has been seeded, excelsior matting shall be installed, held in place and over-seeded as specified for 667.03, 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. The excelsior shall be in contact with the soil. No vegetative mulching material shall be used under the excelsior matting.

668.04 Maintenance. The matting areas shall be maintained as described for jute matting in 667.04.

668.05 Method of Measurement. The yardage of excelsior matting shall be the number of square yards (soil surface area) of seeding and excelsior matting placed in accordance with these Specifications, completed and accepted.

668.06 Basis of Payment. Payment for accepted quantities placed, will be made at Contract price for:

Item	Unit	Description
668	Square yard	Seeding and excelsior matting

The liming and fertilizing required on the area covered by seeding and excelsior matting will be paid for under Item 659.

ITEM 671 EROSION CONTROL OR TURF REINFORCEMENT MATS

671.01 Description
671.02 Materials
671.03 Construction
671.04 Maintenance
671.05 Method of Measurement
671.06 Basis of Payment

671.01 Description. This Work consists of furnishing, placing, and maintaining temporary erosion control matting or permanent turf reinforcement matting as shown on the approved Plans or as directed by the Engineer. This Work also consists of furnishing, placing, and maintaining seeding and mulching when the seeding and mulching is to be held in place with erosion control mats.

671.02 Materials. Furnish Materials conforming to:

Seed and Mulch	Item 659
Lime and Fertilizer	Item 659

Erosion Control Mats as per plan or Proposal

Furnish staples consisting of 12 inch No. 11 gage steel wire bent into narrow U-shape with the ends of the staples approximately 1 inch apart producing a 6 inch staple or furnish pins conforming 18 inch long, 1/4 inch in diameter, with attached 1 1/2 inch washer. Drive staples until the staple is flush with the ground surface. Drive pins until the attached washer is flush with the ground surface.

For clay, shale, and other heavy soils, furnish 3 inch steel staples, No. 9 gage or thicker with points approximately 1 inch apart, as required by the Engineer.

671.03 Construction. Before placing any type of mats, prepare the surface, apply the fertilizer and lime if specified, and seed as specified in Item 659 or as shown on the Plans. Place the mats in the locations shown on the Plans. The installation is to be performed in accordance with the manufacturer's recommendations and in accordance with the Dayton Water Department's Engineering Design Standards.

671.04 Maintenance. Maintain the specified areas until all Work in the Contract has been completed and the Engineer issues the Final Acceptance.

Restore damaged areas to the condition and grade existing just before placing the mat. Relime, refertilize, and reseed restored areas according to Item 659. Replace all damaged mats.

671.05 Method of Measurement. Measure matting by the number of square yards completed and accepted. Determine the area based on the surface area covered by the mats.

671.06 Basis of Payment. Payment will not be made for maintenance as detailed in 671.04 that is required due to the Contractor's negligence, carelessness, or failure to install erosion controls.

If erosion control items in the Contract are properly placed according to the Contract Documents, payment will be made for maintenance detailed in 671.04 or according to 117.10.

Payment for liming and fertilizing of areas covered by the mats will be made under Item 659. No separate payment will be made for the seeding and mulching performed under or over the mats.

Payment will be made for accepted quantities at the Contract prices as follows:

Item	Unit	Description
671	Square Yard	Erosion control mat, type__
671	Square Yard	Turf reinforcement mat, type __

700 MATERIAL DETAILS

Materials shall conform to the stated requirements and/or the requirements of the referenced Specifications including modifications as noted.

ITEM 701 HYDRAULIC CEMENT

701.01 Air-Entraining Portland Cement
701.04 Portland Cement
701.05 High-Early-Strength Portland Cement
701.07 Masonry Cement
701.08 Expansive Hydraulic Cement
701.10 Micro-Silica
701.13 Fly Ash for Use in Portland Cement Concrete

701.01 Air-Entraining Portland Cement. ASTM C150, Type 1A. The Gillmore time of set and the air-permeability (fineness) tests shall govern.

701.04 Portland Cement. ASTM C150, Type I. The Gillmore time of set and the air-permeability (fineness) tests shall govern. This cement may be used in lieu of 701.01 Cement provided 705.10 Admixture is added at the mixer.

701.05 High-Early-Strength Portland Cement. ASTM C150, 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 C91.

701.08 Expansive Hydraulic Cement. ASTM C845, Type K.

701.10 Micro-Silica. Micro-silica shall be provided according to ASTM C1240. Micro-silica admixtures shall not be provided in dissolvable bags.

701.13 Fly Ash for Use in Portland Cement Concrete. Fly ash shall be in accordance with ASTM C618, Class C or F, except ensure a maximum loss of ignition of three percent.

ITEM 702 BITUMINOUS MATERIALS

702.00 Application Temperatures
702.01 Asphalt Cements
702.02 Cut-Back Asphalt
702.03 Cut-Back Asphalt Emulsions
702.04 Emulsified Asphalts
702.05 Asphalt Primer for Waterproofing
702.06 Asphalt for Waterproofing

702.00 Application Temperatures. Bituminous Materials for the several applications in the Specifications shall be applied within the temperature ranges indicated in the following table.

Type and Grade of Material	Application Temperature, Range,°F.	
	Spray	Mix
RC-70	75-150	-
RC-250	100-175	80-150
RC-800	150-225	150-200
RC-3000	200-275	75-225
MC-30	50-120	-
MC-70	75-150	-
MC-250	100-225	100-225
MC-800	150-250	150-225
MC-3000	225-275	200-250
All Emulsions	50-140	50-140
Creosote for Priming Coat	50-80	-
Coal-Tar Pitch	250-350	-
Asphalt Primer for Waterproofing	50-80	-
Asphalt for Waterproofing	300-350	-
CBAE 350, CBAE 350 Sp.	100-150	100-150
CBAE 800, CBAE 800 Sp.	125-175	125-175
Primer 20	60-120	-
Primer 100	75-125	-
Asphalt Cements	350 Max.	325 Max.

702.01 Asphalt Cements. AASHTO M226, Table 2.

702.02 Cut-Back Asphalt. Rapid curing, AASHTO M81, medium curing AASHTO M82. In lieu of viscosity on the residue, the penetration in note 3 (AASHTO M81) or note 4 (AASHTO M82) shall govern.

702.03 Cut-Back Asphalt Emulsions. These emulsions shall be prepared by compounding a suitable volatile solvent and water with 702.01 asphalt shall produce emulsions conforming to the requirements of Table 702.03-1.

TABLE 702.03-1

	CBAE 350	CBAE 350 Special	CBAE 800	CBAE 800 Special	Primer 20	Primer 100
Kinematic Viscosity at 140°F, Centistokes	350-700	350-700	800-1600	800-1600	20-40	100-200
Water Content, *%	4-12	4-12	4-12	4-12	3-8	3-8
Volatile Solvent, *%	12-25	12-25	10-20	10-20		
Asphalt Content, *%	67+	67+	72+	72+	45+	60+
Adhesion Test*	**	**	**	**		
Wet Stone Coating Test*		**		**	**	**
Stripping Test*		**		**		
	Tests on Residue From Distillation					
Penetration at 77°F	80-150	80-150	80-150	80-150	100-200	100-200
Ductility at 77°F, in	100+	100+	100+	100+	100+	100+
Total Bitumen (Sol. in CS2), %	99+	99+	99+	99+	99+	99+

*These tests shall be in accordance with Supplement 1014 on file in the Office of the Director of the State of Ohio Department of Transportation.

**Shall meet.

702.04 Emulsified Asphalts. AASHTO M140 or AASHTO M208.

702.05 Asphalt Primer for Waterproofing. ASTM D41.

702.06 Asphalt for Waterproofing. ASTM D312, Type III.

ITEM 703 AGGREGATE

703.01 General Soundness
703.02 Aggregate for Portland Cement Concrete
703.03 Fine Aggregate for Mortar or Grout
703.04 Aggregate for Bituminous Aggregate Base, Aggregate Base, and Slope and Channel Protection
703.05 Aggregate for Asphalt Concrete, Prime Coat, and Seal Coat
703.06 Sand Cover
703.07 Mineral Filler
703.10 Screenings

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. Aggregates shall not be removed from stock piles within 1 foot of the ground until final cleanup of the Work and 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 aggregates, stockpiling will be required.

Size. Aggregate shall conform to the size specified in the material specification, the construction item or as shown in AASHTO M43.

Method of Test. Aggregate shall be tested by the following methods:

Amount finer than No. 200 sieve	S1004*
Clay lumps	S1017*
Coal and lignite	AASHTO T113
Crushed pieces	S1021*
Deleterious Materials	S1029*
Effect of organic impurities on strength of mortar	AASHTO T71
Liquid limit	AASHTO T89
Micro-Deval	AASHTO TP58
Percent of wear, Los Angeles abrasion test.	AASHTO T96, or ASTM C535
Plasticity index	AASHTO T90
Sieve Analysis	S1004*, S1005*
Sieve analysis of mineral filler	AASHTO T37
Silicon Dioxide	ASTM C146
Sodium sulfate soundness test, five cycles	ASHTO T104
Sodium sulfate soundness test, Rock Slabs	ASTM D5240
Specific gravity and percent absorption for fine and coarse aggregate	S1031*
Unit weight	AASHTO T19
Light weight chert in aggregates	ASHTO T113
Sand equivalent	AASHTO T176
Uncompacted void content	AASHTO T304
Flat and elongated	ASTM D4791
Rapid freezing and thawing	ASTM C666, Procedure B
Insoluble residue of carbonate aggregates	ASTM D3402
Compaction testing of Unbound Materials	S1015*
In place gradation sampling	S1090*
Sulphur leachate test	S1027*
Soundness of aggregate by freezing and thawing	AASHTO T103

*Method of test shall be in accordance with Supplement on file in the Office of the Director of the Ohio Department of Transportation.

TABLE 703-1
SIZES OF COARSE AGGREGATE
(AASHTO M 43)

Size #	Nominal size square openings (1)	Amounts finer than each labaratory sieve (square opening), percentage by weight														
		4	3 1/2	3	2 1/2	2	1 1/2	1	3/4	1/2	3/8	No. 4	No. 8	No. 16	No. 50	No. 100
1	3 1/2 to 1 1/2	100	90 to 100		25 to 60		0 to 15		0 to 5							
2	2 1/2 to 1 1/2			100	90 to 100	35 to 70	0 to 15		0 to 5							
24	2 1/2 to 3/4			100	90 to 100		25 to 60		0 to 10	0 to 5						
3	2 to 1				100	90 to 100	35 to 70	0 to 15		0 to 5						
357	2 to No. 4				100	95 to 100		35 to 70		10 to 30		0 to 5				
4	1 1/2 to 3/4					100	90 to 100	20 to 55	0 to 15		0 to 5					
467	1 1/2 to No. 4					100	95 to 100		35 to 70		10 to 30	0 to 5				
5	1 to 1/2						100	90 to 100	20 to 55	0 to 10	0 to 5					
56	1 to 3/8						100	90 to 100	40 to 75	15 to 35	0 to 15	0 to 5				
57	1 to No. 4						100	95 to 100		25 to 60		0 to 10	0 to 5			
6	3/4 to 3/8							100	90 to 100	20 to 55	0 to 15	0 to 5				
67	3/4 to No. 4							100	90 to 100		20 to 55	0 to 10	0 to 5			
68	3/4 to No. 8							100	90 to 100		30 to 65	5 to 25	0 to 10	0 to 5		
7	1/2 to No. 4								100	90 to 100	40 to 70	0 to 15	0 to 5			
78	1/2 to No. 8								100	90 to 100	40 to 75	5 to 25	0 to 10	0 to 5		
8	3/8 to No. 8									100	85 to 100	10 to 30	0 to 10	0 to 5		
89	3/8 to No. 16									100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5	
9	No. 4 to No. 16										100	85 to 100	10 to 40	0 to 10	0 to 5	
10	No. 4 to 0 (2)										100	85 to 100				10 to 30

(1) In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series

(2) Screenings

Where standard sieve 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 don as directed by the Engineer.

703.02 Aggregate for Portland Cement Concrete

Fine aggregate.

(a) The fine aggregate shall be natural sand or sand manufactured from stone.

(b) Sieve analysis.

	Total Percent Passing	
Sieve Size	Natural Sand	Manufactured Sand
3/8 inch	100	
No. 4	95-100	100
No. 8	70-100	90-100
No. 16	45-80	50-75
No. 30	25-60	30-60
No. 50	5-30	14-30
No. 100	1-10	4-12
No. 200	0-4	0-5

If the fineness modulus of a job control sample of sand from any source varies by more than 0.20 from that of a representative sample from that source, the sand may be rejected.

(c) Soundness, sulfur, etc.

Maximum
Percent

Loss, sodium sulfate soundness test, Items 305,.....12
451, 452, 511, 519, 608, 609, 610, and 612.....10

Where 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 ninety-five percent of the compressive strength of mortar made with treated sand.

Aggregations of soil silt etc., maximum percent, by weight, 0.5.

Coarse Aggregate:

(a) The Coarse aggregate shall be washed gravel, or crushed carbonate stone.

(b) Physical properties.

Percent of wear, Los Angeles test, maximum
(stone or gravel).....40
Loss, sodium sulfate soundness test, percent,
maximum: Item 305.....15
Items 452, 511, 519, and 610.....12

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 five times the average thickness	15	15
Shale and shaley material	0.5	1.0
Other deleterious substances, such as limonitic concretions, alkali, metallic particles and chert which disintegrates in five cycles of the soundness test	0.5	1.0

(c) 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 Concrete
Crushed carbonate stone	3.4	3.8
Washed gravels of fracture	2.0	2.2

703.03 Fine Aggregate for Mortar or Grout.

(a) The fine aggregate shall be natural sand or sand manufactured from stone.

(b) Sieve analysis.

Sieve Size	Total Percent Passing
No.4	100
No.8	95-100
No.50	10-40
No.100	0-10
No.200	0-5

(c) Soundness, sulfur, etc.

Loss, sodium sulfate soundness test,
maximum percent.....10
Aggregations of soil, silt, etc.
maximum percent.....0.50

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 ninety-five percent of the compressive strength of mortar made with treated sand.

Aggregations of soil, silt, etc., maximum percent, by weight, 0.5.

703.04 Aggregate for:

These properties shall apply for bituminous aggregate base, Item 301, aggregate base, Item 304, and slope and channel protection, Item 601.

(a) The coarse aggregate for bituminous aggregate base used in combination with rigid pavement shall be of crushed carbonate stone, or crushed gravel. The coarse aggregate for bituminous aggregate base used in flexible pavements shall be of crushed carbonate stone, or crushed gravel. The fine aggregate for bituminous aggregate base shall be natural sand or sand manufactured from stone, or gravel.

(b) Physical properties.

	301	304	601
Percentage of wear, Los Angeles test, maximum (stone or gravel)	50	50	50
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 301
Soft pieces	3.0
Coal and lignite	1.0
Clay lumps	0.25
Pieces having a length greater than five times the average thickness	15
Shale, shaley material, and… chert which disintegrates in five cycles of the soundness test	2.5

Gravel used under Item 304 shall be crushed from material retained on the 1/2-inch sieve.

Under Item 304, the portion of aggregate passing the No. 40 sieve shall have a maximum liquid limit of twenty-five percent and a maximum plasticity index of 6.

703.05 Aggregate for:

These properties shall apply for prime coat, Item 408 and seal coat, Item 409.

Fine Aggregate.

(a) The fine aggregate shall be natural sand or sand manufactured from stone, or gravel.

(b) Sieve Analysis

Sieve Size	Total Percent Passing
3/8 inch	100
No. 4	90-100
No. 8	65-100
No. 16	40-85
No. 30	20-60
No. 50	7-40
No. 100	0-20
No. 200	0-10

(c) Soundness, etc.

Loss, sodium sulfate soundness test,
percent, maximum.....15
Aggregations of soil, silt, etc.,
maximum percent by weight.....0.5

Coarse Aggregate.

(a) The coarse aggregate shall be crushed carbonate stone, or washed crushed gravel.

(b) Physical Properties.

Percentage of wear, Los Angeles test maximum
(stone or gravel).....40
Loss, sodium sulfate soundness test, percent, maximum:
Items 403, and 404.....12
Item 409.....15
Percent by weight of fractured pieces minimum:.....40

Deleterious substances shall not exceed the following:

	Percent by Weight
Soft Pieces	3.0
Coal and lignite	1.0
Clay lumps	0.25
Amount finer than No. 200 sieve	3.0
Pieces having a length greater than five times the average thickness	15
Shale, shaley material and other deleterious substances, such as limonitic concretions, alkali, and chert which disintegrates in five cycles of the soundness test	2.5

General Requirements for Coarse and Fine Aggregate.

Each individual sieve fraction soundness loss shall be calculated and ensured that the fractional size does not exceed the following:

(a) Thirteen percent for all surface courses and any asphalt concrete course directly below an open graded friction course.

(b) Thirteen percent for No. 8 aggregate fractions used in intermediate courses that will be exposed to traffic over the winter months.

(c) Fifteen 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, 408.

(a) The sand shall be natural sand or sand manufactured from stone.

(b) Sieve analysis

Sieve Size	Total Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-10

703.07 Mineral Filler.

(a) The mineral filler shall be limestone dust, portland cement, or other inert mineral matter. It shall be thoroughly dry and free from lumps.

(b) Sieve analysis.

Sieve Size	Total Percent Passing
No. 30	100
No. 50	95-100
No. 200	65-100

703.10 Screenings.

(a) The screenings shall be No. 10 size gravel or stone. Where crushed material is specified, it shall be crushed from material larger than the 1/2 inch sieve.

(b) Loss, sodium sulfate soundness,
percent, maximum.....15

ITEM 704 MASONRY UNITS

704.01 Clay or Shale Brick
704.02 Concrete Brick
704.03 Concrete Masonry Blocks

704.01 Clay or Shale Brick. ASTM C32 with the following exceptions:

4.1 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.

6.1 Inspection shall be done at the Project site. Random samples shall be obtained from material delivered to the Project site or at other location designated by the Engineer.

704.02 Concrete Brick. ASTM C55, Type II Grades N-II or S-II, with the following exceptions and additions:

5.1.1 and 5.1.2 Cement shall conform to 701 Portland Cement.

5.2 Aggregate shall conform to the quality requirements of 703.02.

7.1 The units shall be of one 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 rectangular cross section with square corners. The ends, edges, and one face shall be plain surfaces.

9.2 Brick shall be sampled and tested in accordance with ASTM C140. 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.

704.03 Concrete Masonry Blocks. ASTM C139, with the following exceptions and additions:

7.1 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. 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.

ITEM 705 CONCRETE PAVEMENT INCIDENTALS

705.03 Preformed Fillers
705.04 Hot Applied Crack and Joint Sealer
705.05 Burlap Cloth
705.06 Sheet Materials for Concrete Curing
705.07 Liquid Membrane-Forming Compounds for Curing Concrete
705.08 Compounds for Curing Concrete
705.10 Air-Entraining Admixtures
705.11 Preformed Elastomeric Compression Joint Seal for Concrete
705.12 Chemical Admixture for Concrete
705.13 Fly Ash for Use in Portland Cement Concrete
705.21 Quick Setting Concrete Mortar
705.23 Concrete Sealers
705.24 Epoxy Injection Resin

705.03 Preformed Fillers. AASHTO M153 or AASHTO M213 with the following exceptions and additions:

5.7 The producer shall certify to the Engineer that the asphalt cement content is at least thirty-five 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 Crack and Joint Sealer. ASTM D6690, Type II.

705.05 Burlap Cloth. AASHTO M182, Class 2.

705.06 Sheet Materials for Concrete Curing. AASHTO M171, for moisture loss and reflectance only.

705.07 Liquid Membrane Forming Compounds for Curing Concrete. ASTM C309 with the following additions:

11.1 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 Compounds for Curing Concrete. The material shall meet the requirements of FSS TT-C-800, Type I or II, Class 1 (Clear) or Class 2 (Pigmented) except that the unit moisture loss (gm/sq cm at seventy-two hours) maximum shall be 0.055. The Contractor shall submit the manufacturer's certified analysis for each lot shipped.

705.10 Air-Entraining Admixtures. AASHTO M154.

705.11 Preformed Elastomeric Compression Joint Seal for Concrete. ASTM D2628 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.

12.1 In addition, markings shall be not less than 1 foot 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 C494. The minimum relative durability factor shall be 90.

705.13 Fly Ash for Use in Portland Cement Concrete. ASTM C618, Class C or F, except the maximum loss on ignition shall be three percent.

705.21 Quick Setting Concrete Mortar. Only packaged mortar material, that requires the addition of water, shall be provided.

(a) Gradation shall meet the requirements of Table 703.01-1 for No. 8, 89, 9 or a combination thereof.

(b) AASHTO M43 , maximum passing No. 200 sieve shall not exceed 0.2 percent.

(c) AASHTO T84 and T85, absorption, shall not exceed two percent.

(d) AASHTO T104, soundness loss, shall not exceed two percent.

Materials containing more than 50 parts per million of chloride shall not be used. Any admixture containing more than 50 parts per million of chloride shall not be used in conjunction with these Materials.

Quick setting concrete mortar shall be packaged in strong moisture resistant paper bags or other suitable containers capable of withstanding shipping, normal handling, and storage, without breakage. The package will protect the material from deterioration when stored in a dry condition for a period of one year. Each package or container must display information regarding the minimum nominal yield and instructions for mixing. Volumetric yield determination shall be calculated using the manufacturers' recommended water content.

The material shall meet the following requirements:

Test	Type 1	Type 2
Compressive Strength ASTM C109[2]		
Pounds per square inch		
@ one hour	100	2000
@ two hour	250	-
@ twenty-four hours	2000	5000
@ seven Days	-	7000
Compressive Strength ASTM C39[1], [2]		
Pounds per square inch		
@ one hour	100	2000
@ two hour	150	-
@ twenty-four hours	1000	3500
@ seven Days	-	6000
Initial time set (minutes) ASTM C266	5	10
Bond Strength, ASTM C882[1]		
Pounds per square inch		
@ twenty-four hours	1000	1000
@ seven Days	1500	1500
Flexural Strength ASTM C78[1]		
Pounds per square inch		
@ four hour	-	200
@ seven Days	650	500
Freeze and Thaw ASTM C666 (use either procedure B or A)[1]		
Procedure B (350 cycles)		
Durability Factor	80%	80%
Procedure A (300 cycles)		
Durability Factor	79%	79%

[1] Extend test specimens fifty percent by dry mortar weight with aggregate.

[2] Test the mortar as received with the addition of water. The amount of water is to be designated on the packing container by the manufacturer.

705.23 Concrete Sealers. Epoxy-Urethane sealer shall conform to the following requirements:

Absorption. Absorption shall conform to ASTM C642 (non-air entrained concrete). Proportioning and mixing concrete shall be in accordance to ASTM

C672. Sealed concrete, under total immersion, will not exceed one percent after forty-eight hours or two percent after fifty Days.

Scaling Resistance. Resistance shall be in accordance with ASTM C672, with a rating of “No scaling” after 100 cycles on the sealed concrete (non-air entrained concrete) as compared to "Severe Scaling” on untreated concrete.

The NCHRP 244, Series II Cube Test shall yield the following results:

(a) Weight gain - not to exceed twenty-five percent of untreated cube.

(b) Absorbed chloride - not to exceed twenty-five percent of untreated cube.

The NCHRP 244, Series IV Southern Climate test shall yield the following results:

Absorbed chloride - not to exceed ten percent of untreated concrete.

The application rate (square footage/gallon) of sealer shall be recorded and reported during the tests.

Test data shall be provided from an approved independent testing facility.

Non-Epoxy sealer shall conform to the following requirements:

(a) Absorption - ASTM C642 (non-air entrained concrete). Proportion and mix concrete shall be in accordance with ASTM C672. Sealed concrete, under total immersion, will not exceed one percent after forty-eight hours or two percent after fifty Days.

(b) 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.

The NCHRP 244, Series II Cube Test shall yield the following results:

(a) Weight gain - not to exceed twenty-five percent of untreated cube.

(b) Absorbed chloride - not to exceed twenty-five percent of untreated cube.

The NCHRP 244, Series IV Southern Climate test shall yield the following results:

Absorbed chloride - not to exceed ten percent of untreated concrete.

The application rate (square footage/gallon) of sealer shall be recorded and reported during the tests.

Test data shall be provided from an approved independent testing facility.

705.24 Epoxy injection Resin.

Epoxy injection resin capable of application, positive adherence, and strength development when applied to moist or wet surfaces at temperatures of 33°F and above shall be provided.

Products that contain one hundred percent solids material and no non-reactive diluents, solvents, or other fillers shall be used. Materials shall meet the following requirements:

(a) The injection will meet the requirements of ASTM C881 Type IV, Grade 1, and Class B or C, and viscosity 600 cps at the lowest ambient material and substrate temperature to be used.

(b) The paste Materials will meet the requirements of ASTM C881 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 Engineer:

(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 two kits of the injection Materials.

ITEM 707 STEEL, ALUMINUM, AND PLASTIC PIPE

707.10 Square and Rectangular Steel Tubing

707.10 Square and Rectangular Steel Tubing. The Contractor shall provide square and rectangular steel tubing according to ASTM A501 or ASTM A500, Grade B, with the following modifications:

The tubing shall be galvanized in accordance with 711.02.

The Contractor shall test the tubular steel from all heat numbers supplied for toughness according to ASTM E436 except as modified herein. Tubing test samples shall be taken and tested before delivery of the railing. The taking of the test samples shall be witnessed by the Engineer and the testing performed by an independent test Laboratory. Certified Test Data shall be submitted for review and approval.

The Contractor shall perform testing on test specimens obtained from galvanized tubing with the same heat number as that being used. Testing shall be conducted at a temperature of 0°F on 2 x 9 inch specimens supported to provide a 7 inch clear span. The Contractor shall not remove the galvanizing from the specimens. Three 2 x 9 inch test specimens shall be cut from each of the unwelded sides for a total of nine specimens. If all three unwelded sides are not large enough to remove 2 x 9 inch specimens, nine specimens shall then be removed from any unwelded side.

The Contractor shall disregard the three specimens from the side with the lowest average shear area when calculating the final average shear area. If specimens were not removed from three unwelded sides, then the three specimens with the lowest average shear area shall be disregarded. The Contractor shall calculate the final average shear area using the six remaining specimens. If the average shear area falls below fifty percent, material from the heat represented by these tests will be rejected. However, if the average shear area is 30 percent or greater, the Engineer will allow one retest at a sampling frequently three times that of the first test, and with no samples excluded in calculating the average. Materials not having a fifty percent average shear area upon retest shall be rejected.

Before galvanizing, the manufacturer of the tubing shall identify the product with the steel heat number (or with some number that is traceable to the heat number) and with the manufacturer's unique identification code to facilitate acceptance or rejection of the material. The Contractor shall ensure that the identification method is such that identification is on only one face of the section, and is repeated at intervals no greater than 4 feet, and does not extend into the curved surface of the tubing at the corners.

ITEM 708 PAINT

708.01 OZEU Structural Steel Paint
708.14 Traffic Zone Paint
708.17 Inorganic Zinc Silicate Primer Paint
708.18 Blue-Green Vinyl Finish Coat

708.01 OZEU Structural Steel Paint. This specification covers the formulation and testing of a three-coat structural steel paint system consisting of an organic zinc prime coat, an epoxy intermediate coat, and a urethane finish coat (OZEU). Material requirements for the respective coats are as follows:

General. For each lot of all coatings, a coated card, minimum card size 3 inches by 5 inches, shall be furnished that shows the color, gloss, and general appearance of the material covered by the lot. The color must match the color card furnished for the Contract or order within visual limits determined by the Engineer. In case of disagreement, test data shall be provided according to ASTM D2244 showing a color difference of no greater than 2.0, Delta E* (C.I.E 1976 L*a*b*).

Organic Zinc Prime Coat. The paint shall be an organic zinc prime coat consisting of a zinc dust filled, two or three component epoxy polyamide, and selected additives as required. The coating shall also meet the following:

(a) Physical Requirements.

(1) Total solids, % by weight of paint, ASTM D2369. seventy percent minimum.
(2) Pigment, % by weight of total solids, ASTM D2371. eighty-three percent minimum.
(3) Total zinc dust, % by weight of pigment. ninety-three percent minimum.
(4) Total zinc, % by weight of total solids (by calculation). seventy-seven percent minimum.
(5) Total solids, % by volume, ASTM D2697. forty-five percent minimum.
(6) Color. Greenish gray, approximating FS-595B-34159, visual comparison.
(7) Pot life. SSPC-Paint 22, Section 5.5 with the following exception: six hours, minimum at 77°F with no evidence of gellation. The coating shall be in a free-flowing condition and easily sprayed.

By observation of Ford B cup viscosity, pot life is deemed exceeded if the viscosity rises more than thirty percent or if gelled particles appear in the mix. A 1 quart container of mixed material is used.

(b) Qualitative Requirements.

(1) Mixing. Section 5.2, SSPC-Paint 20 using only a high shear (Jiffy) mixer.
(2) Storage Life. Section 5.4, SSPC-Paint 20.
(3) Mudcracking. Section 5.7, SSPC-Paint 20.

(c) Material Quality Assurance. Analysis for each component.

(1) Three-Component Systems.

(a) Resin.

Test	Variance
Nonvolatiles, % by weight	± 2
Density	± 0.2 pounds per gallon
Viscosity	± 5 KU or ±5 seconds, Ford Cup

(b) Hardener.

Test	Variance
Nonvolatiles, % by weight	±2
Density	±0.2 pounds per gallon
Viscosity	±5 KU or ± 5 seconds, Ford Cup

(c) Zinc.

Test	Variance
Total zinc metal, % by weight	±2

(2) Two-Component Systems.

(a) Zinc/Resin.

Test	Variance
by weight	±2
Density	±2 %
Viscosity	Dependent on test
Nonvolatiles, % by weight	±2

(b) Hardener.

Test	Variance[1
Nonvolatiles, % by weight	±2
Density	±0.2 pounds per gallon
Viscosity	Dependent on test

[1] Variance shall be within the noted range based upon the test average of the previously submitted sample.

Epoxy Intermediate Coat. A two-part epoxy intermediate coat composed of a base component and a curing agent suitable for application over the epoxy-polyamide zinc rich primer shall be provided. The base component shall contain an epoxy resin together with color pigments, mineral fillers, gellant, leveling agent, and volatile solvents. The curing agent component shall contain a liquid polyamide resin and volatile solvent. The coating shall also meet the following:

(a) Physical Requirements.

(1) Color. White, meeting or exceeding, FS-595B-37875 as per ASTM E1347.
(2) Components. Two, mixed before application.
(3) Volume solids, ASTM D2697. fifty percent minimum.
(4) Pot life. SSPC-Paint 22, Section 5.5 with the following exception: six hours, minimum at 77°F with no evidence of gellation. The coating shall be in a free-flowing condition and easily sprayed.
(5) Curing time.
(a) Set-to-touch, ASTM D1640. four hours, maximum at 77°F.
(b) Dry-to-recoat, ASTM D1640. twenty-four hours, maximum at 77°F.
(c) Full cure. seven Days, maximum at 50°F. No pick-up when rubbed with a cloth soaked in Methyl Ethyl Ketone.
(6) Fineness of grind, ASTM D1210. Hegman 3 minimum.
(7) Volatile Organic Compounds (VOC), maximum, ASTM D3960. 3.5 pounds per gallon, as applied.

(b) Material Quality Assurance. Analysis for each component.

Test	Variance[1]
Density, %	±2
Viscosity	Dependent on test
Total solids, % by weight	±2
Pigment, % by weight	±2
Nonvolatile vehicle, % by weight	±2

[1] Variance shall be within the noted range based upon the test average of the previously submitted sample.

Urethane Finish Coat. A two-component urethane finish coat composed of a polyester and/or acrylic aliphatic urethane and suitable for use as a finish coat over the white epoxy polyamide intermediate coat shall be provided. The coating shall also meet the following:

(a) Physical Requirements.

(1) Finish, Specular gloss, ASTM D523. Fed Std 595B-16440 Gray: seventy percent minimum after three thousand hours weathering resistance. Color change less than 2.0 ΔE*, (C.I.E 1976 L*a*b*) ASTM D2244.
(2) Volume solids, ASTM D2697. forty-two percent minimum.
(3) Curing time, at 77°F and 50% RH. Set-to-touch, ASTM D1640: thirty minutes, minimum; four hours, maximum.
(4) Pot life. Pot life. SSPC-Paint 22, Section 5.5 with the following exception: four hours, minimum at 77°F with no evidence of gellation. The coating shall be in a free flowing condition and easily sprayed.
(5) Volatile Organic Compounds (VOC), maximum, ASTM D3960. 3.5 pounds per gallon, as applied.
(6) Colors.
(a) Specified.[2]

Brown	FS-595B, 10324
Green	FS-595B, 14277
Blue	FS-595B, 15526

[2] Contractor's choice unless specified on Plans

(b) Elective. As specified on the Plans. Gloss requirements, ASTM D523.

Full gloss	minimum 80% unless specified on the Plans
Semi-gloss	30 to 45%
Lusterless (Matte)	maximum 6%

(b) Material Quality Assurance. Analysis for each component:

Test	Variance[1]
Density, %	±2
Viscosity	Dependent on test
Total Solids, % by weight	±2
Pigment, % by weight	±2
Nonvolatile Vehicle, % by weight	±2

[1] Variance shall be within the noted range based upon the test average of the previously submitted sample.

Performance Requirements. The coating system, which consists of the organic zinc prime coat, the epoxy intermediate coat, and the urethane topcoat, shall be tested prior to use.

Three panels shall be prepared for each of the specified tests according to ASTM D609, except provide a minimum thickness of 1/8 inch and use ASTM A36 hot rolled steel. The surface shall be blasted clean (using coal slag abrasive) to equal, as nearly as is practical, the standard Sa 2 1/2 of ASTM

D2200 (Steel Structures Painting Council SSPC-SP10 meets this requirement). The surface shall have a nominal height of profile of 1 to 3.5 mils verified by using appropriate replica tape. Panels shall be coated and cured the panels according to the manufacturer's printed instructions. A dry film coating thickness for the system to be tested as follows:

Organic Zinc:	3.0 to 5.0 mils
Epoxy:	5.0 to 7.0 mils
Urethane:	2.0 to 4.0 mils

The coating system shall pass each of the following tests:

(a) Fresh Water Resistance Test (ASTM D870). Panels shall be scribed according to ASTM D1654 to the depth of the base metal in the form of an "X" having at least 2-inch legs, and immersed in fresh tap water at 75°F ± 5°F. After thirty Days of immersion, the panels are to be examined to verify that they show no rusting and that the coating shows no blistering, softening, or discoloration. Blistering will be rated according to ASTM D714.

(b) Salt Water Resistance Test (ASTM D870). Panels shall be scribed as specified in (a) above, and immersed in a water solution of five percent sodium chloride at 75°F ± 5°F. After seven, fourteen, and thirty Days of immersion, the panels shall be examined to verify that they show no rusting and that the coating shows no blistering or softening. Blistering will be rated according to ASTM D714. After examination at seven and fourteen Days, the sodium chloride solution shall be replaced with a fresh solution.

(c) Weathering Resistance Test. Panels shall be tested in accordance with ASTM D4587, Method D, using Ultra Violet A 340 bulbs. The panels are to be placed on test at the beginning of a wet cycle. After three thousand hours of continuous exposure, panels shall be examined to verify that they show no rusting and that the coating shows no blistering or loss of adhesion. The 60 degree specular gloss measurements shall be performed on the sprayed panels utilized for this test. The three initial measurements (one per panel) are averaged together. Also, average the three final measurements together.

(d) Salt Fog Resistance Test. The panels shall be scribed as specified in (a) above, and tested according to ASTM B117. After three thousands hours of continuous exposure, coating is examined to verify that it shows no loss of bond and that it shows no rusting or blistering beyond 1/16 inch from the center of the scribe mark. Blistering is rated in accordance with ASTM D714.

(e) Elcometer Adhesion Test, ASTM D4541, Type IV. Panels are tested in accordance with the following:

(1) Lightly sand the coating surface and aluminum dolly, and apply a quick set adhesive.
(2) Allow adhesive to cure overnight.
(3) Scribe the coating and adhesive around the dolly before testing.
(4) Make a minimum of four trials to failure, and report the four trials. Ensure that each trial is less than 400 pounds per square inch (2.8 MPa). Reject trial if fracture at the primer-blast interface occurs.

Prequalification. Before approval, copies of the manufacturer's Certified Test Data showing that the coating system complies with the performance requirements of this specification shall be submitted to the Engineer. The Certified Test Data shall also state the following physical properties for each coating: Density, pounds per gallon; Solids, percent by weight; Solids, percent by volume; Viscosity; Drying time; and VOC content, pounds per gallon.

An independent testing Laboratory, approved by the Engineer, shall be used to develop the test data. Included with the test data shall be the brand name of the paint, name of manufacturer, number of lots tested, and date of manufacture.

Additionally, the Contractor shall submit the following items to the Engineer before approval: manufacturer's technical data sheet for each coating, Material Safety Data Sheet for each coating, enough components to produce a 1 gallon sample of each coating; and a 1 quart sample of the thinner to be used with each coating.

Once the Engineer approves the coating, no further performance testing will be required by the manufacturer unless the formulation or manufacturing process has been changed, in which new certified test results will be required. All accepted variances of sampling shall be established by the Engineer.

708.14 Traffic Zone Paint. White and yellow ready-mixed traffic paint suitable for marking 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 can not be readily broken up with a paddle to a smooth uniform paint capable of easy application by spray. Paint purchased by Departmental Purchase Orders which deteriorates in storage within one year shall be replaced at no cost to the City. All paint shall comply with the following:

(a) Viscosity. CONVENTIONAL: The viscosity shall be 65-75 Krebs Units at 77°F. determined in accordance with Federal Test Method Standard No. 141, Method 4281.
FAST DRY: The viscosity shall be 90-110 Krebs Units at 77°F. determined in accordance with Federal Test Method Standard No. 141, Method 4281.

(b) Color. The white paint after drying shall be free from tint and have a daylight reflectance (45-0 degrees) not less than seventy-five percent of that of magnesium oxide. The yellow paint shall conform to No. 33538 of Federal Standard No. 595, within 6.0 CIELAB Units (Commission Internationale de l'Eclairage).

(c) Drying Time. CONVENTIONAL: When applied under normal field conditions, the paint shall dry within thirty minutes and remain entirely free from tackiness thereafter.
FAST DRY: When applied under normal field conditions, the paint shall dry to a no-tracking condition in not less than fifty seconds or more than two minutes.

(d) Bleeding. The paint shall not bleed or discolor when sprayed on bituminous surfaces.
The paint shall meet the requirements of paragraphs (a) and (b) in order to be eligible for the service test. Samples of paint for the service test will be called for by an invitation to submit samples issued by the City.

708.17 Inorganic Zinc Silicate Primer Paint. AASHTO M300, Type I or Type IA, with the following additions.

Color. A green colorant approximating No. 34159 of FS 595B.

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 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 predisposed.

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 requirements and possess a color closely approaching Federal Standard No. 595-34241.

	Minimum Percent	Maximum Percent
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 + 5.0 Krebs Units of the viscosity of the previously submitted sample. The weight per gallon of the paint shall be within + 0.3 pounds of the previously submitted sample.

708.19 Structural Steel Prime Paint. FSS TT-P-615, Type V.

ITEM 709 REINFORCING STEEL

709.00 Epoxy Coated Reinforcing Steel
709.01 Deformed and Plain Billet steel Bars for Concrete Reinforcement
709.03 Rail Steel Deformed and Plain Bars for Concrete Reinforcement
709.05 Axle Steel Deformed and Plain Bars for Concrete Reinforcement
709.08 Cold-Drawn Steel Wire for Concrete Reinforcement
709.09 Fabricated Steel Bar or Rod Mats for Concrete Reinforcement
709.10 Welded Steel Wire Fabric for Concrete Reinforcement
709.11 Deformed Steel Wire for Concrete Reinforcement
709.12 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
709.13 Coated Dowel Bars

709.00 Epoxy Coated Reinforcing Steel. ASTM A775, with the following exceptions and additions:

5.1 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.

5.2 The coating material shall meet the requirements listed in Annex A1 and shall be a color that facilitates inspection of the installed bar. The color shall be subject to approval of the Engineer.

5.3 A sample shall be required.

8.3.1 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 A615 or ASTM A996, as applicable. The bend test for adhesion of the coating shall be made at a uniform rate and shall take up to ninety 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.

12.1 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.

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 according to ASTM A 775, Section 1.

709.01 Deformed and Plain Billet Steel Bars for Concrete Reinforcement. ASTM A615, with the following exceptions and additions:

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 practical, one tension test and one bend test shall be made for each bar designation number in each lot of ten tons or fraction thereof.

17.1 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.

709.03 Rail Steel Deformed and Plain Bars for Concrete Reinforcements. ASTM A996, with the following exceptions and additions:

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.

16.1 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.

709.05 Axle Steel Deformed and Plain Bars for Concrete Reinforcement. ASTM A996, with the following exceptions and additions:

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.

16.1 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 A82, with the following exceptions:

7.2 Galvanized wire shall be completely covered 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 A90.

11.1 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.

709.09 Fabricated Steel Bar or Rod Mats for Concrete Reinforcement. ASTM A184, with the following exceptions:

4 Bars shall be deformed.

4.1 Longitudinal bars shall conform to Grade 60 of 709.01, 709.03, or 709.05.

4.2 Longitudinal bars shall conform to Grade 60 of 709.01, 709.03 or 709.05. Transverse bars shall conform to 709.01.

10.1 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 A185, with the following exceptions:

13.1 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.

709.11 Deformed Steel Wire for Concrete Reinforcement. ASTM A496, with the following exceptions:

13.1 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.

709.12 Welded Deformed Steel Wire Fabric for Concrete Reinforcement. ASTM A497, with the following exceptions:

13.1Inspection 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 Coated Dowel Bars. AASHTO M254, with the following exceptions:

3.1 The core material shall be of steel meeting 709.01, 709.03 or 709.05.

4.2 Is waived. The thickness of the coating shall be that approved under 2.5 and shall be within the manufacturer's stated tolerance.

If the Contractor elects to use basket supports for positioning of the above dowel bars as per 451.08 (b) or plan requirements, the coating of the baskets and repair of damaged areas shall be as per the above coating requirements or an approved equivalent coating.

Coating on dowel bars or baskets, damaged during installation, shall be repaired.

Coated dowels shall not be exposed to weather or sunlight for a period exceeding one hundred eighty Days.

13.1 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.

710 FENCE AND GUARDRAIL

710.01 Barbed Wire
710.02 Woven Steel Wire Fence Type 47
710.03 Chain-Link Fence
710.06 Deep Beam Rail
710.09 Wire Rope Rail
710.11 Fence Posts and Braces
710.12 Square Sawed and Round Guardrail Post
710.14 Pressure Treated Guardrail and Fence Posts, Braces, and Blocks
710.15 Steel Guardrail Posts
710.16 Guard Posts

710.01 Barbed Wire. ASTM A121, Type Z, Class 3 Galvanizing, with the following exceptions:

6.3 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.

7.1 Barbed wire strand wires shall be No. 12 1/2, 13 1/2, or 15 1/2 steel wire gage. Barbs shall be four point round steel wire spaced 5 inches center to center.

9.2 Sufficient completed barbed wire shall be cut from the end of a spool to provide a sample length of 5 feet.

11.1 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.

710.02 Woven Steel Wire Fence Type 47. ASTM A116, Type Z, Class 3 galvanizing, with the following exceptions:

7.1 The fence fabric shall be Simplified Practice Recommendations R 9-47 design number 1047-6.9.

11.1 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.

Galvanizing. In addition all hardware and attachments shall be galvanized in accordance with 711.02.

710.03 Chain-Link Fence. AASHTO M181 with the following exceptions and additions:

3.1 Posts, gate frames, post braces and top rails shall be Type I or Type III material. Type I shall also conform to the requirements of Table 710.03-1. Type III shall also conform to the requirements of Table 710.03-2.

TABLE 710.03-1
STEEL POSTS, GATE FRAMES, POST BRACES, AND TOP RAILS

Usage Nominal Fence Height	Section Thickness	Outside Diameter Inches	Weight Nominal Pounds	Tolerance Percent	Minimum Yield Strength Pounds per square Inch
6 feet or less					
	Grade 1 Pipe	2.375	3.65	-5	25,800
Line Posts	Grade 2 Pipe	2.375	3.12	-5	50,000
	C-Section	2.25x1.70	2.73	-6	45,000
	H-Section	2.25x1.70	3.26	-5	45,000
	Grade 1 Pipe	2.875	5.79	-5	25,800
End,	Grade 2 Pipe	2.880	4.64	-5	50,000
Corner	Square	2.500	5.70	-3	40,000
Pull Posts	Roll-Form	3.500x3.50	5.14	-6	35,000
Gate Posts for nominal width of gate (single or one leaf of doubles)					
	Grade 1 Pipe	2.880	5.79	-5	25,800
Up to	Grade 2 Pipe	2.880	4.64	-5	50,000
6 Feet	Square	2.500	5.70	-3	40,000
incl.	Roll-Form	3.500x3.50	5.14	-6	35,000
Over 6 to	Grade 1 Pipe	4.000	9.11	-5	25,800
13 Feet	Grade 2 Pipe	4.000	6.56	-5	50,000
incl.	Square	3.000	9.35	-3	40,000
Over 13 to 18 feet	Grade 1 Pipe	6.630	18.97	-5	25,800
Over 18	Round	8.625	24.70	-5	25,800
Gate	Grade 1 Pipe	1.900	2.72	-5	25,800
Frames	Grade 2 Pipe	1.900	2.28	-5	50,000
	Square	2.000	2.66	-3	40,000

Top	Grade 1 Pipe	1.660	2.27	-5	25,800
Rails	Grade 2 Pipe	1.660	1.84	-5	50,000
post	H-Section	1.50x1.31	2.25	-5	45,000
braces	Roll-Form	1.625x1.25	1.35	-6	35,000
	Round Tubing	1.660	1.38	-5	50,000

When tension wire is specified, it shall be of 0.177 inch diameter.

The fabric shall be fastened to the posts using either aluminum alloy or galvanized steel bands or wires. Tie wires shall be 0.148 inch minimum diameter and the zinc coating on steel fasteners shall not be less than 0.8 ounces per square foot.

Stretcher bars shall be flat bars having a 3/16 x 3/4 inch cross section or equivalent cross section with length equal to full height of fabric. Truss rods shall be steel 3/8 inch diameter or equivalent cross section and shall have suitable adjustment. Brace rods shall be 3/8 inch outside diameter or equivalent cross section.

Brace bands shall be beveled edge bars 1 x 1/8 inch section.

Bolts shall have anodic coating at least 0.0002 inch in thickness, chromate sealed.

Top rails shall be furnished in lengths not less than 18 feet. Top rail couplings shall be self-centering and shall be outside sleeve type at least 6 inches long. A minimum of twenty percent of the coupling shall have an internal heavy spring to take up expansion and Contraction.

Post tops shall be ornamental caps of steel, malleable iron or cast iron. They 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.

Gates shall be swing type, complete with latches, stops, keepers, hinges, locks and fabric. They shall be covered with fabric matching the fence. Gate frames shall be assembled by welding using properly designed formed sheet or sandcast fittings. Hinges shall be the offset type and 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. 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 iron.

11.1 The size of fabric shall conform to 0.148 inch nominal diameter of coated wire, 2 inch mesh.

14.1 Table 5. Type I Zinc-Coated Steel Chain Link Fabric shall have Class D weight of coating.

19.1 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.

20.1 Certification. Three certified copies of the chemical and physical properties of each of the aluminum components shall be furnished to the Engineer.

32.2 Does not apply.

32.3.3.2. The minimum weight of interior coating shall be increased to an average of 0.9 ounces per square foot and not less than 0.8 ounces per square foot on an individual specimen.

TABLE 710.03-2
DIAMETERS OR PLAIN END,
SCHEDULE 40 ALUMINUM ALLOY PIPE

The weights and dimensions shall be as specified in ANSI H35.2.

Material	Nominal Pipe Size (in)
Brace rails and top rails	1 1/4
Gate frames and rail couplings	1 1/2
Line posts	2
End and corner posts	2 1/2
Gate posts-single or one leaf of double:	
Gate opening-feet	
to 6	2 1/2
over 6 to 12	3 1/2
over 12 to 18	6
over 18 to 32	8

710.06 Deep Beam Rail. AASHTO M180, Type II, Class A, with the following exceptions:

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.

5.2 Acceptance by sampling shall apply.

5.2.1 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.

9.1.2. The minimum check limits for both triple and single-spot tests apply.

710.09 Wire Rope Rail. AASHTO M30 Class A, Type I Rope.

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.

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, and free from knots, splits and shakes, and shall be treated in accordance with 712.06.

Steel line posts shall conform to ASTM A702 with the following exceptions:

5.3 Holes shall not be acceptable.

5.6.2 Fasteners or clamps shall be 0.120-inch diameter and galvanized in accordance with ASTM A116, Type Z, Class 3.

5.6.3 Each post shall be supplied with a sufficient number of fasteners or clamps.

6.2.1 Post lengths shall be as designated.

7.1 Line posts and anchors shall be galvanized as per 711.02.

7.2 Delete.

9.1 Sampling shall be as per 712.06.

13 Certification and documentation shall be required.

710.12 Square Sawed, and Round Guardrail Posts. 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 be 8 inches plus or minus 1 inch in diameter and have a uniform taper. The sweep shall not exceed 1 inch for the length of the post. 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 2 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.

710.14 Pressure Treated Guardrail and Fence Posts, Braces, and Blocks. Posts, braces and blocks shall conform to the requirements of AASHTOM 168 and 710.11, 710.12 and 712.06. Posts, braces and blocks shall be inspected before treatment for conformance to the requirements of this specification by an agency qualified and approved by the Engineer for such inspection. Posts and braces shall bear the identification mark of the inspection agency. 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 A36. Posts shall be galvanized in accordance with 711.02.

710.16 Guard Posts. Pressure treated wood posts shall be furnished in accordance with 710.04. Posts shall be either 5 x 6 inch sawed square or 5 1/2 inch x 1/2 inch diameter round when measured 30 inches from the top. Furnish posts that are 5 feet, 3 inches in length and are embedded such that 30

inches remain exposed. The center-to-center spacing shall be at 6 foot intervals, unless otherwise shown on the Plans.

Posts and braces shall bear the identification mark of the inspection agency. 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.

ITEM 711 STRUCTURAL STEEL AND STRUCTURE INCIDENTALS

711.01 Structural Steel
711.02 Galvanized Steel
711.03 Steel for Sheet Piling
711.04 Cold Rolled Steel
711.07 Steel Castings
711.09 High-Strength Steel Bolts, Nuts and Washers
711.10 Machine Bolts
711.12 Gray Iron Castings
711.13 Ductile Iron Castings
711.14 Stainless Steel Fasteners
711.15 Sheet Copper
711.16 Phosphor Bronze Plate
711.17 Cast Bronze
711.18 Leaded Bronze
711.19 Sheet Lead
711.20 Aluminum for Railings
711.21 Preformed Bearing Pads
711.24 Waterproofing Fabric
711.25 Type 2 Membrane Waterproofing
711.26 Structural Timber, Lumber and Piling
711.27 Prestressing Steel
711.28 Cellular Polyvinyl Chloride Sponge
711.29 Type 3 Membrane Waterproofing
711.30 Aluminum for Steps
711.31 Reinforced Propylene Plastic Manhole Steps

711.01 Structural Steel. Steel shall be structural steel ASTM A36, or when specifically called for high-strength low alloy steel ASTM A572 Grades 42 through 50, A588, or A709.

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 A673. The (H) frequency of heat testing shall be used, and the test data shall be provided as required by the Engineer.

ASTM Designation	Thickness and Connection Method	Min CVN Value
A 36	Up to 4" mechanically fastened or welded	15 foot pounds @ 40°F
A 572, A 588	Up to 4" mechanically fastened	15 foot pounds @40°F*
A 572, A 588	Over 2" to 4" welded	20 foot pounds @ 40°F*
A 572, A 588	Up to 2" welded	15 foot pounds @ 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 A123 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.

Bolts, nuts, washers, and similar threaded fasteners shall be galvanized in accordance with ASTM A153. These items may be mechanically zinc coated according to ASTM B695, Class 50. Except for ASTM A325 bolts, electrogalvanizing may also be used if the coated item meets the thickness coating requirements of ASTM A153.

711.03 Steel for Sheet Piling. ASTM A328.

711.04 Cold Rolled Steel. ASTM A108 Grade 1016 through 1030 for pins, rollers, trunnions and other similar parts.

711.07 Steel Castings. ASTM A27, Grade 65-35 or 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.

711.09 High-Strength Steel Bolts, Nuts and Washers. ASTM A325 with the following exception:

12.1 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.

Bolts for steel used in bare unpainted applications shall be ASTM A325 Type 3.

When galvanized bolts, nuts and washers are specified, they may be mechanically galvanized.

Bolts used to fasten painted steel shall be galvanized and need not be painted.

711.10 Machine Bolts. ASTM A307 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 Engineer.

Mechanical galvanizing is permitted.

711.12 Gray Iron Castings. ASTM A48, Class 30B, with the following exceptions:

9.1 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.

12.2 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.

15.1 Inspection shall be made at the Project site. Test bars representing the lot shall be made available to the Engineer 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 A536, with the following additions and exceptions:

8.1. 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.

10.2 A keel block or Y-block specimen made shall accompany the shipment for each heat number, ladle number and date of casting.

12.1 Inspection shall be made at the Project site.

14.1 Test bars shipped with castings shall be accompanied by a certification stating the bars were prepared in accordance with specified requirements.

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 B370.

711.16 Phosphor Bronze Plate. ASTM B103.

711.17 Cast Bronze. ASTM B22, Copper Alloy No. C91100 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 B584, Copper Alloy No. C93700 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 B29.

711.20 Aluminum for Railings. Aluminum other than permanent mold castings shall conform to the following requirements:

Portion of Railing	ASTM Designation	Alloy	Condition or Temper (B296)
Sand castings	B26	356.0	T6
Shims	B209	1100	0
Washers	B209	Clad 2024/6061	T4/T6
Sheet and plate	B209	6061	T6
Drawn seamless tubes	B210	6061 or 6063	T6
Bars, rods, wire	B211	6061	T6
Bolts, set screws	B211	2024*	T4
		6061	T6
Nuts	B211	6061/6262	T6/T9
Extruded bars, rods, shapes	B221	6061 or 6063	T6
		6351	T5
Extruded tubes	B221	6061 or 6063	T6
		6351	T5
Pipe	B241	.6061 or 6063	T6
Rivets	B316	6061	T6

*Shall have an anodic coating.

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 and rubber hardness figures shall be 80 + 10 as measured by Shore Durometer test. The ultimate break down 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 and all bolt holes accurately located and cleanly cut.

711.24 Waterproofing Fabric. ASTM D173.

Type 2 Membrane Waterproofing.

Physical Properties
Thickness ASTM D1777.....60 mils min.
Width.....36 inches min.
Pliability [180° bend over 1/4 inch
mandrel @ -25°F] ASTM D146.....No effect
Elongation ASTM D412 (Die C) .....300% min.
Puncture Resistance-Membrane..
ASTM E154.....40 lb. Min.
Permeance (Grains/ft²/hr/in Hg)
ASTM E96, Method B.....0.1 max.
Water Aborption (% by weight)
ASTM D570.....0.2 max.
Adhesion to concrete ASTM D903……...5.0 min.

Submit Certified Test Data and letter of certification to the Engineer.

711.26 Structural Timber, Lumber and Piling. 712.06 and AASHTO M168 with the following additions:

Timber and lumber shall be air dried or kiln dried to a moisture content not to exceed nineteen percent by weight. Size and grade shall conform to American Lumber Standards.

All structural timber, lumber, and piling shall be subject to inspection by an authorized Inspector of the City.

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:

(a) West Coast Lumber Inspection Bureau

(b) Western Wood Products Association

(c) Southern Pine Inspection Bureau

(d) 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 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, and

(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 A416 with the following exceptions:

11.1 Sampling and inspection as directed by the Engineer.

711.28 Cellular Polyvinyl Chloride Sponge. Cellular polyvinyl chloride sponge shall meet the requirements of AASHTO M153, Type I except the density of the PVC sponge shall be not less than 20 pounds per cubic foot.

711.29 Type 3 Membrane Waterproofing.

Type 3 Membrane Waterproofing.

Physical Properties
Thickness.....0.135 inches min.
Width.....36 inches min.
Weight.....0.8 pounds per foot min.
Tensile strength (machine Direction) ASTM D882.....275 pounds per inch
Modified*.....200 pounds per square inch
Tensile strength ASTM D882 (90° machine direction.....150 pounds per inch
Modified*.....200 pounds per square inch
Elongation at break ASTM D412 Modified.....100%
Brittleness ASTM D517.....Pass
Softening point (mastic) ASTM D36……....200°F min.
Peel Adhesion ASTM D413*.....2.0 pounds per inch
Cold flex ASTM D146.....No cracking
2 x 5 inch Specimen-180° bend over 2 inch mandrel
Heat stability.....No dripping or Delamination
2 x 5 inch Specimen vertically suspended in a mechanical convection oven two hour @ 190°F

*12 inches per minute test speed and 1 inch initial distance between the grips

Submit Certified Test Data and letter of certification to the Engineer.

711.30 Aluminum for Steps. ASTM B221, Alloys 6061-T6 or 6005-T5.

711.31 Reinforced Propylene Plastic Manhole Steps. Steps shall conform substantially with details shown on the Plans. Steel rod 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 D4101 Table B33430.

ITEM 712 MISCELLANEOUS

712.01 Expansion Shield Anchors Self Drilling
712.02 Calcium Chloride
712.03 Sodium Chloride
712.04 Lime
712.05 Glass Beads Used in Traffic Paint
712.06 Preservative Treatment for Structural Timber, Lumber, Piling, Posts, Braces and Blocks
712.09 Geotextile Fabric

712.01 Expansion Shield Anchors Self Drilling. Anchors shall conform to the dimension requirements on the Plans and the following:

Type A. Federal Specification FF-S-325, Group II, Type 4 Class 1, and Group VIII, Type 1.

Type B. Federal Specification FF-S-325, Group III, Type 1 (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 D98.

712.03 Sodium Chloride. ASTM D632 Type I, Grade 1, with the following exception:

4.1. Total Chlorides (NaCl, CaCl2, and MgCl2 as NaCl based on dry weight) not less than ninety-seven percent.

712.04 Lime. Lime for masonry purposes shall conform to ASTM C207 Type S.

712.05 Glass Beads Used in Traffic Paint. AASHTO M247, Type 1 without flotation properties but coated for moisture resistance, with the following exceptions:

4.1 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.

4.5 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. Structural timber, lumber, piling, posts and braces shall conform to the current AWPA standards and the requirements of this specification. However, the minimum retention for blocks shall be 0.40 pounds per cubic foot.

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 City 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 material. The supplier shall furnish a Notarized Certificate of Conformance with each shipment of material stating the size, species, quantity shipped, Project number, source of material, where treated, type of treatment, date treated, retention in pounds per cubic foot, charge number, inspection agency, inspection report number and date issued.

When guardrail offset blocks are furnished, a Notarized Certificate of Conformance shall be furnished by the supplier with each shipment of material stating the size, species, quantity shipped, Project number, vendor's order number, type of treatment and retention in pounds per cubic foot.

Materials. Timber preservatives shall conform to AASHTO M133 and shall include creosote, creosote coal-tar solution, ammoniacal copper arsenite (ACA), chromated copper arsenate (CCA), Types A, B or C, and pentachlorophenol.

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 so separated as to insure contact of the treating medium with all surfaces.

Framing. So far as practicable, all adzing, boring, chamfering, framing, graining, mortising, and surfacing shall be done prior to treatment.

Incising. All Douglas fir, except rails and rail posts, the least dimension of which is 2 inches or over, shall be incised by a suitable power-driven machine before treatment. Lumber having a thickness of 3 inches and over, shall be incised on all four sides. Lumber less than 3 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	INCISION (Minimum Depth, in.)
2x12	3/8
3x12	7/16
4x12	1/2
8x10	9/16
10x12	5/8
12x12	3/4

Intermediate sizes in proportion.

Amount of Preservative. The net retention in any charge shall be not less than ninety 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 one hundred percent of the quantity specified. The minimum amounts of preservative retained shall be as specified by AASHTO M133 which are those set forth in the referenced American Wood-Preservers' Association Standard. All species of structural timber, lumber, piling, posts and blocks shall be treated according to the current AWPA standard Specifications.

712.09 Geotextile Fabric. The fabric shall be composed of strong rot-proof polymeric fibers formed into a woven or non-woven fabric which meets the following requirements:

Type A: Underdrains and Slope Drains.

Minimum Tensile Strength(1).....80 pounds
Minimum Puncture Strength(2).....25 pounds
Minimum Tear Strength(3).....25 pounds
Apparent Opening Size(4)
Soil Type-1: Soils with 50% or less passing
US No. 200 sieve.....AOS < 0.6 mm.
Soil Type-2: Soils with 50%-85% passing
US No. 200 sieve.....AOS < 0.3 mm.
Permeability(5).....100 centimeter per seconds

Type B: Filter Blankets for Rock Channel Protection.

Minimum Tensile Strength (1).....200 pounds
Minimum Puncture Strength (2).....80 pounds
Minimum Tear Strength (3).....50 pounds
Minimum Elongation (1).....15%
Apparent Opening Size (4).....AOS < 0.6 mm.
Minimum Permeability (5).....0.001 centimeters per second

Type C: Sediment Fences.

Minimum Tensile Strength (1).....120 pounds
Maximum Elongation at 60 pounds (1).....50%
Minimum Puncture Strength (2).....50 pounds
Minimum Tear Strength (3).....40 pounds
Apparent Opening Size (4).....AOS < 0.84 mm
Minimum Permeability (5).....0.01 centimeter per seconds
Ultraviolet Exposure Strength Retention (6)...70%

Type D: Subgrade-Subbase Separation or Stabilization.

Minimum Tensile Strength (1).....180 pounds
Maximum Elongation at 170 pounds (1).....35%
Minimum Tear Strength (3).....70 pounds
Minimum Puncture Strength (2).....70 pounds
Apparent Opening Size (4).....Same as Type A
Permeability (5).....0.001 centimeter per seconds

Type E: Pavement Reinforcement Fabric.

AASHTO M288, Section 9, Table 7

(1) ASTM D4632
(2) ASTM D4833
(3) ASTM D4533
(4) ASTM D4751
(5) ASTM D4491
(6) ASTM D4355

All minimum strengths shown are average roll minimum values in the weakest principal direction.

The fabric shall be free of any treatment which might significantly alter its physical properties. During the shipment and storage, the fabric shall be wrapped in a heavy-duty protective covering to protect it from direct sunlight, dirt, dust and other debris.

The manufacturer shall submit Certified Test Data to cover each shipment of material.

ITEM 725 LIGHTING AND ELECTRICAL MATERIALS

725.00 General
725.01 Steel Light Poles
725.02 Electrical Cable
725.03 Unit Type Duct-Cable System
725.04 Rigid Ferrous Metal Electrical Conduit and Fittings
725.07 Polyvinyl Chloride Conduit and Fittings
725.081 Square Pre-Cast Concrete Pull Box
725.082 Square Cast-In-Place Concrete Pull Box
725.09 Polymer Concrete Pull Box
725.10 Structure Junction Boxes
725.11 Luminaires for High Intensity Discharge Lamps
725.13 Luminaires for Underpasses
725.14 Lamps
725.15 Cable Connector Kits for 600-Volt Multiple Circuits
725.16 Copper-Clad Ground Rods
725.17 Structure Ground Cable
725.19 Power Service Components
725.21 Light Towers

725.00 General. Lighting and electrical Materials covered by these Specifications shall be inspected and certified as follows:

(a) 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.

(b) Certification. When required by the Engineer, a manufacturer's certification shall be provided for the lighting and electrical Materials in lieu of samples. Certifications are statements covering manufacturer's test data sworn to by a Person having legal authority to act for the company supplying the Materials. Independent Laboratory reports covering test data or the welder's qualifications are acceptable in lieu of or supplementary to manufacturer's certifications. The certifications and Laboratory reports shall include the City contract number.

In the case of light poles, certified copies in triplicate of the chemical and physical properties of all Materials incorporated in the standards and accessories, the test results obtained from the deflection and permanent set tests and the welder qualification tests shall be furnished to the City. In the case of other Materials covered under this section, certified copies in triplicate of the

manufacturer's or private testing Laboratory's test report or a certification by the supplier, accompanied by a copy of test results, that the material has been sampled, tested and inspected in accordance with the applicable section of these Specifications shall be provided.

Luminaires, Conduits, wire, switch gear, and other electrical hardware shall be listed with Underwriters Laboratories.

Each item of manufactured electrical apparatus, as a unit shall have a durable nameplate identifying the manufacturer and manufacturer's product identification.

725.01 Steel Light Poles.

(a) Scope. These Specifications cover Materials and manufacturing methods to be used in the fabrication of steel poles.

(b) Shafts.

(1) Shafts shall be circular tapered steel tubes of 11, 3 or 0 gauge as specified and the steel shall have a minimum yield strength of 55,000 pounds per square inch after all fabricating operations have been completed. Shafts formed without cold working shall be fabricated from steel conforming to ASTM A242, A375, or A572, Grade 50.

(2) The minimum yield strength of the steel will be determined by the 0.005 inches per inch extension under load method performed in accordance with ASTM A370 using autographic Equipment.

(3) There shall be only one longitudinal, automatically and electrically welded joint and no transverse joints or welds. The weld shall be not less than the thickness of the base material and the bead height shall not exceed 1/16 inch.

(4) The shaft shall have a continuous taper of approximately 0.14 inches per foot, the weld shall be finished to form a smooth outside surface, the wall shall be of uniform thickness throughout (including the weld area) and free from flat spots.

(5) The shafts shall conform to the minimum requirements for deflection and permanent set as tabulated for the respective pole sizes on the Plans. The load for determining deflection and permanent set shall be applied 18 inches from the top end of the pole and measurements shall be taken at this point.

(6) Fittings shall be as detailed on the Plans and the approved shop Drawings.

(c) Anchor Type Bases.

(1) Anchor bases shall be one piece cast steel conforming to 711.07.

(2) 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.

(d) Transformer Type Bases. Transformer type bases shall be fabricated from steel or aluminum in accordance with the following:

(1) Non-frangible steel transformer bases meeting the dimensional requirements of the Plans and approved shop Drawings shall be capable of transmitting the design dead, live, ice, and wind loads of the light pole to be mounted on it to the foundation without failure or permanent deformation, has a flush door permanently attached by means of a top-mounted continuous stainless steel hinge, and is made from steel conforming to ASTM A36/A36M hot dipped galvanized after fabrication.

(2) Frangible aluminum transformer bases meeting the dimensional requirements of the Plans and approved shop Drawings shall be capable of transmitting the design dead, live, ice, and wind loads of the light pole to be mounted on it to the foundation without failure or permanent deformation, has a flush door permanently attached by means of a top-mounted continuous stainless steel hinge, and bears easily found and read, durable labeling indicating which AASHTO frangibility criteria the base meets. Aluminum transformer bases shall have been tested and accepted by the FHWA as complying with the 1985 AASHTO frangibility requirements.

(3) The transformer base shall be fastened to the shaft anchor base by means of four 1 inch diameter hex head machine bolts and nuts conforming to ASTM A307 and galvanized in accordance with ASTM A153. When either the top or bottom of an aluminum transformer base is to be fastened against non-galvanized steel, both the steel and the aluminum mating surfaces shall be coated or painted with a heavy film of zinc-rich paint (Federal Specification TT-P-641-Type II) to reduce galvanic action between the two dissimilar metals.

(e) Anchor Bolts.

(1) Anchor bolts conforming to the dimensions shown on the Plans and approved shop Drawings shall meet the requirements of ASTM A307. Nuts shall be capable of developing the full strength of the anchor bolt.

(2) The threaded ends of the anchor bolts and the nuts shall be galvanized in accordance with ASTM A153, with galvanizing extending at least 2 inches beyond the threads.

(f) Bracket Arms.

(1) Bracket arms shall be provided for light poles where indicated on the Drawings and shall be installed normal to the centerline of the street. The shaft end of the bracket arm shall be continuously welded to a fabricated steel shoe and shall be designed to fit over and double bolt to a steel foot continuously welded to the shaft. The arms shall accommodate a 2 inch slip-fitter luminaire.

(2) The luminaire bracket arm assembly shall be tapered and "oval" in cross section. The component, as well as all others incorporated into the final Project, shall have the same dimensions and shall be as similar as possible in appearance to that shown in the Plans.

(3) Bracket arms shall have an internal raceway with a minimum internal diameter of 1 3/32 inches free of Projections and obstructions, which, when assembled to the shaft, will permit installation of the luminaire supply conductors without insulation damage and which will not require bending the conductors to a radius less than 3 inches.

(g) Welding. Welding Equipment shall be of such capacity, design and condition as to produce first class welds. All surfaces to be welded shall be smooth, uniform and free from fins, tears and other defects which might adversely affect the quality of the welds. Surfaces to be welded shall be free from loose scale, slag, rust, moisture, grease, paint and other foreign material. Mill scale shall be removed by power brushing, blasting or grinding.

(h) Galvanizing. All steel poles shall be hot dipped galvanized after fabrication in accordance with the requirements of ASTM A123.

(i) Painting. Galvanized poles specified to be field painted shall be given one coat of wash primer conforming to Federal (Military) Specification MIL-P-15328C and shall be given one shop coat of paint immediately when the wash primer is dry.

(j) Identification. The circuit number and pole number identification labels shall be adhesive labels with silver white reflective characters on a reflective green background meeting the requirements of 730.18.

(k) Tests. The Engineer may require the approval of poles to be based on complete testing, including destructive testing at the factory prior to delivery.

725.02 Electrical Cable. Non-shielded wire or cable rated 0-2kV shall be single conductor, stranded copper with cross-linked thermosetting polyethylene insulation, non-jacketed, meeting the requirements of ICEA S-95-658/NEMA/WC70 and is of UL Type RHH-RHW-USE except for conductors #10 AWG and smaller for which those with insulation meeting the requirements of UL Type XHHW may also be used.

Non-shielded wire or cable rated 2001-5kV shall be single conductor, stranded copper with chemically cross-linked polyethylene insulation, non-jacketed, meeting the requirements of ICEA S-96-659/NEMA WC71 and of UL Type MV-90 dry.

Each cable shall have an identification tag or band defining its use. Cable tags shall be copper, brass, or plastic (except for tags within switch and device cabinets which shall be non-conducting) 1/32 inch minimum in thickness permanently fastened to the cables by means of cable tying straps. Cable identifying bands shall be approximately 1/32 inch thick wrap completely around the cable and closed securely. Each tag or band shall be marked using 1/4 inch minimum height embossed or engraved letters.

Conductors shall be marked “CKT” followed by the circuit designation shown on the Plans and the grounding conductors shall be marked “GND”, neutral conductors marked “NEU”, and the hot conductors marked “Line” followed by “1” or “2” for single phase power or “Phase” followed by “A” or “B” or “C” for three phase power.

725.03 Unit Type Duct-Cable System.

(a) 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 but in no case shall the inside diameter of the duct be less than 1 1/2 inches.

(b) Conductors and neutrals. The cables used as conductors and neutrals shall conform to 725.02.

(c) Polyethylene duct. Duct shall conform to NEMA TC-7. The manufacturer's name and the year of manufacture shall be included in the marking. Compound shall be high density polyethylene, Type III, Class C, Category 5, Grade 34.

725.04 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. Fittings shall comply with the requirements of ANSI/NEMA FB 1 AND ANSI/UL 514B.

725.07 Polyvinyl Chloride Conduit and Fittings. Polyvinyl chloride Conduit and fittings shall conform to NEMA Standards Publication No. TC-2.

725.081 Square Pre-Cast Concrete Pull Box. The square pre-cast concrete pull box shall be 18 inches by 18 inches square inside and 30 inches deep with 4 inch thick walls of reinforced concrete. Concrete shall be Class D and all wall areas shall be reinforced with 4x4 inch No. 4 x No. 4 steel mesh conforming to 709.10 or 709.12 or an equivalent amount of steel bars conforming to 709.08 or 709.11. The pull box shall have three slots with center lines spaced 90 degrees apart in the lower end of the box. Slots shall be 5x10 inches with the 10 inch dimension parallel to the vertical axis of the box. A 6 inch gravel drainage pocket shall be provided at the bottom of the pull box. The pull box cover shall be constructed of steel and have, in clearly legible block letters 1 inch to 2 inches in height, the word “TRAFFIC”, “LIGHTING”, “ELECTRIC”, or “TELEPHONE” to designate the circuit(s) contained. The word designating the use shall be in raised letters that are either integral to the cover or integral to a stainless steel plate 1/16 inch in thickness securely mechanically attached to the cover at the four corners of the tag and at intervals 2 to 3 inches along the perimeter between corners. The cover shall closely fit the opening and be secured by stainless steel bolts and hardware and the threaded holes into which the cover bolts fasten shall be of open bottom design.

725.082 Square Cast-In-Place Concrete Pull Box. The cast-in-place pull boxes shall conform to the Plans. The 6 inch walls shall be Class D concrete. Covers shall be 1/4 inch minimum thickness cast iron conforming to 711.12 or 711.13. The letter "E" shall be cast in the top surface of the cover, forming a letter 1 to 2 inches in height.

725.09 Polymer Concrete Pull Box. Polymer concrete pull boxes and lids shall be constructed of aggregate bound with a polymer resin. The body of the box shall be of one-piece construction, although the box depth may be obtained through the use of extensions or stacking. All surfaces of the box and cover shall be smooth and the cover shall have a molded slip resistant surface. Ensure that the cover is labeled in clearly legible block letters 1 inch to 2 inches in height integral to the cover with the word “TRAFFIC”, “LIGHTING”, “ELECTRIC”, or “TELEPHONE” to designate the circuit(s) contained. The cover shall closely fit the opening and be secured by stainless steel bolts and hardware

and the threaded holes into which the cover bolts fasten shall be of open bottom design. The box shall meet the structural requirements of Society of Cable Telecommunications Engineers Tier 15 and the lid Tier 22. A 6 inch gravel drainage pocket shall be provided at the bottom of the pull box. A 10” x 10” Class D concrete ring shall be placed around the perimeter of the box when installed in non-paved areas.

725.10 Structure Junction Boxes.

(a) Scope. This specification covers junction boxes used in the safety curbs, piers, pier caps, abutment walls or retaining walls and pull boxes located in the railing parapets of Structures.

(b) Composition. The Structure junction boxes shall be Gray Iron Castings ASTM A48, hot-dip galvanized in accordance with ASTM A123.

(c) Detailed Requirements.

(1) Junction boxes shall be the size specified and shall be UL listed as "Rain tight".
(2) The wall thickness of the boxes shall be such that five full threads of the Conduit shall engage the threaded holes in the box. Bosses may be employed to obtain the five threads.

725.11 Luminaires for High Intensity Discharge Lamps.

(a) Scope. This specification covers pole-bracket-arm mounted 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:

(1) The small horizontal Style A luminaire shall not be used for lamps rated over 12,500 lumens.
(2) The medium horizontal Style B luminaire shall not be used for lamps rated over 30,000 lumens.

(3) The large horizontal Style C luminaire shall not be used for lamps rated over 55,000 lumens.

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.

(b) Detail requirements.

(1) 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.
The luminaire shall be equipped with a device indicating the direction and amount of tilt over a range of 0 to 5 degrees in any direction. The level indicator shall have three major calibrations which are accurate within 1/2 degree. The calibrations shall be approximately as follows:

(a) Level
(b) Three degree tilt
(c) Five degree tilt

The indicating device shall be clearly discernible in daylight from a distance of 50 feet and shall in no way alter or reduce the amount of light from the luminaire. It shall be constructed of a transparent container having one horizontal surface which is curvilinear in any vertical cross section for supporting an indicator and a damping fluid. The damping fluid shall be a liquid which shall be suitable for operation at -40°F. The transparent container shall be fabricated from clear ultraviolet-inhibited acrylic or similar material.
(2) 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.
(3) Support clamp. The support clamp shall be the slipfitter 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.
(4) 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.

(5) 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.

(6) 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 adaptors 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.

(7) Ballast. Ballasts shall conform to the following requirements.

(a) The mercury ballast shall be a high power factor, constant wattage or regular type with 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 thirteen percent. The regulation of 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.

(b) The metal halide ballast shall be a high power factor, peak load auto-regulator 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 ten percent with plus or minus ten percent variation in applied voltage.

(c) 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 1000 watt high pressure sodium lamps shall be a high power factor, auto-regulator 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.

(d) The starter component shall be comprised of solid state devices capable of withstanding ambient temperatures of 212°F. 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:

(i) Lamp wattage must be maintained within the trapezoid recommended by lamp manufacturers within the full rated input voltage range.

(ii) Amplitude of the pulse shall be 2500 volts minimum and 4000 volts maximum. Operation of the pulse at spike voltage levels near minimum is desirable.

(iii) The minimum pulse width shall be one microsecond at 2250 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.

(iv) Pulses must be present when ballast is correctly wired and nominal voltage less fifteen percent is applied to the ballast windings.

(v) The high pressure sodium ballast, including starting aids, shall protect itself against normal lamp failure modes. The ballast shall be capable of operation with the lamp in an open or short circuit condition for six months without significant loss of ballast life.

(e) The low pressure sodium ballast shall be a high power factor corrected (ninety 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°F and shall deliver rated lamp current circuit voltage variations of plus or minus ten percent. Wattage regulation shall not exceed a range of -five percent to +three percent for lamps rated at 90 watts or more.

(8) 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.

The luminaire manufacturer shall supply ballast electrical data and lamp operating volt-watt traces for nominal and plus or minus ten percent rated line voltage to verify ballast performance and compliance with ANSI lamp Specifications, for the rated life of the lamp.

725.13 Luminaires for Underpasses.

(a) Scope. This specification covers luminaires for mounting in underpasses. The luminaire shall be a complete lighting device, less lamp, consisting of a housing, reflector, shrouded porcelain socket, refractor, door and integral ballast, conforming to the requirements of 725.11, and fuse holder with fuse. The assembly shall be pre-wired, and shall be weatherproof and sealed against dust.

(b) Detail Requirements.

(1) The housing shall be cast aluminum.
(2) The door shall be a cast aluminum frame, containing a thermal shock resistant glass refractor, attached to the frame with stainless steel latch and hinges.
(3) The luminaire shall provide for accommodation of a 100 watt high pressure sodium lamp.
(4) The integral ballast shall be of the regulator or constant wattage type and shall be rated to the circuit voltage and size of lamp specified.
(5) The assembly shall be pre-wired and when in operation shall be weatherproof and sealed against dust or bug entry.
(6) The refractor shall be protected by means of an approved guard or shield.

725.14 Lamps.

(a) 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. Each lamp shall be provided with a date recording feature.

(b) Mercury lamps.
(1) 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 those values shown in the following table:

ANSI	Watts	Horizontal Lumens Initial	Economic Life Hours
H38HT	100	3,900	16,000
H39KB	175	6,950	16,000
H37KB	250	10,500	16,000
H33CD	400	19,200	16,000
H35NA	700	34,600	16,000
H36GV	1,000	53,000	16,000

(2) The lumen output of the mercury lamps after twelve thousand hours use shall produce a minimum of seventy-eight percent of its initial lumen rating.

(c) High pressure sodium lamps.

(1) 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:

ANSI	Watts	Horizontal Lumens Initial	Economic 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

(2) The lumen output at the end of economic life shall be not less than eighty percent of the initial lumen rating.

(d) Metal halide lamps.

(1) 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 those values shown in the following table:

ANSI	Watts	Horizontal Lumens Initial	Economic 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

(2) The lumen output at the end of economic life shall be not less than sixty-five percent of the initial lumen rating.

(e) 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 be not less than those values shown in the following table:

Watts	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

(f) Incandescent lamps. Incandescent lamps of the size, type and wattage specified shall conform to Federal Specification Number W-L-101.

(g) Fluorescent Lamps. Fluorescent lamps of the size, type and wattage specified shall conform to Federal Specification Number W-L-116.

725.15 Cable Connector Kits for 600-Volt Multiple Circuits.

(a) Scope. This specification covers cable connector kits for use in handholes of signing and light poles as well as in junction and pull boxes.

(b) Requirements. Cable connector kits furnished under this specification shall conform to one of the following types:

Type I. In-line Connector Kits. In-line connector kits shall contain:

(a) A copper pin and a copper receptacle, both of at least ninety percent conductivity, to be crimped to the cable. The receptacle shall establish contact pressure with the pin through the use of a copper beryllium sleeve spring and shall be equipped with a disposable mounting pin. The copper pin shall be of at least half-hard material and the crimping portion shall be fully annealed while the rest of the pin is maintained in its original state of hardness. The receptacle shall have a centrally located recessed locking area so constructed that it is filled and retained by the rubber housings.

(b) A plug and a receptacle housing each made of water resistant synthetic rubber suitable for burial in the ground or exposure to sunlight. Each housing shall form a water-seal around the cable and between the two housings at the point of disconnection. The interior arrangement shall be such as to suitably receive and retain the copper pin and receptacle. Each kit shall be supplied with sufficient silicone compound to lubricate the metal parts and the rubber housings for easy assembly.

(c) Each kit shall also be provided with complete installation instructions.

Type II. Fused, Quick Disconnect Y Connector Kit. This type of connector kit shall contain:

(a) A pair of spring-loaded, ninety percent minimum conductivity, contacts suitable for gripping the specified size of cartridge fuse, two terminal lugs, a bolt and self-locking nut. One of the contacts shall be so constructed that it can be crimped to the cable and retained securely in the proper position within a rubber load-side housing. The second contact shall be pre-assembled and retained in a rubber Y insert body and shall provide a mounting hole by which the terminal lugs shall be fastened with the bolt and self-locking nut. Both contacts shall be fully annealed.

(b) A load-side housing, a Y insert body and a Y housing each made of water-resistant synthetic rubber suitable for burial in the ground or exposure to sunlight. The load-side housing shall have an interior arrangement to suitably receive and retain the crimpable copper fuse contact and to retain the fuse when disconnected and shall be permanently marked "load-side."

The Y insert body shall retain the second copper fuse contact. A water seal shall be provided between the housings and the cables, between the insert body and the Y housing and between the housings at the point of disconnection. Each kit shall be supplied with sufficient silicone compound to lubricate the metal parts and rubber housings for easy

assembly, and a disposable mounting pin used in assembling the load-side terminal.

(c) Each kit shall also be provided with complete installation instructions.

Type III. Unfused, Quick Disconnect Y Connector Kit. This type of connector kit shall contain:

(a) A copper pin and copper receptacle both of at least ninety percent conductivity, two terminal lugs, a bolt and a self-locking nut. The copper pin, to be crimped to the conductor, shall be of at least half-hard material and the crimping portion shall be fully annealed while the rest of the pin is maintained in its original state of hardness. The pin shall have a centrally located recessed locking area so constructed that it is filled and retained by a rubber plug (tap) housing. The receptacle shall establish contact pressure with the pin through the use of a copper beryllium sleeve spring and shall be pre-assembled and retained in a rubber Y insert body. The receptacle shall be fully annealed and shall provide a mounting hole by which the terminal lugs can be fastened with the bolt and self-locking nut.

(b) A plug (tap) housing, a Y insert body and a Y housing each made of insulating water resistant synthetic rubber suitable for burial in the ground or exposure to sunlight. The plug housing shall have an interior arrangement to suitably receive and retain the copper receptacle. A water seal shall be provided between the housings and the cables, between the insert body and the Y housing and between the housings at the point of disconnection. Each kit shall be supplied with sufficient silicone compound to lubricate the metal parts and the rubber housings for easy assembly.

(c) At the end of a circuit, one insulated plug the same diameter as the cable shall be provided.

(d) Each kit shall also be provided with complete installation instructions.

Type IV. Semi-permanent, Y Connector Kit. This type of connector kit shall contain:

(a) Three terminal lugs, a bolt and a self-locking nut. The three lugs shall each be provided with a mounting hole by which they shall be fastened together with the bolt and nut.

(b) A tap housing and a Y housing each made of water-resistant synthetic rubber suitable for burial in the ground or exposure to sunlight.

The Y housing shall have an interior arrangement to receive the terminal lugs. A water seal shall be provided between the housings and the cables, and between the housings at the point of disconnection. Each kit shall be supplied with sufficient silicone compound to lubricate the metal parts and the rubber housings for easy assembly.

(c) Each kit shall also be provided with complete installation instructions.

725.16 Copper-Clad Ground Rods. The ground rods shall be the size shown on the Drawings or otherwise specified. The rods shall have an outer jacket of copper, welded to the core of steel to form a strong, durable, rustproof rod. The rods shall conform to Federal Specification W-R-550A.

725.17 Structure Ground Cable. Structure ground cable shall be size 1/0 AWG, seven-strand, copper cable conforming to ASTM B8, Class A.

725.19 Power Service Components.

(a) Scope. These Specifications cover Materials and Equipment normally comprising a service pole and including service Equipment as follows:

(b) Poles and pole keys. Poles and pole keys shall be Western Red Cedar 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 not be less than ten pounds of creosote type or not less than 1/2 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.

(c) Wood crossarms. Wood crossarms shall be treated and of the specified dimensions. Treatment shall be as specified in (b) above.

(d) Pole hardware. Pole hardware, including bolts, nuts, washers, clamps, screws, braces, racks, etc., shall be of specified sizes, galvanized in accordance with 711.02.

(e) 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.

(f) Ground wire moulding. Ground wire moulding shall be either wood or plastic, in sections not less than 8 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.

(g) Anchors and anchor rods. Anchors shall be malleable iron, 6 inch minimum diameter, two-way or four-way expanding type. Anchor rods shall be 5/8 inch minimum diameter, 8 feet minimum length galvanized steel provided with twin thimbleye.

(h) Guy strand. Guy strand shall be 5/16 inch minimum diameter, conforming to ASTM A475, copper clad.

(i) Primary service Equipment.

(1) Transformers 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.
(2) Primary fused disconnects and lightning arresters shall be open type having the specified ratings for voltage, amperage, interrupting capacity and instantaneous amperes RMS.
(3) Primary switches shall be open blade type, single-pole, single-throw; remote controlled oil immersed type or ground operated air break type.
(4) Cable pothead terminations shall have the specified ratings for phase-to-phase operating voltage, impulse voltage at 1 1/2 x 40 wave, corona voltage level to ground, cable range and corona voltage acceptance level.

(j) Secondary service Equipment. Riser Conduit shall be as specified in 725.04 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 ratings of the device shall be as specified but not less than 60 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.

(j) 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.

(k) 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.

(l) Lighting contactor shall be open type rated 600 volts AC and provided with an electromagnetically held, 120 volt, 60 Hz coil. The contactor shall be rated at 60 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.

(m) Photoelectric control shall be a utility grade, solid state, cadmium sulfide type with hermetically sealed silicon rectifier rate 120 or 480 volts, 60 Hz and 1000 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 1 vertical foot-candle and "turn-off" at a maximum illumination value of 6 vertical foot-candles. These limitations shall be set by the manufacturer and maximum tolerances of $\pm$ twenty percent for the specified values shall be acceptable.

Photoelectric controller shall be twist-lock type. A suitable mounting bracket with EEI-NEMA locking-type receptacle and all other necessary mounting hardware shall be furnished.

(n) 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.

(o) Enclosures shall be NEMA ICS-1-110.15 Type 4 and shall be adequate to house the designated Equipment for outdoor locations. Enclosures shall be fabricated from No. 16 gauge or heavier AISI Type 302 or 303 annealed stainless steel with a brush finish. All seams shall be fully welded. All fastenings used in assembly or mounting of the enclosures shall conform to ASTM A320 (AISI-300 series).

Each enclosure shall be provided with a door so constructed that it may not be opened when the principal electrical disconnecting 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:

(1) 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.

(a) Release door latch with one hand on door latch handle while simultaneously operating door latch defeater screw with a screwdriver in the other hand.

(b) 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.

(2) An insulated solid copper common neutral bus of adequate ampere rating and capable of terminating the specified sizes of wire.

(3) A schematic wiring decal of the entire control center installed on the inside of the door.

(4) 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.

(5) A removable 14 gauge 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.
(6) Mounting flanges, hubs, weep holes, etc., as shown on the Plans.

725.21 Light Towers.

(a) Scope. These Specifications cover Materials and manufacturing methods to be used in the fabrication of light towers, tower components, and anchors used to support luminaires at heights of 70 feet, and greater, above the foundation. 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.

(b) 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 and 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. Outlets, inlets and plugs for connecting electrical power to the luminaire mounting assembly shall have pin arrangements conforming to NEMA Configurations for Locking Devices as follows: for three wire, 240 volt systems, use NEMA Configuration G-33, and for two wire, 480 volt systems, use NEMA Configuration G-17. 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 4 enclosure with grounded neutral bar. The breaker shall be internally mounted and readily 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.

(c) 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 pounds per square inch 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.

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 that is the larger of 2 feet or 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 twenty percent thicker than the shaft material. Shaft welds on longitudinal seams shall have at least sixty percent penetration except in areas where the shaft section telescopes over another section. In the overlapping areas, longitudinal seam welds shall be complete-penetration welds for a distance of the nominal splice length plus 6 inches.

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 the 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 continuous stainless steel hinges having nonremovable stainless steel hinge pins. The door shall include provisions for padlocking. Each tower shall be furnished with at least one padlock. The padlock shall have a bronze or brass lock body and a corrosion protected steel shackle. All padlocks for a Project shall be keyed alike and the Contractor shall obtain the master key number from the maintaining agency. A tapped hole shall be provided at the base of the tower for a 1/2 13 galvanized bolt and washer connection for the grounding cable to be carried through the electrical metallic tubing in the foundation to the ground rod.

Shafts shall be hot dipped galvanized after fabrication in accordance with the requirements of 711.02.

(d) Luminaire Ring Assembly. The luminaire ring assembly shall be fabricated from steel which conforms to ASTM A36 or material which has the same strength characteristics as the tower. The ring shall be

fitted with the appropriate number of 2 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 terminated in a NEMA 4 corrosion resistant junction box with weathertight cable connections. The main electrical supply cable and its cable clamp terminator 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. 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 miles 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 the 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. The indicating flags or reflectors shall be clearly discernible from the ground when the luminaire ring is in the latched position. 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 a minimum of three roller-contact spring loaded centering arms in continuous contact with the pole shaft during raising and lowering of the ring. The guide arm rollers shall be made of a nonabrasive, water-resistant material.

(e) Head Frame Assembly. The head frame assembly shall be fabricated from steel which conforms to the requirements of ASTM A36, or steel which has the same strength 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 power cord roller assembly shall consist of rollers mounted between two cold-rolled steel plates. The power cord shall ride on rollers mounted on AISI 304 stainless steel shafts. Rollers shall be located on a radius on either end of the plates to support the power cord in a minimum 7 inch bending radius. At either end of the plates, a keeper bar shall be provided over the power cord between the plates to keep the cord in its track during pole erection and during normal operation.

The head frame assembly shall contain three latch barrels which support the luminaire ring assembly at the top of the pole. Latching shall be accomplished by the alternate raising and lowering of the luminaire ring assembly. The latch barrels shall be cast high-strength, copper-free aluminum meeting ASTM B26.

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 cover made of either copper free spun aluminum or fiberglass.

(f) Winch Assembly. The winch drum shall have a diameter not less than 4 inches, and shall be supported by rigidly mounted bearings of the proper load capacity. The drum flanges shall have a diameter at least 3 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.

(g) 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.

(h) Base Plates. The base plate shall be fabricated from steel which conforms to the requirements of ASTM A36.

(i) Anchor Bolts and Nuts. Anchor bolts shall be steel with an 85,000 pounds per square inch (minimum) yield strength and shall be galvanized in accordance with 711.02. Galvanizing shall extend at least 2 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 bolts shall be provided with nuts capable of developing the full strength of the anchor bolt.

(j) Fittings. 725.01, 2 (f), except that galvanized steel fittings shall not be permitted.

(k) Welding. 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 D.1 Structural Welding Code Article 9.25.3 for tensile stress.

(l) Luminaires. The luminaires shall consist of an optical assembly, lamp, ballast, and aluminum housing with side entry mounting for a 2 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. When specified for use with 1000 watt lamps, the unit shall be provided with a lamp support around the neck of the lamp and independent of the socket.

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. 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 725.11 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 1000 lamp lumens at angles between 55 degrees and 65 degrees from nadir (downward). The nadir initial intensity shall not exceed 100 candlepower per 1000 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 1000 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 1000 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 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 sixty-five percent of the bare lamp lumens, with twenty-five to thirty-five 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.

ITEM 730 TRAFFIC SIGN AND SUPPORT MATERIAL

730.015 U-Channel Posts
730.08 Steel Hardware
730.11 Aluminum Sheet and Plate
730.15 Aluminum Forgings
730.17 Aluminum Hardware
730.18 Reflective Sheeting Type F
730.19 Reflective Sheeting Type G
730.191 Reflective Sheeting Type G, Reboundable
730.192 Reflective Sheeting Type H
730.193 Reflective Sheeting Type J
730.20 Nonreflective Sheeting
730.22 Silk Screen Inks
730.23 Transparent Electronic Cuttable Films

730.015 U-Channel Posts. The Contractor shall furnish U-channel posts fabricated from steel into a characteristic cross-section that may be used alone or paired to form a heavier post by being bolted together back to back. The Contractor shall furnish posts with a uniform cross section for their full length. The Contractor shall cut posts square to a length tolerance ±1 inch and ensure that posts do not have ragged or sharp edges, or cracks or other imperfections affecting strength or durability. The back of the posts may be flat or contain raised longitudinal ribs.

The Contractor shall furnish posts meeting the deflection criteria of ODOT Supplement 1075. The Contractor shall furnish posts manufactured from rail or billet steel according to ASTM A499, Grade 60.

The Contractor shall provide a yield type driven post without breakaway devices conforming to NCHRP 350 requirements. The Contractor shall provide a copy of the approval letter from FHWA.

Other material Specifications may be accepted by the City for drive posts conforming to the dimensional requirements listed below and on ODOT standard Drawings and the performance requirements of NCHRP 350.

The Contractor shall furnish posts with a nominal weight before punching or galvanizing as follows:

Post SizeNumber	Weight pounds per foot	Tolerances%
1	1.12	-3.5, +10.0
2	2.00	-3.5, +10.0
3	3.00 (4.5)	-3.5, +10.0

The Contractor shall furnish posts with 3/8 inch diameter holes accurately punched on the centerline spaced at 1 inch centers beginning not more than 1 1/8 inches from the top of the post through the entire length, to allow bolting the posts back to back, without redrilling, using 5/16 inch diameter bolts. The Contractor shall furnish posts that have been galvanized after punching according to 711.02.

The Contractor shall furnish Materials according to the ODOT's Department's Qualified Products List (QPL).

730.08 Steel Hardware. The Contractor shall furnish bolts 5/8 inch diameter or larger according to ASTM A325 (A 325M). The Contractor shall furnish bolts and screws less than 5/8 inch diameter according to SAE J429, Grade 5. The Contractor shall furnish nuts of all size, except anchor nuts and leveling nuts according to SAE J995, Grade 2. The Contractor shall furnish flat washers according to ANSI B18.22.1. The Contractor shall furnish lock washers according to ASME B18.21.1. The Contractor shall furnish U-bolts according to ASTM A307. The Contractor shall furnish all hardware that is hot-dipped galvanized according to ASTM A153 or mechanically galvanized according to ASTM B695, Class 50.

The Contractor shall furnish certified material according to ODOT Supplement 1092 or 1093.

730.11 Aluminum Sheet and Plate. The Contractor shall furnish sheets for extrusheet panels according to ASTM B209 (B209M), 3003-H18, or 5052-H38. The Contractor shall furnish sheets for flat sheet and overlay signs, according to ASTM B209 (B209M), 3004-H38, 5052-H38, or 6061-T6. The Contractor shall furnish plates for sign support Structures according to ASTM B209 (B209M), 6061-T6.

The Contractor shall furnish certified material according to ODOT Supplement 1092 or 1093

730.15 Aluminum Forgings. The Contractor shall furnish forgings according to ASTM B247 (B247M), 6061-T6.

The Contractor shall furnish certified material according to ODOT Supplement 1092 or 1093.

730.17 Aluminum Hardware. The Contractor shall furnish hardware according to:

	ASTM Designation	Alloy	Condition/ Temper
Bolts and screws	B211/(B211M)	2024	T4
		6061	T6
Nuts-hex	B211/(B211M)	6061	T6
		6262	T9
Nuts-lock	B211/(B211M)	2017	T4
Washers-flat	B209/(B209M)	Clad 2024	T4
		6061	T6
Lock washers	B211/(B211M)	7075	T6

The Contractor shall furnish certified material according to ODOT Supplement 1092.

730.18 Reflective Sheeting Type F. The Contractor shall furnish sheeting according to ASTM D4956, Type I, including supplemental requirement S1.

730.19 Reflective Sheeting Type G. The Contractor shall furnish Type G reflective sheeting according to ODOT Supplement 1049, and contained on the list of prequalified reflective sign sheeting Materials. The Contractor shall furnish sheeting according to ASTM D4956, Type III or IV, including supplemental requirement S1.

The Contractor shall furnish Materials according to the ODOT's Qualified Products List (QPL).

730.191 Reflective Sheeting Type G, Reboundable. The Contractor shall furnish Type G reboundable reflective sheeting according to Supplement 1049, and contained on the list of prequalified reflective sign sheeting Materials. The Contractor shall furnish sheeting according to ASTM D4956, Type III or IV, including supplemental requirements S1 and S2, with watermarks or other identification marks inconspicuously incorporated into the face of the sheeting on a repeating pattern if necessary to distinguish the sheeting from other similarly appearing sheetings.

The Contractor shall furnish Materials according to ODOT's Qualified Products List (QPL)

730.19 Reflective Sheeting Type H. The Contractor shall furnish Type H reflective sheeting according to Supplement 1049, and contained on the List of Prequalified Reflective Sign Sheeting Materials. The Contractor shall furnish sheeting according to ASTM D4956, Type VII, VIII, or X, including supplemental requirement S1.

The Contractor shall furnish Materials according to the ODOT's Qualified Products List (QPL).

730.193 Reflective Sheeting Type J. The Contractor shall furnish Type J reflective sheeting according to ODOT Supplement 1049, and contained on the list of prequalified reflective sign sheeting Materials. The furnish sheeting according to ASTM D4956, Type IX, including supplemental requirements S1.

The furnish Materials according to the ODOT's Qualified Products List (QPL).

730.20 Nonreflective Sheeting. The Contractor shall furnish non-reflective sheeting according to ASTM D4956, except provide sheeting that does not incorporate any optical elements.

The Contractor shall furnish Materials according to the Department's Qualified Products List (QPL).

730.22 Silk Screen Inks. The Contractor shall furnish opaque and transparent process color inks used in the silk screen process that the manufacturer of the reflective sheeting accepts and warrants according to ODOT Supplement 1049. The Contractor shall use inks that provide a tough, durable film of uniform thickness and appearance on the sign surface. The Contractor shall furnish transparent process color inks used in the reverse screen process according to the color specification limits in ASTM D4956, Table 17.

730.23 Transparent Electronic Cuttable Films. The Contractor shall furnish transparent electronic cuttable films the manufacturer of the reflective sheeting warrants according to ODOT Supplement 1049. The Contractor shall use films that provide a uniform appearance on the sign surface. The Contractor shall furnish films according to the color specification limits in ASTM D4956, Table 17.

731 SIGN LIGHTING MATERIAL

731.01 Mercury Vapor Luminaire
731.03 Changeable-Message Sign, Lamp Type
731.04 Changeable-Message Sign, Drum Type
731.05 Internally Illuminated Sign
731.06 Sign Flasher Assembly
731.07 School Speed Limit Sign Assembly
731.08 Flexible Conduit
731.09 Ballast Wiring Enclosure
731.10 Timer with Enclosure

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 11 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 waterproof 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 it's 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 1 foot square areas over a vertically-oriented 10 by 10 foot square grid with the luminaire positioned 4 feet in front of the vertical center line of the grid and 1 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:

(a) The maximum illumination on any 1 foot square area shall be 50 foot-candles.

(b) The average of the individual measurements shall be at least 20 foot-candles.

(c) The ratio of the maximum and minimum values obtained shall be no greater than 6.0.

(d) 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.

731.03 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 Roadway 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, and 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 8 or 12 inch yellow 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 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. Flasher control units shall have all solid state components and shall meet NEMA TS-1, part 6. 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. The beacons shall be external to the sign face.

The beacons shall be yellow and 6 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 flashers 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. Flashers shall have all solid state components and shall meet NEMA TS-1, part 6. 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.

731.09 Ballast Wiring Enclosure. Ballast wiring enclosure shall be a weatherproof NEMA Type 4 enclosure fabricated of sheet steel galvanized in accordance with 711.02. A removable cover shall bear a warning sign conforming to 725.19, (o) (4). The enclosure shall contain a panel in accordance with 725.19, (o) (5). The panel shall accommodate necessary terminal blocks and busbars rated at 600 volts, and shall be provided with marker strips. Conduit fittings and hardware shall be included.

731.10 Timer with Enclosure. The timer shall permit automatic sign operation for a minimum of 3 times per Day and for selected Days of the week. The timer shall be solid state with a back-up battery to maintain timekeeping and program memory for at least forty-eight hours. The battery shall have a design life of ten years under field conditions when power failures over the ten year period would accumulate to one hundred Days. When installed outdoors, the timer shall be housed within a lockable, weatherproof, corrosion-resistant enclosure. Each enclosure shall be furnished with at least one padlock. Padlocks shall have a bronze or brass lock 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.

732 TRAFFIC SIGNAL MATERIAL

732.01 Vehicular Signal Heads, Conventional
732.02 Vehicular Signal Heads, Optically Programmed, 12-inch Lens
732.03 Vehicular Signal Heads, Optically Programmed, 8-inch Lens
732.04 Signal Lamps
732.05 Pedestrian Signal Heads
732.06 Pedestrian Pushbuttons
732.07 Loop Detector Units
732.08 Loop Detector Units, Delay and Extension Type
732.09 Magnetometer Detector Units
732.10 Magnetometer Sensor Probes
732.11 Signal Supports
732.12 Strain Poles
732.13 Wood Poles
732.14 Down Guy Assemblies
732.15 Pedestals
732.16 Conduit Risers
732.17 Cable Support Assemblies
732.18 Messenger Wire
732.19 Cable and Wire
732.20 Power Service
732.21 Disconnect Switch with Enclosure

732.01 Vehicular Signal Heads, Conventional. Vehicular traffic signal heads shall conform to the ITE "Vehicle Traffic Control Signal Heads" standard. In conformance with the above standard, the Contractor shall provide signal heads that are made of polycarbonate material, with glass lenses, and reflectors of either highly specular finished aluminum or silvered glass.

Traffic signals shall consist of specified assemblies of optical sections containing 8 or 12-inch diameter colored lenses, a black housing, a yellow door frame with stainless steel hinge pins and latching device, gasketing, visor, reflector, wiring, lamp socket and include an incandescent or LED lamp in accordance with 732.04. The reflector and lamp socket are not required with LED lamps. 12-inch lenses are the standard wide angle type. Incandescent lamp sockets shall be rotatable for optimum lamp filament orientation.

Each optical section shall be fitted with a black tunnel type visor that is open at the bottom unless other type visors or louvering are specified. The visors for 8-inch lenses shall be at least 7 inches long and those for 12-inch lenses shall be at least 9 ½ inches long.

Optical sections shall be designed for assembly with all 8-inch, all 12-inch, or intermixed arrangements. Traffic signals shall be assembled using

suitable hardware that forms weatherproof joints with no light leakage from one section to another. Assembly arrangements shall contain the specified number of optical sections, lens size, lens color, and circular or arrow configuration. From 1 to a maximum of 5 sections shall be assembled as specified to form a signal face.

Multi-way heads shall be furnished with appropriate top and bottom brackets with an opening in the center of the top bracket provided for mounting purposes. Signal face height inequalities for multi-way heads shall be corrected for proper accommodation between top and bottom brackets by the use of pipe spacers.

Signal heads shall be furnished with required mounting hardware including entrance adapters, spacers and spreaders, and balance adjusters. Signal faces shall be oriented to traffic by serrated rings or other devices on housing sections and mounting hardware. Adjustments shall be permitted in increments not greater than 5 degrees of rotation and not affected by wind gusts when locked. The Contractor shall furnish galvanized steel or aluminum spacers and drop pipes 1 ½ inches in diameter. Disconnect hangers shall have at least twelve terminals unless a greater number is required.

732.02 Vehicular Signal Heads, Optically Programmed, 12-inch Lens. Optically programmed signal heads shall incorporate an optical system projecting an indication that is programmed to be visible only within boundaries of a specified area. The optical system shall be capable of being veiled anywhere to within 15 degrees of the optical axis using procedures and opaquing material according to the manufacturer's instructions.

The signal sections shall conform to applicable portions of the ITE standard and 732.01. Optical sections shall be furnished and mounted with 1 12-inch lens size alone or in combination with additional sections of optically programmed or conventional optics types to form signal faces and heads. An optically programmed signal section shall be furnished with an incandescent lamp or, if specified, a LED lamp.

The housing design of optically programmed sections shall include a ± 10-degree tilt adjustment from the horizontal while maintaining a fixed mounting axis.

A visor shall be furnished with each signal section.

732.03 Vehicular Signal Heads, Optically Programmed, 8-inch Lens. Optically programmed signal heads with 8-inch lenses shall consist of a conventional 8-inch signal housing, reflector and door, and an extension portion which is attached in place of a conventional lens and shall contain a lens system

capable of optical programming. The conventional signal housing shall be furnished with reflector and wiring, and the optical programmable extension portion shall be furnished according to applicable requirements of 732.01 and 732.02.

A cutaway visor shall be furnished with each signal section. The signal sections shall include an incandescent lamp or when specified, a LED lamp.

Programming the 8-inch lens type head shall require the use of an extender tool as recommended by the manufacturer to move the extension portion to the side to expose the optics for programming purposes.

732.04 Signal Lamps.

(a) Optically Programmed and Pedestrian Signal Incandescent Lamps. Optically programmed and pedestrian signal incandescent lamps shall conform to the ITE A Standard for Traffic Signal Lamps and Table 732.04-1.

TABLE 732.04-1

Lens configuration	Lumens min. initial	Watts max. Input	Light Center Length inches [1]	Envelope Glass	Rated Life hours
12-inch vehicular optically programmed	950[2]	150		Seal beam	
8-inch vehicular optically programmed	1260	115	2 7/16	frosted	6000
Pedestrian, type A-1	1300	120	2 7/16	clear	6000
Pedestrian, type A-2	1650	150	3	clear	6000
Pedestrian, type D-2	550	70	2 7/16	clear	6000

[1] Light center length is the distance between the filament center and the base tip.

[2] Beam intensity, integral reflector type.

(b) Vehicular Signal Incandescent Lamps. Vehicular signal lamps shall conform to the ITE A Standard for Traffic Signal Lamps and Table 732.04-2.

TABLE 732.04-2

Lens configuration	Lumens min. initial	Watts max. Input	Light Center Length inches [1]	Envelope Glass	Rated Life hours
12-inch vehicular	1650	150	3	clear	8000
8-inch vehicular (YELLOW)	550	70	2 7/16	clear	8000
8-inch vehicular (GRN/RED)	1260	116	2 7/16	clear	8000

[1] Light center length is the distance between the filament center and the base tip.

In addition to the requirements of Table 732.04-2, the Contractor shall provide model A-19 or AT-19 lamps for 8-inch and model A-21 or AT-21 lamps for 12-inch. The Contractor shall supply a medium brass screw type base with reflection disk. The Contractor shall furnish a C-11V or C-9 filament with a minimum of five hook supports for maximum filament stability. The lamp shall contain at least eighty-five percent Krypton gas. The design voltage shall be 120V ±10V, 60 hertz cycle. The lamp shall operate over the temperature range from –40 to 165°F and from zero to one hundred percent humidity. The lamp shall be operated in the horizontal position. The glass envelope and base shall have a maximum seal temperature of 662°F. The glass shall be free of any impurities that might allow moisture build up within the lamp. The glass envelope of the lamp shall be indelibly marked to show: original manufacturer's identification, rated voltage, rated lumens, rated average life, rated wattage, date of manufacture, and batch code.

(c) Vehicular and Pedestrian Light Emitting Diode (LED) Lamps. The Contractor shall furnish vehicular and pedestrian LED lamps according to the Ohio Department of Transportation Supplemental Specification 872.

732.05 Pedestrian Signal Heads. The Contractor shall furnish pedestrian signal heads that conform to the ITE Pedestrian Traffic Control Signal Indications. The contractor shall furnish signal heads that are complete units made up of two optical compartments with no leakage of light from one compartment to another. The signal heads shall alternately display the symbol of

an upraised hand in portland orange and the symbol of a walking Person in white light. The Contractor shall not furnish outline style symbols. The Contractor shall furnish a housing made of black polycarbonate material. The housing shall be adequately reinforced. The lens frame shall be polycarbonate material.

The lenses shall be glass and shall display the legend with translucent symbols within an opaque black background.

The lens shall be sealed to the door frame by the use of a weatherproof seal. The Contractor shall furnish an elastomeric gasket between the door frame and housing to ensure a dust and weatherproof seal.

A signal head design that provides adequate dissipation of heat to ensure rated lamp life shall be utilized.

The reflectors shall distribute light evenly from the source to the lens and shall be fastened or fitted securely in the compartment. Reflectors shall be made of highly specular finished aluminum, silvered glass, porcelained steel, or break resistant silvered plastic. Reflector material shall be finished to preserve the original reflective properties.

Each compartment of pedestrian signal heads shall be fitted with a visor that is at least 7 inches in length or, in lieu of visors, the entire face shall be protected with a sunshade fastened close to the lens. A sunshade shall be a black grid fabricated of high impact resistant plastic with a nominal depth of 1 ½ inches and consisting of horizontal members spaced at not more than 1/12-inch and vertical members spaced appropriately.

Pedestrian signal heads shall be furnished with required mounting brackets. Pipe type brackets shall be furnished 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.

Pedestrian signal heads shall be furnished with 1 1/2-inch galvanized steel pipe brackets with necessary fittings and adapters, and that are one-way or two-way as required. The signal faces shall be oriented to crosswalks by selective meshing of serration rings or other devices provided on housings and mounting brackets. Adjustments shall be made in increments not greater than 5 degrees of rotation and shall not be affected by wind gusts when locked.

The Contractor shall furnish two-piece hinged brackets of cast aluminum with stainless steel hinge pins, and when closed will be secured by a tamperproof bolt. The mounting shall incorporate a terminal block for quick disconnect of field wiring. The mounting design shall permit attachment to the pole by banding, bolting, or by lag screws in the case of wood poles.

Pedestrian signal head types shall be furnished according to Table 732.05-1

TABLE 732.05-1

Signal Head Type	Symbol Height, Inches	Light Source
A1	6	Clear Lamp
A2	9	Incandescent, LED
D2	9	Clear Lamp Incandescent, LED

If specified, the types listed below shall be furnished:

Type A1. A signal head that utilizes the housings of two 8-inch lens type vehicular traffic sections connected together to form a vertical unit shall be furnished. The sections shall have square lenses. The upper lens shall display the symbol of an upraised hand in portland orange and the lower lens shall display the symbol of a walking Person in white. A lamp shall be installed in each section.

Type A2. A signal head that utilizes the housing of two 12-inch lens type vehicular traffic sections connected together to form a vertical unit shall be furnished. The sections shall have square lenses with the same symbol position as Type A1. A lamp shall be installed in each section.

Type D2. A single housing signal head with a lens in one piece or in two sections, one for each message shall be furnished. The lens shall be colored and masked to display in portland orange the symbol of an upraised hand from the left compartment and the symbol of a walking Person in white from the right compartment. Reflectors and baffle that form two light compartments shall be furnished. A clear glass incandescent lamp shall be installed in each compartment. When a LED light source is specified, the upraised hand and the walking Person symbols may be integral in the same compartment.

732.06 Pedestrian Pushbuttons. Pushbuttons of sturdy construction that consist of a base housing and a removable cover shall be furnished. Pushbuttons with normally open contacts shall be furnished and shall include all electrical and mechanical parts required for operation. The electrical circuitry shall be suitable for testing at 120 volts although a lower voltage is used when operating.

The design of the pushbutton and its associated contacts and housing shall be sturdy and resistant to mechanical shocks and abuse. A concentrated force of 50 pounds applied to the button or any exposed portion shall not damage

the unit or misadjust the contacts. A housing with a curved back surface shall be furnished for mounting on poles of various diameters. The curved surface shall be integrated with the housing or an adapter supplied with a flat back type housing. The cover assembly shall be attached to the housing by stainless steel machine screws, resulting in a weatherproof and shockproof assembly. A hole threaded for a 1/2-inch pipe shall be furnished in the housing for Conduit attachment purposes. External surfaces shall be painted yellow with enamel paint of Color 13655, Federal Standard 595.

The maximum force required to operate the pushbutton shall be 5 pounds per foot. A raised or flush pushbutton with a minimum of 2 inches at its smallest dimension shall be furnished.

Pedestrian pushbutton signs shall be a minimum of 0.07-inch steel or 0.10-inch aluminum. The legends and backgrounds shall be baked enamel paint for steel signs or non-reflective sheeting for aluminum signs.

732.07 Loop Detector Units.

(a) NEMA TS-1. Loop detector units shall comply with the requirements of NEMA TS-1, section 15, with the following modifications. Shelf mounted loop detector units shall be powered from 120 volts. Solid state isolated output units shall be used for all controller applications where directly connected to a solid state digital controller unit. The conductors in the cable harness for loop input pins shall be twisted three to 5 times per foot.

The electrical connections for four-channel shelf-mounted units shall be either the 19-pin MS connector, as required by the foregoing specification, or shall consist of four connectors of the type required for single-channel shelf-mounted detector units.

If specified, detector unit electrical connection plugs or wiring harness shall be designed such that any multi-channel shelf-mounted detector unit may be readily replaced with single-channel detector units. This shall be accomplished 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, plug-connected to an adapter harness which is mated to the multi-channel connector of the detector unit.

(b) NEMA TS-2. Loop detector units shall comply with the requirements of NEMA Standards TS-2.

732.08 Loop Detector Units, Delay and Extension Type. Loop detector units of this type shall comply with the requirements of NEMA TS-1, section 15. Shelf-mounted loop detector units shall be powered from 120 volts. Solid state isolated output units shall be used for all controller applications where directly connected to a solid state digital controller unit. When specified, the provisions of 732.07 shall be applied for possible replacement of multi-channel units with single channel units.

732.09 Magnetometer Detector Units. The detection system shall be capable of satisfactory operation when the probes are installed in locations in close proximity to steel Structure such as on or within Bridges. Each detector unit shall be suitable for connection with up to six sensor probes and with lead-in cable lengths up to 750 feet. Magnetometer detector units shall comply with applicable requirements of 732.07.

732.10 Magnetometer Sensor Probes. Magnetometer sensor probes shall be fully compatible with the detector unit supplied. Sensor probes shall include attached leads of sufficient length for proper installation and their operation shall be satisfactory with up to six probes connected to a single lead. Probes shall be moisture proof, corrosion resistant, and suitable for embedment within pavement holes with flexible sealant.

732.11 Signal Supports. Signal poles and mast arms shall be circular tapered tubes of a true continuous taper. Any measurements of circular tube diameter at a specific point along the longitudinal axis shall not vary by more than 3/16-inch. The taper shall be between 0.54 and 1.3 percent.

Mast arms of the true continuous taper type shall be fabricated in two portions joined by overlapping of sections with the overlap being 1 1/2 diameters as determined by the largest diameter of the outer portion. The sections shall be assembled with a 5/8-inch minimum stainless steel or galvanized steel hex head through bolt.

There shall not be more than one longitudinal, automatically electrically welded seam on circular poles. The welded seams shall be neat and uniform in appearance and have a thickness not less than the base material and a bead height not exceeding 1/16-inch. The wall thickness at each pole or arm cross-section shall be of uniform thickness, except at weld beads. Transverse seams or welds shall not be placed on true continuous taper type poles or arms, except on types consisting of straight sections. After fabrication, poles and arms shall be hot-dip galvanized according to 711.02.

Guy rods or truss type arms shall not be used. Poles and mast arms shall be furnished with attachment plates and gussets. Poles and mast arms shall

be assembled using high-strength bolts with the connection developing the full moment-resisting capability of the arm. The butt diameter of mast arms shall not exceed the nominal diameter of the pole at the point of attachment.

Poles shall be fitted with a welded-on cast or plate steel base designed to mount on an anchor bolt foundation according to 725.01 and each pole shall include the furnishing of anchor bolts and Conduit ells for installation in each foundation. At least one 3-inch diameter Conduit ell shall be furnished for installation in each foundation. Conduit ells shall be polyvinyl chloride complying with 725.05; however, if they connect to steel Conduit, they shall comply with 725.04.

Steel anchor bolts shall conform to ASTM F1554, Grade 105 and shall be galvanized according to 711.02. The galvanizing shall extend at least 2 inches beyond the threads. The ends shall either be bent or have a drilled and tapped steel plate as shown on the Plans.

Poles shall include a handhole near the base oriented as required. The handhole shall be reinforced with a welded-on steel frame with a grounding lug and shall be fitted with a cover plate fastened by stainless steel screws. The poles shall also include a cable and wire support J-hook welded near the top and a removable pole cap. Poles and arms shall be designed so their interiors conceal wiring and their mast arms shall include grommeted wire outlets for the signal heads. Hanger clamps with clevises shall be furnished on the mast arms for the signal heads as required. Arm caps shall be made of steel and shall cover at least fifty percent of the end area.

Signal poles combining provisions for Roadway lighting shall include an additional handhole located opposite the mast arm flange with an additional J-hook located above.

Pedestrian pushbutton access holes and blind half couplings for controllers and pedestrian signal heads shall be furnished as required. Any unused holes shall be plugged.

732.12 Strain Poles. Signal strain poles for the attachment of span wire that are steel tapered tubes shall be furnished according to the requirements of 732.11. For embedded poles the portion below the groundline shall not be used in determining the taper. All poles shall include a removable pole cab, and messenger wire clamps with clevis and shackle unless otherwise specified.

Anchor bolt foundation type strain poles shall include a welded-on cast or plate steel base, bolt covers, a handhole, and a J-hook, as required by 732.11, and shall also include at least one 2-inch cable entrance with a weatherhead and a welded blind half-coupling. The poles shall include the furnishing of anchor bolts and Conduit ells for installation in the foundation. At least one 3-inch

diameter Conduit ell shall be furnished for installation in the foundation. Conduit ells shall be polyvinyl chloride complying with 725.05; however, if they connect to steel Conduit, they shall comply with 725.04.

732.13 Wood Poles. Wood poles shall conform to ANSI 05.1 "Specifications and Dimensions for Wood Poles", shall be made of Southern Pine or Western Red Cedar, and shall be full-length pressure treated according to 725.19.

732.14 Down Guy Assemblies. Down guy assemblies shall conform to 725.19. Insulators and hardware shall conform to 732.18. Anchors shall be the expanding or screw type and shall be capable of withstanding a guy tension of 8000 pounds when installed in firm moist soil.

732.15 Pedestals. Pedestals for the support of traffic control Equipment shall be fabricated of 4-inch schedule 40 steel or aluminum pipe. The steel pipe shall be fitted with a welded-on base of plate or cast steel, or when specified the steel pipe shall be threaded into a gray cast iron transformer type base. Galvanized steel pedestals shall comply with 711.02. Aluminum pipe shall be threaded into an aluminum cast transformer type base. Design pedestals shall be designed to mount on an anchor bolt foundation and shall include the furnishing of anchor bolts and Conduit ells for installation in the foundation.

732.16 Conduit Risers. Risers shall have Conduit and fittings according to 725.04 and a weatherhead made of aluminum or galvanized ferrous metal and threaded.

732.17 Cable Support Assemblies. The cable grip used with cable support assemblies shall be of the proper size and strength for the cables and shall be of the flexible "closed" or "split with rod" type, of stainless steel or tin coated bronze, and shall be equipped with a single "U" eye bale. The smallest cable grip permitted shall have a minimum rated breaking strength of 250 pounds.

The slings for cable supports shall be made from copper clad or galvanized multi-strand steel wire with an overall diameter of not less than 1/8-inch and a breaking strength of at least 400 pounds. Thimbles shall be used to form eyes at each end of the sling with grooves to match the wire. The sling shall be adjusted to the proper length with the wire at each thimble lapped and secured with split bolt clamps.

732.18 Messenger Wire. The Contractor shall furnish Utilities Grade messenger wire, twisted strand copper clad steel wire, 7 strand, Extra High Strength, 30% Conductivity according to ASTM B228. All accessories shall have a rated loading strength equal to or greater than the messenger wire minimum breaking strength. Copper clad steel helical lashing rods in 5-foot lengths shall be furnished. Strain insulators of the wet porcelain process type shall be furnished.

732.19 Cable and Wire. Cable and wire shall meet the requirements of Table 732.19-1 and shall be rated at 600 volts with conductors of copper unless otherwise specified. The cable or wire jacket shall be indelibly marked at intervals of not more than 6 feet with nomenclature stating the size, the type, the organization specifying the type, and the manufacturer's name or trademark.

732.20 Power Service. Risers for power service shall be 1 to 1 1/2-inch diameter Conduit and fittings shall comply with 725.04. Weatherheads shall be threaded and made of aluminum or galvanized ferrous metal. A disconnect switch shall be included with the enclosure.

732.21 Disconnect Switch with Enclosure. The switch enclosure shall be a UL listed watertight lockable stainless steel NEMA Type 4 supplied with the Conduit hubs listed on the enclosure UL label. The enclosure shall contain as a minimum a single-throw, 2 pole, solid neutral, fused safety disconnect switch (or circuit breaker) UL listed as suitable for a service disconnect with a minimum capacity of 30-amperes at 240 VAC. The unit shall be capable of being padlocked in both the "ON" and "OFF" positions.

TABLE 732.19-1 CABLE AND WIRE

Cable or Wire	Number of Conductors	Wire gage	Specification or Type	Conductor Type	Notes
Signal Cable	As specified	As specified	IMSA 19-1 IMSA 20-1 IPCEA S-61-402	Copper, color coded, stranded	
Loop detector Wire	Single	No. 14 AWG	IMSA 51-1	Copper, conductor	1
Loop detector lead-in cable	Two conductor	No. 14 AWG	IMSA 50-2	Copper, twisted pair, shielded, stranded	2
Magnetometer	Four conductor	No. 18 AWG	Heavy duty, direct burial type	Copper, color coded, stranded	3
Power cable	Two conductor	As specified	UL: RHH/RHW/USE, XHHW cross linked Polyethylene	Aluminum,* color coded, stranded	4
Service cable	Two conductor (duplex)	As Specified	XHHW or cross linked polyethylene insulation w/a thickness of 0.045 inches (min.)	Aluminum* twisted stranded	5
Ground wire	Single conductor		UL: RHH/RHW/USE, XHHW cross linked	Copper stranded polyethylene	

Notes

1 Jacket: High density polyethylene, thickness 0.026 inches (min.) Low conductor to conductor capacitance.**

2 Jacket: Black polyethylene, thickness 0.04 inches (min.) Insulation: polyethylene.

3 Jacket: High density polyethylene, thickness 0.026 inches (min.) Low conductor to conductor capacitance.**

4 Three-conductor cable may be specified. Permitted Substitution:2 (or 3) single conductor cable.

5 Three-conductor cable (triplex) may be specified. Aerial self-supporting aluminum conductor steel reinforced support wire as elec. Neutral.

* Copper conductors may be substituted. When used, wire gage may be one size smaller.

** 18 picofarads per foot (adjacent pairs), 15 picofarads per foot (diagonal pairs).

733 TRAFFIC SIGNAL CONTROLLER MATERIAL

733.01 References and Definitions
733.02 Controller Units
733.03 Cabinets
733.04 Cabinet Risers
733.05 Flasher Controller

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.

733.02 Controller Units.

(a) General Requirements. Each controller unit shall contain internal time based coordination and, if used in a coordination system, a communication device or transceiver for connection to fiber optic communication cables as shown on the Plans.

If used in a coordination system, the local intersection controller shall contain all of the software features necessary to operate with the system.

When the signal timing and phasing configuration shown on the Plans requires a pre-timed operation, the controller unit shall meet all requirements of this section and can also be configured in a pre-timed, sequential phase, fixed interval mode.

Controllers shall have 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. A communication port shall be furnished for connection to a laptop computer for database upload/download. Software for the personal computer to completely program all features of the controller unit shall be furnished. Unless otherwise shown on the Plans, the controller unit shall be provided with software that provides the following

features even if not used by the signal phasing operation shown on the Plans:

(1) NEMA eight phase, dual ring capability with four pedestrian movements, four overlaps, and the ability to program an exclusive pedestrian movement. The controller shall be 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 three dials, three offsets, three 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 twenty-four hour period in fifteen minute increments
(14) Detector failure monitoring and logging features for constant calls and absence of calls

Controllers shall have twenty-four-month warranties or the manufacturer's standard Warranty, whichever is greater. The Warranty period shall begin on the date of shipment to the Project. Each unit shall have a permanent label or stamp indicating the date of shipment.

(c) Type TS-2/A1. The Contractor shall furnish a controller unit that meets NEMA TS-2 Specifications and is shelf or rack mounted. The controller settings shall be programmable through a keyboard on the front panel. The front panel shall contain an eight line by 40-character display.

(d) Type TS-2/A2. The Contractor shall furnish a controller unit that meets NEMA TS-2 Specifications and is suitable for shelf mounting. The controller unit shall include all ports and input/output connectors for complete interchangeability between NEMA TS-1 and TS-2 cabinets. The controller settings shall be programmable through a keyboard on the front panel. The front panel shall contain an eight-line by 40-character display.

733.03 Cabinet. All cabinets shall comply with the requirements of this 733.03. All NEMA specified cabinets shall be equipped as follows:

Two through four phase controller operation shall be supplied with a minimum eight position backpanel, configured for two pedestrian movements and two overlaps, with a six channel NEMA TS-1 conflict monitor or NEMA TS-2 malfunction management unit.

Five through eight phase controller operation shall be supplied with a minimum 12 position backpanel, configured for four pedestrian movements and no overlaps, with a 12 channel NEMA TS-1 conflict monitor or NEMA TS-2 malfunction management unit.

For signal phasing configurations that require a larger capacity backpanel or conflict monitor, a 16 position backpanel with one 16 channel NEMA TS-1 conflict monitor or NEMA TS-2 malfunction management unit shall be supplied.

Each cabinet main door shall be equipped with a sturdy, permanent lubricated lock that is covered with a weatherproof tab. The Project locks shall be keyed to the master key used by the City. Two keys shall be supplied with each lock. Also, the small door-in-door shall be equipped with a lock that is keyed to the City's master key.

Type TS-1.

(a) Cabinets. Cabinets shall be of a size 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. Cabinet shall have sufficient shelf space to accommodate all existing, proposed, and designated future Equipment. The space provided shall accommodate the appropriate controller unit frame as designated in NEMA TS-1, Section 14.

Cabinets shall be constructed of cast aluminum or sheet aluminum, drawn or formed, with aluminum support and stiffening of members provided as necessary. The exterior shall be smooth with no sharp edges. All joints shall be welded. The cabinet shall be rigid and shall be designed to support all components. The application of the following loads shall not result in breakage, deformation, or loss of weatherproof qualities: a 100 pound load applied to any 1 inch square surface of the cabinet or door (open or closed), in any direction; or a 300 pound load applied vertically downward to any 4 inch square of the top surface or to the top edge of the closed and latched door.

Cabinet exterior surfaces shall be bare aluminum. When the Plans specify a cabinet color, all cabinet exteriors shall be primed and finished

with two coats of high-grade enamel paint of the specified color. The cabinet interior surfaces shall be the same as the exterior, or may be painted flat white.

Cabinets shall contain at least one rain-tight louvered vent equipped with a replaceable filter. Vents shall be installed to allow for the release of excessive heat and any explosive gases that might enter the cabinet.

The cabinets shall be functional in design and have a door in the front providing access to substantially the full interior area. A gasket of elastomeric material shall be attached to the cabinet or door to form a weatherproof seal. Door hinge pins shall be stainless steel or equivalent corrosion resistant material. A door stop to retain the door in at least a 90 degree open position shall be furnished.

Cabinets shall include a small, hinged, and gasketed door-in-door (police door) on the outside of the main controller door. The door-in-door shall not allow entrance to the controller mechanism nor to exposed electrical terminals, but shall provide access to a small switch panel and compartment (police panel).

The cabinet shall be fitted with the necessary provisions for mounting, with a bottom Conduit connection provided for pole-mounted cabinets. Suitable hardware and Equipment shall be furnished 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. Steel anchor bolts that are galvanized at least 1 inch beyond the threads shall be furnished.

All Equipment designed for shelf mounting shall be directly placed on a shelf except for loop detector units (amplifiers) and similar devices designed for stacking on each other. Components on shelves and devices on the door shall be arranged so that a 1 inch minimum space separates them when the door is shut. Plugs, wires, controls, or similar items shall not compromise this space.

A minimum 4 inch clear area on the bottom of the cabinet shall be reserved for the routing of cables. Panel mounted Equipment shall not be located in the bottom 6 inches of the cabinet. Shelves or components shall not be located within 6 inches of the bottom of foundation mounted cabinets.

All Equipment shall be arranged for easy withdrawal and replacement, without the necessity of disturbing adjacent Equipment. Devices shall be permanently located within the cabinet to allow free circulation of air and not restrict air flow from fan ducts or vents.

Auxiliary Equipment shall operate within a weatherproof cabinet at ambient temperatures between –30 and 165°F.

When terminals and panel mounted devices with exposed electrical contact points are located next to shelf mounted Equipment, spacers, shelf lips, or other means shall be provided to assure that component units cannot be accidentally moved into contact with any exposed electrical terminal points.

Load switches, relays, flashers, fuses, switches, terminal blocks, and other Equipment mounted or plugged into the back or side panels shall be readily accessible. Switches, controls, and indicator lights shall be visible and easily operable without moving the components from their normal shelf positions.

(b) Accessory Equipment.

(1) Ventilating Fan. All cabinets shall be equipped with a forced air ventilating fan that provides a capacity of at least 100 cubic feet per minute and is thermostatically controlled and adjusted to start at cabinet temperatures above 120°F and to stop when the temperature has dropped below 100°F.

(2) Load Switches. All cabinets shall be furnished with solid state, triple-signal load switches complying with NEMA TS-1, Section 5. Additionally, all load switches shall have both input and output indicators.

(3) Conflict Monitor. All cabinets shall be furnished with a separate solid-state conflict monitor device. The cabinet wiring, in the event of monitor disconnection, shall transfer the signals to a flashing condition. A conflict monitor that complies with NEMA TS-1, Section 6 shall be furnished. Additionally, all conflict monitors shall be capable of causing the signals to flash as a result of the following events:

(a) All red lamps associated with a load switch are burned out;

(b) Within one second when red and green, or yellow and green color pairings are displayed on the same phase;

(c)The absence of a minimum yellow interval.

The monitor shall indicate the exact load switch output channel upon which the failure event occurred. A conflict monitor that is capable of storing a minimum of nine fault events (event logging feature) shall be furnished. A monitor that utilizes a LCD display and has a RS-232 port for connection to a laptop computer shall be furnished. Software and connector cables to diagnose the conflict monitor shall be furnished.

(4) Flashers. Solid-state flashers that comply with NEMA TS-1, Section 8 shall be furnished. When signals have a normal stop-and-go sequence that includes flashing, either a controller unit that generates the flashing display or flashers shall be furnished. For this purpose, separate flashers from those provided for emergency back up shall be furnished. Flashers that are designed with two circuits of at least 10 amperes each shall be furnished.

Each controller cabinet shall be equipped 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.

(5) Relays. The relays required for proper operation of the specified Equipment shall be furnished and completely wired. Relays that are enclosed, readily replaceable, and designed for one-million operations without failure or need for adjustment shall be furnished.

(6) Lightning Protection Devices. Lightning protection shall be furnished on incoming power lines, interconnect lines, and detector leads.

The AC power line shall be connected to an easily replaceable plug and socket type 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. A SPD that has five terminals for the following connections: LINE-IN, LINE-OUT, NEUTRAL-IN, NEUTRAL-OUT, and GROUND shall be furnished. It may have a 6^{th} terminal for MAIN LINE. A two stage metal oxide varistor (MOV) based SPD shall be furnished. The SPD shall not contain gas tubes. The first stage shall contain two MOV's, one connected between LINE-IN and GROUND and the second between the NEUTRAL-IN and GROUND. The second stage shall be a filtering network with a MOV connected across LINE-OUT and NEUTRAL-OUT. The specified MOV's may be single devices or MOV's in parallel as needed to obtain the specified performance.

The SPD shall be mounted inside the controller cabinet in a space of no more than 8 inches wide, 4 inches high, and 3 inches deep. The IN and OUT terminals shall be connected to the appropriate AC power lines and the GROUND terminal shall be connected to the ground rod for the controller cabinet.

A SPD that meets the following performance requirements shall be furnished:

(a) A SPD that is capable of withstanding 20 repeated surges each of 20,000 amps with an eight microsecond rise time to the peak current and a fall to one-half of the peak current after twenty microseconds shall be furnished. The surges shall be 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 ampere surges, the voltage across the LINE-OUT and NEUTRAL-OUT terminals shall be no more than 260 volts after one nanosecond.

(b) The filtering capacity shall be such that there is no loss in a 60 hertz signal applied across the IN terminals and measured across the OUT terminals. The measured losses for signals from 50 kilohertz to 5 Megahertz shall be at least 40 dbs.

(c) The line switching mitigation capacity shall be such that during the application of an input spike voltage of ±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 ±50 volts.

(d) The current capacity shall be such that it can carry 10 amperes at 120 VAC RMS continuously for one week without damage.

Loop detector lead-in cable protection that consists of devices installed in each detector circuit where the lead-in connects to the terminal block shall be furnished. Each device shall be housed in a case that consists of two stages; a three electrode gas tube arrestor and a semiconductor circuit. The arrestor shall shunt to ground a common mode transient with a 1,000 ampere peak and an 8/20 microsecond waveshape, ionizing at 400 volts within one hundred nanoseconds when subjected to a 1,000 volt per microsecond transient. A semiconductor circuit that clamps a differential transient to 30 volts within forty nanoseconds of the appearance of the transient, and a common mode transient to 30 volts within five hundred nanoseconds of the ionization of the gas tube arrestor shall be furnished. The second stage shall be able to withstand a peak current of 13 amperes. 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 shall be furnished.

Pedestrian pushbutton inputs with the same protection as specified for the loop detector lead-in cables shall be furnished.

Interconnect cable shall be protected against transients by devices across each conductor of the cable and ground. The devices may be either two or three-terminal devices. If three-terminal devices are used, two conductors and ground shall be connected to the same device. 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 shall be furnished. The maximum time from beginning of the transient to ionization shall be 1.1 microseconds on a 10,000 volt per microsecond transient. The device shall not be ionized by normal voltage variations on a 120-volt AC line. A device that is able to withstand a 10,000 ampere peak with an 8/20 microsecond waveshape shall be furnished.

(7) Main Power Breaker. 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 shall be furnished.

(8) Radio Interference Filter. An incoming AC+ power line that contains a radio frequency interference (RFI) filter installed between the main circuit breaker and the solid state Equipment shall be furnished. Also, RFI filtering for the load switches and flasher shall be furnished, unless the Equipment furnished provides signal and flasher circuits switching at the zero voltage point of the power line sinusoid waveform.

(9) Convenience Outlet and Light. A convenience outlet shall be wired into the cabinet for use by electrical maintenance Equipment. The outlet shall contain at least one standard duplex three-wire plug receptacle of the ground-fault circuit-interrupting type. A standard incandescent lamp and socket shall be furnished and mounted in the upper portion of the cabinet. A door switch to control the convenience light shall be furnished.

(10) Manual Control and Pushbutton. When required by the Plans, intersection controller units with means for substituting manual operation of interval timing for automatic interval timing shall be furnished. The manual operation shall provide the same interval sequence as when the controller unit is operating automatically.

Manual interval timing shall be obtained by a momentary pushbutton contact switch mounted on a 5 foot minimum flexible weatherproof extension cord. The switch and cord shall be stored behind the small door-in-door.

(11) Switches. Completely wired switches that are required for proper operation of specified Equipment shall be furnished. Switches shall be clearly and permanently labeled as to function and setting position, and shall be accessible without the necessity of moving components.

(a) Signal Shutdown Switch. A cabinet with a signal shutdown switch for turning off the power to the signals at the intersection shall be furnished. This switch shall only affect the power to the signals, and allow the controller to continue in operation. The switch shall be located in the panel behind the small door-in-door.

(b) Auto/Flash Switch. A cabinet with a flash control switch for activating the flashing of vehicular signals in a preselected emergency flash display shall be furnished. The operation of the flash control switch shall cause a flashing display even under conditions of a controller unit malfunction or of its removal from the cabinet. The operation of the switch shall override any operation commands from a local or remote time switch. The switch shall be located in the panel behind the small door-in-door (police door).

The transfer to and from flashing operation, when called remotely or by a local time switch, shall be programmed to occur only at points in the cycle allowed by the OMUTCD.

(c) Automatic/Manual Transfer Switch. A cabinet with an automatic/manual transfer switch shall be furnished. In the automatic position, the controller unit shall automatically sequence the signal head displays. In the manual position, the signal phase or interval sequencing shall occur only upon manual activation of the manual control pushbutton. The switch shall be located in the door-in-door (police door). It shall be unnecessary, when switching from manual to automatic operation, or vice versa, to do so at any certain time or to make any time adjustments.

(d) Run/Stop-Time Switch. A cabinet with a run/stop-time switch that activates the controller stop-time feature when in the “stop-time” position shall be furnished. The run/stop-time switch shall be located on a switch panel in the cabinet.

(e) Controller Shutdown Switch. A cabinet with a controller shutdown switch that cuts off power to the controller unit, conflict monitor, and detector units shall be furnished. The controller shutdown switch shall not be cut off the power to those components required to maintain flashing operation. The controller shutdown switch shall be located on a switch panel in the cabinet.

(f) Coordinated/Free Switch. Controllers operated in a coordinated system shall be furnished with a coordinated/free switch. This switch shall allow the choice of operating the controller under the supervision of a coordination device or operating the controller independently of coordination control. The coordinated/free switch shall be located on a switch panel in the cabinet.

(g) Detector Test Switches. Momentary contact switches that will enter a vehicular or pedestrian call for any actuated phase shall be furnished. A switch for each actuated phase vehicular and pedestrian detection input shall be furnished. The detector test switches shall be conveniently grouped and labeled.

(12) Terminal Blocks. Cabinets that include terminal blocks mounted on panels on the walls of the cabinet shall be furnished. The blocks shall not be obstructed by shelf-mounted devices. Sufficient terminal sets for each individual harness wire as well as for contacts of signal load switches, flash transfer relays, flasher, and other components shall be furnished. Also, separate terminal sets for field wiring connections, including power, signal, interconnection, and detector lead-in cables shall be furnished. Terminal sets shall be grouped to separate higher voltage (120 VAC) from lower voltage, and shall be arranged into logical groups. Terminal blocks shall be protected from accidental contact during the installation and removal of shelf-mounted Equipment. The blocks shall be located no closer than 4 inches from the bottom of pole and pedestal mounted cabinets, and no closer than 6 inches from the bottom of foundation mounted cabinets.

The terminal points shall be UL listed as suitable to carry the rated loading. The capacity and size of the terminals shall be as specified in NEMA TS-1, Section 10.2.5. The terminal points for signal field wiring for each circuit shall accommodate at least four No. 12 AWG conductors with spade type terminals.

Terminal points for incoming power wiring that accept either spade terminals or bare stranded wire and are suitable for either aluminum or copper conductors shall be furnished.

Terminal sets shall have spades for easy wiring. At least six reserve terminal sets for controllers shall be furnished. Harnesses may terminate on the back of terminal blocks using through-panel terminals. Terminal sets shall be clearly marked for ready identification including through-panel terminals that are identified on both sides. The contact between adjacent terminal points shall be made by bus bar, or by wire jumpers having spade type terminals securely attached to each end.

(13) Terminal Buses. 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 shall be furnished. The requirements for use of radio interference filters shall be according to 733.03 A2h, with the buses supplying load switches and with flashers being filtered when required. A signal bus relay

shall control power to the bus supplying power for the signal load switches.

A common terminal bus for the connection of the neutral wire of the incoming 120 VAC power line shall be furnished. The common bus shall have sufficient terminal points to accommodate all potential cabinet wiring as well as field wiring. A separate common terminal, insulated from the panel, shall be used for the interconnect common.

Bus terminal points that comply with 733.03 A2l for conductor accommodation, attachment, and identification shall be furnished.

(14) Grounding System/Bus Bars. 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 shall be furnished. The ground bus bar and the common terminal bus shall be bonded together with a No. 8 AWG or larger stranded copper wire.

(15) Wiring. The harnesses and wiring bundles to individual terminals shall be neatly organized and routed. Each harness shall provide a wire for each pin or contact of the device. Each wire shall be connected to a marked terminal position. Labeled spade type terminals or plug connections shall be used on all harness wiring. Wire bundles shall be grouped and lashed or restrained in such a manner that they will not interfere with the access to components, terminal blocks or buses, or the legibility of terminal identification. The harnesses shall be of sufficient length to reach any point within the cabinet. The cables and harness bundles shall be easily traceable through the cabinet to their terminations.

The cabinet shall be wired so that controller pin connections associated with a given phase number match the phase number assigned to the specified traffic movement as shown on the Plans.

All wiring shall be furnished with stranded conductors. The wiring shall be adequate for the voltage and load that represents the ultimate load of the devices connected. The ampacity rating of the wires shall be as specified in NEMA TS-1, Section 10.3.3.1. The wiring shall be color coded as follows:

(a) Solid white, AC common.

(b) Solid green or white with green stripes, safety (chassis) ground.

(c) Solid black, AC line side power (AC+).

(16) Loop Detector Units. Loop detector units that comply with the requirements of NEMA TS-1, Section 15, with the following modifications shall be furnished:

(a) Loop detector units that are shelf mounted and powered from 120 volts shall be furnished.

(b) The loop detector units shall use solid-state isolated output devices.

(c) The conductors in the cable harness for loop input pins shall be twisted three to five times per foot.

(d)Detector unit electrical connection plugs or wiring harnesses that are designed such that any multi-channel shelf mounted detector unit is readily replaced with single channel detector units shall be furnished. 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 multi-channel connector of the detector unit shall be furnished.

(e) When shown on the Plans, delay and extension timing capability shall be supplied on the detector unit; otherwise, the controller unit software requirements of 732.02 will provide these features.

(f) The harness shall provide a wire for each pin or contact of the device.

If vehicle detector types other than “loop” detectors are required by the Plans, these detectors shall be provided by separate Bid item.

B. Type TS-2.

(a) TS-2 cabinets. that utilize a high speed data channel to connect the controller unit, malfunction management unit, rear panel (terminals and facilities), detectors, and bus interface units and also comply with the general requirements of 733.03 shall be furnished. A pre-wired cabinet with malfunction management unit, loop detector units, and all accessory Equipment as specified in NEMA TS-2, except as follows shall be furnished:

(1) Section 5.3.4, detector racks shall be used for both Type 1 (A1) and Type 2 (A2) controller units.

(2) Section 5.4.2.7, an incandescent type light shall be provided.

(3) Section 5.4.2.7.2, the incandescent lamp shall be provided.

(4) Section 5.4.2.7.3, the door actuated light switch shall be provided.

(5) Section 7.2, cabinets shall be constructed of cast or sheet aluminum.

(6) Section 7.3, a cabinet with nominal dimensions of 36 inches wide by 48 inches high by 16 inches deep shall be provided. A larger cabinet shall be supplied if required to house the Equipment to meet the plan requirements; such as master controllers,

preemption devices, 16 position backpanels or special detector units.

(7) Section 7.5.7, the police panel shall contain switches for AUTO/FLASH, SIGNALS ON/OFF, and AUTO/MANUAL in the police panel. A pushbutton with a 5 foot cord shall be furnished.

(8) Section 7.7.3, unpainted cabinets shall be supplied.

(b) Loop detector and pedestrian inputs that have lightning/surge protection as specified in 733.03(b)(11) shall be furnished.

(c) Loop detector racks with the necessary number of loop detector units shall be furnished with the cabinet. When shown on the Plans, delay and extension timing capability shall be supplied on the detector units. If vehicle detector types other than "loop" detectors are required by the Plans, these detector units shall be supplied by separate Bid item. If the special Bid detector units use standard TS-2 detector racks, the racks shall be furnished as part of the pre-wired cabinet.

(d) Switches to control the controller unit and cabinet functions as specified in 733.03(b)(6) shall be furnished.

(e) Load switches that have both input and output indicators shall be furnished.

733.04 Cabinet Risers. An aluminum riser that will raise the cabinet approximately 12 inches above the concrete foundation shall be furnished. The bottom of the riser shall bolt to the standard cabinet foundation anchor bolts (not included with the riser) and the top of the riser shall bolt to the bottom of the cabinet. Attachment hardware shall be furnished for connecting the riser to the cabinet.

The riser shall be constructed 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. Hardware shall be furnished for rigidly connecting the riser sections together.

The riser shall be fabricated from 0.125 inch sheet aluminum with flanges on the top and bottom to provide rigidity. Mounting flanges shall be furnished as necessary to connect with the controller cabinet and foundation anchor bolts. The outside surface of the riser shall have a smooth, uniform, natural finish unless controller cabinet painting is shown on the Plans. If painting is required, the riser shall be prepared and painted to match the cabinet.

733.05 Flasher Controller. A solid-state flasher that complies with NEMA TS-1, Section 8, and has two circuits, each rated at 10 amperes shall be furnished. A cabinet that conforms to applicable requirements of 733.03(a) shall be furnished, except that the following items are not required: a small door-in-door (police door), shelves, and a fan. The cabinet size shall be not less than 12 inches high by 10 inches wide by 6 inches deep. Cabinets that are designed for pole mounting with one 1-1/2 inch or larger Conduit opening in the bottom shall be furnished. The auxiliary Equipment shall include: 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.

740 PAVEMENT MARKING MATERIAL

740.01 General
740.02 Traffic Paint
740.04 Thermoplastic Pavement Marking
740.06 Work Zone Pavement Marking
740.07 Epoxy Pavement Marking Material
740.09 Glass Beads

740.01 General. Pavement marking Materials shall meet the requirements of this specification and appear on the Ohio Department of Transportation's current approved list of pavement marking Materials.

Pavement marking material shall be delivered in containers which are clearly marked to indicate the number of gallons, weight or size of material, material color, batch number or other similar manufacturer's identification, date of production and the company name and location.

740.02 Traffic Paint. Traffic paint shall ready-mixed white and yellow suitable for marking various types of pavement. Traffic paint shall be the fast dry, water-based one hundred percent acrylic type and shall appear on the Ohio Department of Transportation's current approved list of pavement marking Materials.

740.04 Thermoplastic Pavement Marking. Thermoplastic pavement marking material shall be formulated expressly for use as retroreflective pavement markings on asphalt concrete or portland cement concrete pavement. The thermoplastic material shall appear on the Ohio Department of Transportation's current approved list of pavement marking Materials.

740.06 Work Zone Pavement Marking. Work zone pavement marking material shall conform to ASTM D4592, Type I (removable) or Type II (non-removable) with the following modifications:

(a) Type I (removable): 0.030 inch minimum thickness.

(b) Type II (non-removable): 0.015 inch minimum thickness.

740.07 Epoxy Pavement Marking Material. Epoxy pavement marking material shall appear on the Ohio Department of Transportation's current approved list of pavement marking Materials.

740.09 Glass Beads.

Type A. Type A glass beads for traffic paint shall conform to AASHTO M247, Type 1 without flotation properties but with moisture-resistant coating.

Type C. Type C glass beads shall be furnished for thermoplastic material. Glass beads dropped on thermoplastic shall meet the following Specifications:

Sieve Size	Percent Retained
No. 16	3 max
No. 20	5 to 20
No. 40	65 to 95
No. 50	0 to 5
Refractive Index	1.50 to 1.60
Roundness	80 min
Coating	Adhesion Promoting

Type D. Type D glass beads shall be furnished for epoxy pavement marking material. The glass beads shall have the following gradation.

SIZE I

Sieve Size	Percent Retained
No. 10	0
No. 12	0 to 5
No. 14	5 to 20
No. 16	40 to 80
No. 18	10 to 40
No. 20	0 to 5
Pan	0 to 2

SIZE II

Sieve Size	Percent Retained
No. 20	0 to 5
No. 30	5 to 20
No. 50	30 to 75
No. 80	9 to 32
No. 100	0 to 5
Pan	0 to 2

Reflective Media: The glass beads shall be smooth, clear, free from any air inclusions, and scratches that might affect their functions as a retro-reflective media, and have the characteristics listed below.

Roundness (Percent by Weight): No more than twenty percent of the glass beads shall be irregular or fused spheroids and that at eighty percent of the beads shall be true beads.

Index of Refraction: The refractive index of the beads shall be a minimum of 1.50 as determined by the liquid immersion method at 77°F. The silica content of glass beads shall not be less than sixty percent.

Coating: Size I glass beads shall be coated with a silane-type adherence coating to enhance its embedment in, and adherence to the applied binder film. The coated beads shall emit a yellow-green fluorescence when tested by the Dansyl Chloride test procedure. Size II glass beads shall be treated with a moisture-proof coating. Both types of glass beads shall not show tendency to absorb moisture in storage and shall remain free of clusters and lumps. The beads shall flow freely from the dispensing Equipment at any time when surface and atmosphere conditions are satisfactory for marking operations.

The moisture-resistance of the glass beads shall be determined on the basis of the following test:

Place 2.2 pounds of beads in a washed cotton bag, having a thread count of 50 per square inch (warp and woof) and immerse the bag in a container of water for thirty seconds. Remove the bag and force the excess water from the sample by squeezing the bag. Suspend and allow draining for two hours at room temperature 70°F to 72°F. After draining, mix the sample in the bag by shaking thoroughly. Transfer a sample slowly to a clean, dry glass funnel having a stem 4 inches in length, with a 3/8 inch inside diameter stem entrance opening, and a minimum exit opening of 1/4 inches. The entire sample shall flow freely through the funnel without stoppage. If the beads clog when first introduced to the funnel, it is permissible to tap the funnel to initiate flow.

ITEM 748 STEEL PIPE MATERIAL

748.01 Steel Pipe Encasement

748.01 Steel Pipe Encasement. The Contractor shall furnish steel casing pipe conforming to ASTM A139, Grade B, or ASTM A53, Grade B, that is galvanized on exterior and interior surfaces as specified in 711.02. Manufacturer's certification shall be furnished. Steel casing pipe shall have a minimum wall thickness as shown below:

Pipe Diameter (in)	Wall Thickness Designation	Wall Thickness (in)
4 to 10	Standard	0.237 to 0.365
12 to 22	Standard	0.375
24 and larger	Extra-strong	0.500

For steel casing pipe specified to be bored or jacked, ungalvanized pipe with the largest wall thickness shall be provided.

ITEM 800 WATER, SANITARY, AND STORM SEWER SYSTEMS

ITEM 801 WATER, SANITARY, AND STORM SYSTEMS-GENERAL

801.01 Description
801.02 Restoration of Private Property
801.03 Restoration of Public Rights-of-Way
801.04 Use of City Owned Piping Systems
801.05 Maintenance of Flow
801.06 Unsuitable Foundation and Changes in Planned Grade
801.07 Cold Weather Construction
801.08 Removal of Existing Pavements, Walks, Structures, etc.
801.09 Tree Removal
801.10 Buried Piping
801.11 Separation of Sewers and Potable Water Lines.
801.12 Product Delivery, Storage, and Handling.
801.13 Basis of Payment

801.01 Description. The City Owned Piping Systems (COPS) include water distribution, wastewater collection, and stormwater conveyance piping systems and appurtenances. The provisions described within the following Item 800 shall apply to all types and kinds of construction on the COPS.

801.02 Restoration of Private Property. When Work is performed on private property within established easements, the Contractor's Work shall conform to all agreements between the City and the private property Owner, with or without the agreement expressly included in the Contract. The Contractor shall at all times avoid needless injury to premises entered. The disturbed premises shall be left in a neat and orderly condition with the removal of rubbish and surplus material, and the premises shall be restored, as approved by the Engineer, to the same general "prior to entry" condition.

For arrangements made directly between the private property Owner and contractor such as material storage, the City has no liability to the private property Owner for restoration.

801.03 Restoration of Public Rights-of-Way. All areas disturbed in the prosecution of the contract shall be completely restored or reconstructed in accordance with “Rules & Regulations for Making Openings in a Public Way” (latest edition). The restoration items within the work area will be listed in the

proposal. All other disturbed surfaces shall be considered beyond the work limits, yet not beyond the Contractor's responsibility, and the Contractor shall restore or reconstruct the damaged parts according to the Specifications herein and at the Contractor's own expense.

If the permanent pavement replacement over an excavation is temporarily delayed for any reason, the Contractor shall lay a temporary base and pavement. The temporary base and wearing surface shall consist of a bituminous or concrete mixture as approved by the Engineer. The Contractor shall maintain the temporary surface in a traversable condition. The crown of the temporary surface shall not exceed 1 inch above the adjoining pavement. No separate payment will be made for temporary pavement unless included in the bid proposal. Reimbursement for the cost of temporary restoration shall be included and made part of the payment for Item 614.

If settlement occurs for any reason, the surface shall be restored to planned grade. If settlement occurs for any reason after the permanent surface Work is finished, the Contractor or their Surety will be required, within the Guarantee period of one year, to remedy the defects, restore the surface and maintain the Work for the remainder of the Guarantee period.

801.04 Use of City Owned Piping System (COPS). At any time during the progress of the Work and by notice to the Contractor, the City may take over and utilize the whole or any part of the completed COPS construction. After take over, the City may permit taps, may issue tap permits and may connect into the utilized COPS construction.

801.05 Maintenance of Flow. Where existing and/or active COPS are to be removed or in any way disturbed during construction, the Contractor shall maintain the flow in closed Conduits or by other means approved by the Engineer.

801.06 Unsuitable Foundation and Changes in Planned Grade. If material in the bottom of any excavation is unsuitable for the foundation, the Contractor shall excavate down to suitable material and shall refill the excavation back to the proper level as directed and approved by the Engineer.

When the flow line is changed less than 1 foot or when it becomes necessary to remove unsuitable material less than 1 foot in depth, the Work shall be part of and included within the contract Unit Price Bid for Item 810. When the flow line is lowered 1 foot or more or when it becomes necessary to remove unsuitable material 1 foot or more in depth, the compensation for the additional Work will be provided in accordance with 117.04.

801.07 Cold Weather Construction. No construction shall be placed on frozen ground or on ground containing frost.

801.08 Removal of Existing Pavements, Walks, Structures, Etc. Where it becomes necessary to remove items such as pavement, curb, walk, Structures, pipes, etc., within the limits of the trench, or to facilitate the construction of new items as provided in the Plans and proposal, the cost of such removal shall be included in the Bid price of the new items.

801.09 Tree Protection and Removal. Trees shall be protected from construction activities unless otherwise shown on the Plans. Tree removal, the whole or any part, shall be included in the Bid price of Item 810 or shall be part of the excavation procedures within any other item. Only those trees indicated on the Plans or approved by the Engineer may be removed. Any tree that has been removed without the Engineer's approval or that may have died due to the Contractor's operations shall be replaced by the Contractor at the contractors expense.

801.10 Buried Piping. Contractor shall provide all labor, Materials, Equipment and incidentals as shown, specified and required to install and test all buried piping, fittings, and appurtenances. The work includes, but is not limited to, the following:

(a) All types and sizes of buried piping, except those specified under other Items.

(b) Supports, restraints, and thrust blocks.

(c) Pipe encasements.

(d) Work on or affecting existing piping.

(e) Cleaning, disinfecting, and pressure testing.

(f) Installation of all jointing and gasketing Materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, and all other work required completing the buried piping installation.

(g) Incorporation of valves and special items shown or specified into the buried piping systems as required and as specified.

All buried piping installation shall comply with the applicable provisions and recommendations as shown or specified within the Plans approved by the Director.

801.11 Separation of Sewers and Potable Water Lines. Whenever possible, existing and proposed potable water mains and service lines and Sewers shall be separated horizontally by a clear distance of not less than 10 feet measured from outside of pipes. If local conditions preclude a clear horizontal a minimum separation 10 feet, the installation may be permitted provided that potable water main is in a separate trench and the Sewer is located so the bottom of the potable water main is at least 18 inches above the top of the Sewer.

801.12 Product Delivery, Storage, and Handling. The Contractor shall deliver, store, and handle Materials as follows:

(a) Materials shall be delivered to the site to ensure uninterrupted progress of the work. Materials received from factory shall be in the new undamaged condition. Materials cracked, gouged, chipped, dented or otherwise damaged will not be accepted and shall be removed from the site immediately at the Contractor's expense.

(b) Pipe and fittings, with concurrence of the Engineer, small and readily damaged areas may be repaired prior to installation.

(c) All pipe, fittings, specials and accessories shall be handled carefully with approved handling devices. Do not drop, roll or skid piping at any time.

(d) Pipe, fittings, and specials shall be unloaded opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Pipe interiors shall be kept completely free from dirt and foreign material.

(e) Covered storage shall be provided for all thermoplastic and ultraviolet sensitive piping and accessories.

(f) All gaskets, seals and other resilient Materials shall be stored in a protective environment in accordance with manufacturer's recommendations.

The Contractor shall schedule deliveries to accept during normal working hours. During the course of the Work, no more than three Days of pipeline construction shall be strung along the side of the road waiting to be installed.

801.13 Basis of Payment. Payment for various items in Item 801 is considered incidental to the contract and shall be included in the Contractor's Bid under subsequent items.

ITEM 802 TESTING

802.01 Description
802.02 Hydrostatic Pressure Test (Water Main)
802.03 Disinfecting (Water Main)
802.04 Preliminary Flushing and Final Flushing & Test (Water Main)
802.05 Infiltration Test (Sanitary Sewer)
802.06 Air Test for Sanitary Sewer Pipe
802.07 Vertical Deflection Test for Thermoplastic Pipe (Sanitary Sewer and Storm Sewer)
802.08 Vacuum Test for Sanitary Manholes
802.09 Repair of Failed Pipe Sections
802.10 Certification

802.01 Description. All newly constructed sanitary Sewer, water lines, force mains, trunk lines, manholes, laterals, and service connections shall be tested as directed by the Engineer.

No water service connection shall be made to the water main until the mainline has been tested for pressure, leakage and potability and released for taps.

802.02 Hydrostatic Pressure Test (Water Main). A hydro-static test as required in Section 4 of AWWA C600 shall be applied, as directed by the Engineer, to the whole or to individual valved off sections of the water mains and fire hydrant leads after all outlets, valves, tees, elbows, hydrants and other fittings and appurtenances have been properly plugged, restrained or blocked. The trench shall also be backfilled prior to hydrostatic testing but the Contractor may, with the approval of the Engineer, leave the joints uncovered for inspection during testing. The Contractor shall assume all risks associated therewith and shall repair any damage caused thereby at no additional cost to the City.

At the locations shown on the Plans or approved by the Engineer for ductile iron pipe, the City will install all taps and corporation stops to be used for testing and disinfecting, billable to the Contractor. At the locations shown on the Plans or approved by the Engineer for concrete pipe, the Contractor shall have the manufacturer install 1 inch NPT outlets. The Contractor shall coordinate the operation of main line valves by the City and the making of the taps for testing and disinfecting with the City. The Contractor shall furnish all labor, Materials, pumps, piping, gauges, connections, other Equipment and all necessary assistance for conducting the test(s).

At the completion of the pressure and leakage test and prior to the purity test, the Contractor shall remove all corporation stops on ductile iron pipe and

replace with brass plugs. The air release outlets on concrete pipe will also be plugged. The installed plugs shall be inspected by the City before the excavation is backfilled.

Pressure Test - Each valved section of pipe shall be slowly filled with water and all air expelled from the line. If permanent air vents are not located at all high points on ductile iron pipe, the Contractor shall request that the City install corporation stops at such points so the air can be expelled from the line.

The nominal test pressure for a test section shall be the larger of 150 pounds per square inch or 1.5 times the average of the working pressures at the points of highest and lowest elevations in the test section. The actual test pressure shall be the nominal test pressure corrected to the elevation of the test gauge, and this pressure shall be applied to the main for duration of at least one hour.

If there are indications of leaks under this pressure test, the Contractor shall locate them at no additional cost to the City. Any cracked or defective pipe, fittings, valves, joints, or other appurtenances discovered as a consequence of this pressure test shall be removed and replaced by the Contractor with approved material at no additional cost to the City, and the test shall be repeated until satisfactory to the Engineer.

Leakage Test - A leakage test shall be performed in accordance with AWWA C600, conducted at the same test pressure used above, again corrected to the elevation of the gauge. The leakage test shall be at least two hours in duration during which time the test pressure shall not vary by more than $\pm$ 5 pounds per square inch.

Leakage is defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 pounds per square inch of the specified test pressure after the pipe has been filled with water and the air expelled. No pipe installation will be accepted until or unless this leakage over a test duration of at least two hours is less than that allowed in AWWA C600. The nominal test pressure defined in these Specifications shall be used to determine allowed leakage.

Should any test of individual or combined sections of pipe disclose leakage greater than the specified limit, the Contractor shall, at no additional cost to the City, locate and repair the leaks until the leakage is within the specified allowance.

Any testing performed against existing valves shall be at the Contractor's risk and in strict compliance with the requirements of the Engineer.

If unable to achieve the required test results the Contractor shall disconnect from the existing valve, plug and re-test until satisfactory results are

obtained. Any damage caused to existing facilities shall be repaired at the Contractor's expense.

802.03 Disinfecting (Water Main). The water main shall be disinfected in accordance with AWWA C651. With the approval of the Engineer, the Contractor may use any method of disinfection described in AWWA C651. For convenience, the Contractor and the Inspector may utilize the pocket booklet "A Guide for the Installation of Ductile Iron Pipe" published by the Ductile Iron Pipe Research Association; however, in the case of disagreement the requirements of AWWA C651 or the decision of the Engineer shall govern.

All material and Equipment required for chlorination including sufficient tubing or pipe to extend outside the trench and an operable valve above ground level shall be furnished and paid for by the Contractor.

All valves and other appurtenances in the section of pipe under treatment shall be operated while the pipeline is filled with the chlorinated water.

802.04 Preliminary Flushing & Final Flushing and Test (Water Main).

Preliminary Flushing - When required, or desired by the Contractor with the approval of the Engineer, the completed water main shall be flushed to remove all fine loose particles of dust, dirt and other foreign material that were not removed during laying.

Flushing velocity of 2.5 feet per second shall be developed in all pipes unless the Engineer determines that conditions do not permit the required flow to be discharged to waste. In larger pipes (48 inches and above) an acceptable alternative to flushing is to broom sweep the main, carefully removing all sweepings prior to testing and disinfecting the main.

Final Flushing - Immediately following disinfection, all highly chlorinated water shall be thoroughly flushed from the newly laid pipe line at its extremities until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use. The highly chlorinated water shall be flushed to the nearest sanitary Sewer manhole or to a location as approved by the Engineer.

Potability Test - After the final flushing and before the water line is placed in service, one or more sets of two bacteriological samples, collected twenty-four hours apart, shall be taken and tested by the City in accordance with the procedures required by the Ohio EPA, and shall show the absence of coliform organisms. At least one set of samples shall be collected from each 1,500 lineal feet of new pipe and from every branch.

Should the initial treatment fail to produce satisfactory results, the disinfection and sampling procedures shall be repeated until satisfactory results are obtained.

802.05 Infiltration Test (Sanitary Sewer). The Engineer will establish when an infiltration test will be required. The infiltration test generally will be conducted on the portion of the sanitary Sewer collection system where the ground water table is above the elevation of the sanitary Sewer. Contractor must provide a means of monitoring the groundwater level while performing the Infiltration Test.

All pumping of ground water shall be discontinued for a period of twenty-four hours prior to testing. Plug the inlet to the test section to be tested. It is usually necessary to also plug the inlet of the upper manhole to prevent the manhole from filling with water or provide a method of de-watering the manhole or remotely removing the plug at the inlet to the test section. All lateral inlets to the line shall be plugged.

The flow at the outlet of the test section shall be measured to determine the infiltration rate. At the outlet of the test section, collect the quantity collected within a specific time. Collection and measurement shall be achieved with use of the plug having a pipe outlet and a calibrated container after constant flow is generated at the pipe outlet. The infiltration test shall also be made by installing a weir or other measuring device approved by the Engineer at the lower end of the sanitary Sewer section to be tested. The apex of the weir should be as near to the pipe invert as practical.

The allowable leakage for sanitary Sewers shall not exceed 50 gallons per Day per mile of pipe per inch of Sewer diameter. If the allowable infiltration rate is exceeded, the line is presumed to have failed the test. The Infiltration Test shall be performed in accordance with ASTM C1091.

All repairs, tests and retests shall be at the Contractor's expense using only Materials acceptable to the Engineer. Any damage caused to existing facilities shall be repaired at the Contractor's expense.

802.06 Air Test for Sanitary Sewer Pipe. This test method provides procedures for testing plastic, vitrified clay and concrete sanitary Sewer pipelines, using low-pressure air to prove the integrity of the installed material and the construction procedures. The time-pressure drop method shall be used. This test shall be performed on lines after all connections and services laterals have been plugged and braced adequately to withstand the test pressure, and after the trenches have been backfilled for a sufficient time to generate a significant portion of the ultimate trench load on the pipe line. This test may also be used as a preliminary test, which enables the installer to show

the condition of the buried line prior to final backfilling, paving, and other construction activities.

For safety:

(a) No one shall be permitted in the manholes during testing.

(b) Air supplies and pressure gages shall be extended with hoses to allow air pressure control and pressure observations from outside of manhole.

(c) All plugs shall be installed securely.

(d) When lines are to be tested, it may be necessary that the plugs be braced as an added safety factor.

(e) Do not over pressure lines.

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 pounds per square inch gauge or 4.0 pounds per square inch gauge greater than the average back pressure of any ground water above the pipe, but not greater than 9.0 pounds per square inch gauge. After a constant pressure of 4.0 pounds per square inch gauge is reached, the air supply shall be throttled to maintain the internal pressure for at least two minutes. This will allow for the temperature of the entering air to equalize with the temperature of the pipe wall. When temperatures have been equalized and the pressure stabilized at 4.0 pounds per square inch gauge, the air hose from the control panel to the air supply shall be cut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 pounds per square inch gauge.

At a reading of 3.5 pounds per square inch gauge, or any convenient observed pressure reading between 3.5 pounds per square inch gauge and 4.0 pounds per square inch gauge, timing shall commence using an accurate timing device. If the time shown in the following table for the designated pipe size and length elapses before the air pressure drops 1.0 pound per square inch gauge, the section undergoing test shall have passed and shall be assumed to be free of defects.

If the pressure drop is more than 1.0 pound per square inch gauge during the test time, the line is presumed to have failed the test. If the line fails the test, segmental testing may be utilized solely to determine the location of the leaks, if any, but not for the acceptance test as required by 802.06.

All repairs, tests and retests shall be at the Contractor’s expense using only Materials acceptable to the Engineer. Any damage caused to existing facilities shall be repaired at the Contractor's expense.

Air test shall be performed in accordance to applicable test standards as follows:

Vitrified Pipe, ASTM C828

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES(MINUTES:SECONDS)

Nominal Pipe Size inches	T (time), minutes/100 feet
8	1:20
10	1:50
12	1:80
15	2:10
18	2:40
21	3:00
24	3:60

Plastic Pipe, ASTM F1417

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 POUND PER SQUARE INCH GAUGE PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015 CFM/SF

Pipe Diameter inches	Minimum Time (minutes:seconds)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	199	3.418L
15	14:10	159	5.342L
18	17:00	133	7.692L
21	19:50	114	10.470L
24	22:40	99	13.674L
27	25:30	88	17.306L
30	28:20	80	21.366L
33	31:10	72	25.852L
36	34:00	66	30.768L

Concrete Pipe, ASTM C924

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES, (MINUTES:SECONDS)

Nominal Pipe Size inches	T (time), minutes/100 feet
8	1:20
10	1:50
12	1:80
15	2:10
18	2:40
21	3:00
24	3:60

802.07 Vertical Deflection Test for Plastic Pipe (Sanitary Sewer and Storm Sewer). After completion of backfill to final grade and at least thirty Days after installation, a Mandrel Test shall be completed. Mandrel shall be hand-pulled. No mechanical devices are to be used. Mandrel shall be sized so that if vertical deflection of pipe exceeds five percent; it will stop.

Mandrel: The "go-no-go" mandrel shall have a minimum of nine evenly spaced blades and shall permit five percent or less deflection in the installed pipe. Dimensions for the mandrels are listed below:

MANDREL DIAMETER ALLOWING 5 PERCENT DEFLECTION

Pipe Dia. inches	PVC SDR 35& ASTMF1803 inches	PVC SDR 26 inches	PVC F949	Length inches
8	7.496	7.114	7.27	8
10	9.371	8.875	9.07	10
12	11.150	10.547	10.77	12
15	13.655	12.896	13.17	15
18	16.694	-	16.11	18
24	22.258	-		24
30	27.939	-		30
36	33.625	-		36
42	39.306	-		42
48	44.992	-		48

All repairs, tests and retests shall be at the Contractor's expense using only Materials acceptable to the Engineer. Any damage caused to existing facilities shall be repaired at the Contractor's expense.

802.08 Vacuum Test For Sanitary Manholes. This test method covers procedures for testing concrete manholes when using the vacuum test method to demonstrate the integrity of the installed Materials and the construction procedures. This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints. All sanitary manholes shall be free of visible leakage. All leaks shall be repaired in a manner subject to the Engineer's approval.

Each sanitary manhole shall be tested in the following manner:

(a) All pipe connections to the manhole shall be plugged and braced as required.

(b) The surface seal of the test Equipment shall be configured such that the integrity of the seal is included in the test.

(c) The Contractor shall provide and install manhole vacuum test and Equipment and conduct testing in the presence of the Engineer.

(d) A vacuum of 10 inches of mercury shall be applied to each manhole, the pump shut off and valves of vacuum lines closed.

(e) The manhole shall pass the test if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the following values.

The Vacuum Test for Sanitary Manholes shall be performed in accordance with ASTM C1244.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS IN SECONDS

Depth (feet)	48-inch	54-inch	60-inch	66-inch	72-inch
8	20	23	26	29	33
10	25	29	33	36	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	67
18	45	52	59	65	73
20	50	53	65	72	81

If the manhole fails to pass the initial test the Contractor shall repair the manhole. Retesting shall be performed and repairs made until a satisfactory test is obtained. All repairs, tests and retests shall be at the Contractor's expense

using only Materials acceptable to the Engineer. Any damage caused to existing facilities shall be repaired at the Contractor's expense.

802.09 Repair of Failed Pipe Sections. Failed tests may require the Contractor to remove and replace, at no extra cost to the City, all sections of pipe which may have failed any of the tests specified in this 802.09.

The pipe shall be overhauled and if necessary re-laid until it passes the required test.

In-kind Materials shall be used when making repairs. Solid sleeves shall be used when repairing water mains.

The Contractor shall furnish all Materials for making the repair and retest in accordance to the Specifications.

802.10 Certification. When required by the Engineer, the Contractor shall furnish an affidavit from each material manufacturer certifying that all the required tests have been made and that the pipe and fittings comply with the requirements specified.

ITEM 810 EXCAVATION AND BACKFILL FOR CITY OWNED PIPING SYSTEMS

810.01 Description
810.02 Materials
810.03 Excavation
810.04 Trench Protection Systems
810.05 Disposal of Water from Excavations
810.06 Locating Underground Utilities
810.07 Bedding and Compaction
810.08 Backfill and Compaction
810.09 Settlement Guarantee
810.10 Street Cut Permit
810.11 Method of Measurement
810.12 Basis of Payment

810.01 Description. Excavation and Backfill for City Owned Piping Systems (COPS) shall be all the excavation, disposal of the excavated material (if necessary), replacement of the disposed excavated material, and related or other necessary Work, except Rock Excavation as defined in 811.01.

The excavation will generally be earth excavation and include: trench and other nearby excavation, earth excavation removal (if necessary) and removal of the obstructions and Structures within the vicinity of the trench and/or restoration of the disturbed areas. When no other excavation or similar item, in part or in whole, is included in the estimated quantities and Proposal, all excavation and backfill Work, except rock excavation, shall be included within this item and the cost shall be equally distributed throughout this item, unless specifically ordered otherwise by the Engineer.

This item shall cover the labor, Materials and incidentals necessary for excavation and backfill as shown on the Plans, specified or ordered by the Engineer.

Excavation, other than rock, shall include:

(a) The loosening, loading, removing and transporting of all Materials whether wet or dry, of every name and nature, and all seen and unforeseen obstacles necessary to be removed for any and all purposes essential to the construction and completion of all (COPS) Work under this contract.

(b) Any suitable and necessary protection. Excavation shall also include the transporting and disposing of all excess excavated Materials and other surplus Materials from the site of the job.

(c) The removal and disposal of paved and concrete surfaces of any type when necessary for the construction of COPS and related Structures or when necessary to construct new items either shown on the Plans or included in the Proposal.

(d) The removal and disposal of old manholes, old catch basins, old Sewers and pipelines that are in the way of the new Work and shall be subject to the salvaging provisions. Sewage lines less than 6 inches in diameter are to be plugged within this Work.

(e) The removal and disposal of trees, where necessary for Sewer construction; however, before any tree is removed, permission must first be obtained from the Engineer.

810.02 Materials. The Materials used shall be as follows:

General: All fill Materials shall be free of toxic contaminants. All fill material shall be approved by the Engineer and as shown on the approved Plans.

Structural Backfill: Structural backfill shall be placed where shown or specified below and around Structures, roads, walks, driveways, in the public right-of-way, etc. Structural backfill shall meet the requirements for Item 813.

Backfill and Fill Materials: Provide approved soil Materials for backfill and fill, free of clay lumps, rock or gravel larger than 6 inches in any dimension, debris, waste, frozen Materials, vegetation and other deleterious matter.

Pipe Bedding Materials: Pipe shall be bedded with one hundred percent crushed stone meeting the gradation requirements of ODOT Table 703.01-1 (AASHTO M43). Pipe bedding Materials for pipe sizes less than 15 inches will be an AASHTO M43 Size No. 8. Pipe bedding Materials for pipe sizes 15 inches and greater will be an AASHTO M43 Size No. 57 or No. 67.

810.03 Excavation. Excavation, other than rock excavation, shall be restricted to the limits as described below:

The excavation shall be according to the plan and grade as shown on the approved Plans, as described in the Specifications or proposal, or as ordered by the Engineer.

Each side of the excavation shall be at least 4 inches beyond the extremities of the Conduit, Structure, or appurtenance (unless otherwise noted). When possible, the sides shall be vertical for the full depth of the Conduit or Structure.

The width of the excavation at the top of the Conduit or Structure shall not exceed 9 inches beyond the prolongation of the Conduit extremities. The Engineer may allow wider widths for trench protection systems or other reasonable purposes.

Rock and boulders, which cannot be paid for as rock excavation, shall be removed to at least 4 inches beyond the Conduit or Structure surface. The void caused by the removal of the above rock shall be replaced with approved material. The approved material shall be Item 813 and shall be considered the same for pay purposes unless designated or ordered otherwise.

Dry trench conditions shall be maintained until joining and backfilling are completed and protected. Pipe, valves, and all fittings shall be kept clean. Pipe shall be placed only in a dry trench and if water should accumulate in the trench, a temporary plug at the end of the pipe shall remain in place until the trench is pumped dry.

For excavation beyond the limits as specified herein, there will be no payment for the excess removal or payment for the excess material replaced, and the Materials used for restoration shall meet the standards as provided in the general subject area, Item 801.

Where unstable material is encountered within and beyond plan grade and side limitations, the unstable material shall be removed as directed by the Engineer. Compensation shall be as set forth in 801.06.

Existing house connections, sanitary Sewer, storm Sewer, water mains, gas mains, Conduit lines, drain pipes and other utilities shall be supported across trenches until backfill is completed.

Excavated Materials shall be promptly removed and disposed of in accordance to Federal, State and Local laws when the Materials are not suitable for backfill or when due to the location of the Work on main thoroughfares or in congested areas, there is not sufficient room to permit the storing of the excavated Materials.

When the storing of the excavated material is permitted at the site of the Work, the same shall be piled to prevent the dirt from spreading over the pavement to the Engineer's satisfaction. Adequate barricading and lighting shall be provided.

No opening shall be made before all Materials, parts and special fittings necessary to complete the Work are on hand and available. No opening shall be kept open longer than is necessary to properly execute the Work for which the opening is made.

In the area of construction, ingress and egress shall be provided by the Contractor to all properties along the way. If it becomes necessary to block walks or driveways, the Contractor shall provide, at no additional cost to the City, suitable temporary runarounds, bridging or other means of ingress and egress to the properties affected.

The Contractor shall comply at all times with the requirements of the traffic control plan as shown on the approved Plans. Access to fire hydrants must be provided and no dirt or material shall be piled within 10 feet of a hydrant.

The Contractor shall provide during construction an effective means of keeping down the dust to the satisfaction of the Engineer and in accordance with applicable dust control measures contained within these Specifications.

Mud tracked onto paved areas outside of the excavation zone shall be prevented. Any tracked mud shall be promptly cleaned up. Streets within the construction area shall be swept clean at the end of the workday or as approved by the Engineer.

Fuel, oils or other spills shall be promptly contained and cleaned up.

For excavations that are near or cross waterways, soil erosion control measures shall be put in place as shown on the approved construction Plans, as approved by the Engineer, and as may be required from any applicable permit(s).

810.04 Trench Protection Systems. The Contractor shall furnish, put in place and maintain an adequate protection system to prevent cave-ins designed in accordance with OSHA Standards. Other safety measures as required by OSHA 1926 shall be observed and practiced.

Protection system options include utilizing a trench box, proper sloping, shoring or sheeting. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer that is hired by the Contractor. Prior to the start of the excavation, the Contractor may be required to submit to the Engineer an excavation plan to demonstrate compliance with OSHA Standard 29 CFR Part 1926.650.

If at any time the City so orders, the Contractor shall install additional protection, but compliance with such orders or failure on the part of the City to exercise its right to give such order shall in no way release the Contractor from liability for damage caused by weak or insufficient protection nor from his responsibility to protect the Work, all Persons, and/or property.

810.05 Disposal of Water from Excavations. The Contractor, at its own expense and at all times during the progress of the Work, shall do all

pumping, draining, bailing or other Work necessary to keep the trenches and excavations free from water. Water from the trenches and excavations shall be disposed of in such a manner as will neither cause injury to the public, nor damage to public or private property, to the Work completed or in progress, to the surface of the streets, nor cause any interference with the use of adjacent property and meet all local, State, and federal requirements for water disposal.

810.06 Locating Underground Utilities. The Contractor shall contact OUPS, utility companies and property Owners to request that all underground utilities are located prior to any excavations.

A forty-eight hour notice must be given. Within the City of Dayton corporation limits, Sewer laterals are considered privately owned and will not be marked by the City.

The information on the Plans is believed to be correct. All underground utilities and Structures shown on the Plans were obtained from survey and available records.

However, the Owner does not assume responsibility for any such utilities or Structures not shown nor for incorrect location and depth. The Contractor shall view the job site and make an independent examination of the Project site for soil conditions, locations and depths of utilities and underground Structures. The Contractor shall uncover and determine the exact location of any utility or Structure that the COPS line crosses, at least 200 feet ahead of construction to permit adjustments in line and grade, if necessary, without undue complications and to provide the necessary protection during construction. The excavating and backfilling cost for exposing and locating the utilities shall be included in the Unit Price Bid for excavation and backfill of the pipe.

Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult piping or utility Owner and Engineer immediately for directions to proceed.

810.07 Bedding and Compaction. Pipe bedding shall be as defined on the approved Plans and 810.02. Payment for bedding shall be included in the Unit Price for Item 810. After preparation of the trench bottom, a pipe bed shall be prepared using one hundred percent crushed stone.

The bedding material shall be spread with the full width of the trench bottom and thoroughly compacted by hand tampering up to the spring line of the pipe in layers not to exceed 3 inches.

The bedding material shall be so placed as to fill the space under the lower part of the pipe by slicing under the haunches with a shovel.

One hundred percent crushed stone shall be placed to a level 6 inches below and 6 inches above the pipe.

810.08 Backfill and Compaction. When native material backfilling is permitted outside of the public Right-of-Way, the excavated backfill material shall be reasonably free of rubbish, muck, unsuitable material, lumps and frozen parts and meet the requirements of 810.02.

When working in the public Right-of-Way, structural backfill is required. Structural backfill above the bedding shall be mechanically compacted in horizontal lifts not exceeding 12 inches in thickness using vibratory compactors and rollers. Mechanical compaction cannot be initiated over vitrified clay pipe until 5 feet of fill has been placed over the pipe. Within the public right-of-way the structural backfill shall be compacted to ninety percent maximum density (Modified Proctor test ASTM D1557) or a seventy percent relative density (ASTM D4253 or D4254). The relative density test is to be used for Materials containing over thirty percent by mass retained on a 3/4 inch sieve.

Do not place or compact fill in a frozen condition or on top of frozen material.

In any of the methods used, the backfill shall remain the total responsibility of the Contractor for the life of the contract and Guarantee periods.

As the Work progresses, the Contractor shall remove and dispose of all surplus material, including material unsuitable for backfill.

810.09 Settlement Guarantee. Bedding and backfilling Specifications are intended to reduce settlement to a minimum amount consistent with economy. It is expected that some settlement may occur and the Contractor's responsibility for repair of such settlement shall continue for a period of one year from the date of acceptance of the Work.

The Contractor shall repair, at its own expense, such settlement that is deemed excessive by the Engineer. The Contractor shall make all repairs and replacements necessary within thirty Days after notice from the Engineer.

810.10 Street Cut Permit. A City of Dayton street cut permit must be obtained from the City Engineer’s office for any excavation Work in the public Right-of-Way.

810.11 Method of Measurement. The excavation, bedding, and backfill to be paid for will be the actual number of linear feet completed and measured horizontally along the centerline of the pipe alignment.

The measurement of the excavation, bedding, and backfill shall be taken through Conduits, valves, manholes, other similar Structures, specials and other like construction. Measurements shall be taken to centerline intersections.

At connection locations as set forth in Item 834 the measurement shall be taken to the nearest inside face or edge of the Conduit or Structure. Measurements shall extend to the termini of the actual Conduits or centerline. The interior widths of Structures included in Item 832 and the length of tunneling included in Item 812 will be deducted from the gross length of excavation and backfill measured.

The excavation, bedding, and backfill for lateral storm Sewer lines between manholes, catch basins or trunk lines shall be measured horizontally along the centerline from inside face to inside face or edge of the Conduits or Structures.

The depth of excavation, bedding, and backfill shall be defined as the measurement from the ground or pavement surface to the bottom surface of the bedding or Structure (if no bedding is required).

810.12 Basis of Payment. Payment shall be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
810	Linear foot	Excavation and backfill for_____" pipe with native material
810	Linear foot	Excavation and backfill for_____" pipe with structural backfill
810	Linear foot	Excavation and backfill for___" (box, elliptical pipe etc. with or without structural backfill)
810	Lump Sum	Street cut permit

The depth measurement shall be subject to 801.06.

ITEM 811 ROCK EXCAVATION FOR CITY OWNED PIPING SYSTEMS

811.01 Definition
811.02 Description
811.03 Limits of Rock Excavation
811.04 Method of Measurement
811.05 Basis of Payment

811.01 Definition. Rock excavation shall be the excavation and removal of the following:

(a) Sandstone, limestone, flint, granite, quartzite, slate, hard shale, or similar material which cannot be removed by normal excavation Equipment, such as a back-hoe or hydraulic excavator, and which requires for its removal, drilling, wedging, sledging or boring.

(b) Material masses or pieces of rock over 1 cubic yard in size. Where rock is in layers and where seams of rock are encountered in two or more ledges, each ledge being not less than 3 inches thick and with underlying strata of earth, clay, or gravel not more than 12 inches thick in each stratum, the entire volume between the top of the top of ledge and the bottom of the bottom ledge will be classified as rock.

811.02 Description. This item shall cover the labor, Materials and incidentals necessary for rock excavation as shown on the Plans, specified or ordered by the Engineer.

811.03 Limits of Rock Excavation. Rock excavation shall be restricted to the limits as described below:

(a) Monolithic concrete Structures or Conduit. The limits of rock excavation shall be between the vertical planes projected up from the extremities of the monolithic concrete surfaces. The bottom of the rock excavation shall be the exterior surface of the monolithic concrete surface as shown on the approved Plans or as described in the Specifications or proposal.

(b) Other type Structure or Conduit. The limits of rock excavation shall be between the vertical planes projected up from at least more than 4 inches and less than 9 inches beyond the extremities of the other type Structure or Conduit surfaces. The bottom of the rock excavation shall

be a horizontal plane at least 4 inches and less than 6 inches below the bottom of the Structure or Conduit surface.

For excavation of rock beyond the limits as specified herein, there will be no payment for the excess removal nor payment for the excess material replaced, and the Materials used for restoration shall meet the standards as provided in the general subject area Item 801.

811.04 Method of Measurement. The rock to be paid for shall be the actual volume of rock excavated, but shall not include the excess beyond the limits as described above (or defined on the approved construction plans). The measurement shall be made after removal.

811.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per cubic yard, measured as provided above, and under the following:

Item	Unit	Description
811	Cubic yard	Rock excavation

Where rock is encountered in the prosecution of the contract and no rock item is listed in the Proposal, the volume of rock excavation will be paid in accordance with the provisions of 117.10.

ITEM 812 TUNNELING

812.01 Description
812.02 Definition
812.03 Requirements
812.04 Materials
812.05 Filling Annular Voids
812.06 Method of Mining Tunnel
812.07 Construction
812.08 Method of Measurement
812.09 Basis of Payment

812.01 Description. This item shall cover the installation of casing pipe and tunnel liners when excavation from the surface is not feasible, and will be performed only when shown on the Plans. Contractor shall provide all labor, Materials, Equipment, supervision, and incidentals required to excavate, dewater, protect existing Structures and furnish and install casing pipe and tunnel liners as shown on the approved construction Plans. Also included is the provision of pipe support Structures, grout, construction bulkheads, and the disposal of waste material.

812.02 Definition. Tunneling shall be boring, jacking or any other safe procedure used to install a tunnel liner or casing pipe.

812.03 Requirements. The furnishing and laying of the casing pipe shall conform to the requirements and regulations of the appropriate agency, utility and the City of Dayton. The Contractor shall prepare necessary shop Drawings, working schedule, description of type of Materials and methods of construction.

The Contractor shall, before commencing Work on the encasement, present evidence to prove to the satisfaction of the Engineer previous experience in tunneling or boring through ground similar to that found on the Project, or shall employ a Superintendent able to furnish such evidence and shall keep such a supervisor continuously employed until the tunnel Work is completed.

The tunnel liner or casing pipe shall provide strength commensurate for the tunnel diameter; depth of cover and all loads imposed during construction and the service life in accordance with the design requirements of AASHTO and AREA.

The Contractor shall notify the appropriate agency or utility at least two working Days in advance of commencing any construction Work on the

encasement. The Contractor shall be wholly responsible for designing, installing and operating the jacking, boring, or tunneling system Contractor selects to accomplish all operations.

The Contractor shall be responsible for costs that may result due to the agency or utility requirements relative to the furnishing of watchpersons, Inspectors and supervision by their forces.

Sizing of casing pipe shall be a minimum of 6 inches larger than the bell and retainer ring of the carrier pipe.

812.04 Materials. Materials for the casing pipe or tunnel liner shall be as specified below. Annular space between the liner and carrier pipe shall be grouted and consist of one part portland cement and eight parts grout sand (Material 701.04 and 703.03).

Steel Casing Pipe – Steel casing pipe shall be steel pipe meeting ASTM A139 Grade B and shall be installed within the limits and at the location shown on the Plans. Steel casing pipe shall have a minimum wall thickness of 0.50 inches unless otherwise approved by the Engineer.

Reinforced Concrete Casing Pipe – Reinforced concrete casing pipe shall be Culvert pipe meeting the requirements of ASTM C76 of the class shown on the Plans.

Tunnel Liner Plates – Tunnel liner plates shall be steel plates meeting ASTM specification A1011. Liner Plates shall be designed in accordance with AASHTO "Design Specifications for Tunnel Liner Plates", Section 16. If specified, bituminous coating material shall conform to AASHTO Designation M190.

If specified, Aluminized steel shall be coated in accordance with AASHTO M274. When galvanized plates are specified, the tunnel liner plates shall be zinc coated in accordance with ASTM A123, except with a minimum of 2 ounces per square foot.

Nuts and bolts shall be as recommended by the manufacturer. All bolts and nuts shall be galvanized per ASTM B695, Class 50.

812.05 Filling Annular Voids. Any space existing outside the tunnel liner plates shall be grouted at low pressure through grout holes provided. These holes shall be installed in suitable locations so that grouting can be completed effectively. The pressure grouting shall preferably begin at the lowest middle hole of each grout section, grout holes above being open, and proceed upward progressively and simultaneously on both sides of the tunnel. Grouting shall be

done as near the end of the lined tunnel as practicable and, if deemed necessary by the Engineer, grout stops shall be placed behind the sections at or near the end of the erected lining to permit grouting to or near the end.

812.06 Method of Mining Tunnel. All shoring, blocking or other special supports required to maintain uninterrupted service together with all watchpersons, flaggers, and supervision of Work by a representative of the respective company, if required, and all other costs incidental to the Work along or across the Right-of-Way shall be provided by the Contractor at no additional cost to the City.

Mining shall be carefully done to avoid loss of ground. In unstable ground the face of the tunnel shall be supported by means of breast boards installed in any approved manner, said breast boards removed individually and advanced as the face of the heading is mined down and the casing pipe installed.

Where the ground will not remain in place long enough to excavate space for a casing pipe and when approved by the Engineer, steel poling plates, wood spilling boards, or a shield shall be used to support the ground while installing the casing pipe.

The actual method of Work proposed by the Contractor shall be subject to approval of the Engineer. Such approval, however, shall not relieve the Contractor of responsibility for the safe and rapid prosecution of the Work.

812.07 Construction. Any pit necessary in the performance of this item shall be located as directed by the Engineer and adequately sheeted to protect the Work, all Persons and adjacent property.

The tunnel or tube shall be installed on a line and grade that will permit the installation of the utility therein to the line and grade as shown on the plan. Sufficient deviation from line or grade, in the opinion of the Engineer, shall be justification for disapproving the installation.

If at any time the City so orders, the Contractor shall provide additional shields, headers or stabilization of the tunnel face to prevent settlement or damage to the area above the tunnel. Compliance with such orders or failure of the City to issue such orders shall in no way release the Contractor from his liability for damages nor from his responsibility for protecting the Work and adjacent property.

The tunnel bottom shall be prepared with rails, concrete or other suitable means to insure a smooth surface on which to install the pipe. Pipe installation through the tunnel or tube shall be performed in a manner to insure against damage to the pipe and Guarantee a satisfactory pipe line.

Backfilling shall fill the void surrounding the pipe within the tunnel liner and all voids outside the tunnel linear. Backfill material, unless indicated otherwise on the Plans, shall be the 1:8 concrete grout mixed to a consistency that will permit pumping into the various voids. The backfill shall be placed to the satisfaction of the Engineer.

812.08 Method of Measurement. The tunneling to be paid for will be the actual number of linear feet of tunnel in place, measured along the centerline.

812.09 Basis of Payment. Payment shall be made at the Unit Price bid per linear foot which price shall include the furnishing and placing of the casing pipe or liner plates, together with all excavating, jacking, boring, pumping, tunnel plugging, grouting, compacted granular backfill, concrete supports, pits and openings, furnishing of all signalers and Inspectors, together with all labor, tools, material, Equipment and appurtenances required to complete the encasement in good and acceptable condition.

Payment does not include the furnishing and installation of the carrier pipe or rock excavation as defined in Item 811.

Payment will be made at contract price for:

Item	Unit	Description
812	Linear foot	Tunneling

ITEM 813 STRUCTURAL BACKFILL

813.01 Description
813.02 Material
813.03 Method of Measurement
813.04 Basis of Payment

813.01 Description. Structural Backfill shall be furnished by the Contractor when shown on the Plans, included in the specification or Proposal, or directed by the Engineer. Structural Backfill shall also include the hauling, depositing, compacting and shaping of the material.

813.02 Material. Structural Backfill shall be ODOT Item 304 or 411**.** The material shall contain no frozen lumps, clay lumps or organic matter.

813.03 Method of Measurement. The quantity to be paid for shall be the actual number of cubic yards of fill furnished and placed. The quantity shall be determined by slips for each load, signed by the Contractor's foreman, and turned into the Engineer each Day. If the quantity as shown on the slips is measured by weight, 4,000 pounds of fill shall be equal to 1 cubic yard. The total quantity of material furnished shall be computed from the slips.

813.04 Basis of Payment. Payment shall be made at the contract Unit Price bid per cubic yard, measured as provided above, and under the following:

Item	Unit	Description
813	Cubic yard	Structural backfill

No separate payment shall be made for structural backfill unless payment is specifically directed by plan Specifications or notes, the proposal or the Engineer. Unless stated otherwise, payment for structural backfill shall be included in the per linear foot price bid for Item 802.

ITEM 820 VITRIFIED CLAY PIPE

820.01 Definition
820.02 Description
820.03 Material
820.04 Pipe Installation
820.05 Joints
820.06 Lateral Connections
820.07 Method of Measurement
820.08 Basis of Payment

820.01 Definition. Vitrified clay pipe shall be designated and classified as follows:

Vitrified Clay Pipe (Extra Strength) ASTM C700 as Item 820.

820.02 Description. This item shall cover the labor, Materials and incidentals necessary for the installation of vitrified clay pipe as shown on the Plans or as required by the Engineer which shall include the furnishing of the pipe, and pipe specials; handling, storing, distributing and installing the Sewer ready for testing; the furnishing of all testing Materials, testing the Sewers for tightness and remedying all defects. Each section of vitrified clay pipe and fittings shall have clearly marked on it the name or trademark of the manufacturer, date of manufacture, ASTM designation, size, class, and load rating.

820.03 Material. Vitrified clay pipe and fittings shall conform to the ASTM C700.

Pipe tests shall conform to the requirements of ASTM C301.

Other material Specifications will be found elsewhere within these Specifications.

820.04 Pipe Installation. The pipe shall be backfilled in accordance with Item 810. The material, on which the pipe lays, shall be firm and shall be so formed as to prevent any subsequent settlement or movement of the pipe.

The lower portion of the pipe shall be in contact with the shaped bedding throughout its full length.

All pipes shall be laid starting at the lower end, with the spigot or tongue ends downgrade from the bell or groove ends. The pipes shall be laid true to line and grade and their ends fully entered so their inner surfaces are reasonably flush, even and form a smooth and uniform invert.

Line and grade shall be set using a laser level unless otherwise approved by the Engineer.

At the close of each Day's Work, and at such other times when pipe is not being laid, the end of the pipe shall be protected with a close fitting stopper.

Following installation, the pipe is to be tested in accordance with Item 802.

820.05 Joints.

(a) Vitrified clay pipe shall be manufactured with a factory fabricated compression type joint in accordance with the requirements of ASTM C425.

(b) Material and test requirements of the resilient joint shall be in accordance with the requirements of ASTM C425.

(c) Provide adapters approved by the Engineer to transition to another type of pipe, manhole or Structure. All adapters must be specifically manufactured for the type of joint being performed.

820.06 Lateral Connections. Lateral connections may only be made using a manufactured vitrified clay wye fitting.

820.07 Method of Measurement. The pipe to be paid for will be the actual number of linear feet of completed pipe (in place) measured horizontally along the Sewer centerline.

The measurement of the pipe shall be taken through tunnels, manholes, other similar Structures, specials and other like construction.

Measurements shall be taken to centerline intersections. At connection locations as set forth in Item 834, the measurement shall be taken to the nearest inside face or edge of the Conduit or Structure. Measurements shall extend to the termini of the actual Conduits. The interior widths of Structures included in Item 832, will be deducted from the gross length of the measured Sewer.

When shown on the Plans or ordered by the Engineer, specials, i.e., wyes, tees, elbows, etc., shall be incorporated in the linear measurement of the Conduit.

820.08 Basis of Payment. Payment shall be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
820	Linear foot	Vitrified Clay ___" Pipe

Excavation and related Work shall be paid for under their appropriate items, Item 810 to Item 814 inclusive. When shown on the Plans or ordered by the Engineer, specials, i.e., wyes, tees, elbows, etc., and their inherent additional cost shall be incorporated in and made part of the Unit Price bid for the pipe.

ITEM 821 REINFORCED CONCRETE PIPE

821.01 Definition
821.02 Description
821.03 Material
821.04 Pipe Installation
821.05 Joints
821.06 Lateral Connections
821.07 Method of Measurement
821.08 Basis of Payment

821.01 Definition. Reinforced concrete pipe shall be designated and classified as follows:

Reinforced Concrete Pipe (Class I) ASTM C76 as Item 813 Reinforced Concrete Pipe (1)

Reinforced Concrete Pipe (Class II) ASTM C76 as Item 813 Reinforced Concrete Pipe (2)

Reinforced Concrete Pipe (Class III) ASTM C76 as Item 813 Reinforced Concrete Pipe (3)

Reinforced Concrete Pipe (Class IV) ASTM C76 as Item 813 Reinforced Concrete Pipe (4)

Reinforced Concrete Pipe (Class V) ASTM C76 as Item 813 Reinforced Concrete Pipe (5)

821.02 Description. This item shall cover the labor, Materials, and incidentals necessary for the installation of reinforced concrete pipe as shown on the Plans or as required by the Engineer and shall include the furnishing of the pipe, pipe specials, cement, sand and water; handling, storing, distributing and installing the Sewer ready for testing; the furnishing of all testing Materials, testing the Sewers for tightness and remedying all defects. The pipe shall be installed according to the type of reinforced concrete pipe shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

821.03 Material. Reinforced concrete pipe shall conform to ASTM C76

821.04 Pipe Installation. The pipe shall be backfilled in accordance with Item 810. The material, on which the pipe lays, shall be firm and shall be so formed as to prevent any subsequent settlement or movement of the pipe. The lower portion of the pipe shall be in contact with the shaped bedding throughout its full length.

All pipes shall be laid starting at the lower end, with the spigot or tongue ends downgrade from the bell or groove ends. The pipes shall be laid true to line and grade and their ends fully entered so their inner surfaces are reasonably flush, even and form a smooth and uniform invert.

Line and grade shall be set using a laser level unless otherwise approved by the Engineer.

At the close of each Day's Work, and at such other times when pipe is not being laid, the end of the pipe shall be protected with a close fitting stopper.

Following installation the sanitary Sewer is to be tested in accordance with Item 802.

821.05 Joints. Joints shall be according to designation storm or sanitary.

(a) Storm Sewer Joints are to be filled with approved bituminous joint filler or cement mortar. The mortar shall be composed of one part Portland cement and two parts sand (701.04 and 703.03). When specified, the storm Sewer joint shall be the rubber gasket type meeting the requirements of ASTM C443.

(b) Sanitary Sewer Joints. On Sewers of 54 inch diameter or smaller, the joint shall be the rubber gasket type meeting the requirements of ASTM C361. For Sewers over 54 inches in diameter, the joint shall be the rubber gasket type meeting the requirements of ASTM C443.

821.06 Lateral Connections. Lateral connections to concrete pipe must be made in neatly cored holes and joined with rubber seals and stainless steel banding. Connectors shall meet ASTM C923 such as NPC Kor-N-Tee or Approved Equal.

821.07 Method of Measurement. The pipe measurement shall meet the requirements as set forth in 820.07.

821.08 Basis of Payment. Payment shall be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
821	Linear foot	Reinf. concrete pipe (1) __" (sanitary or storm)
821	Linear foot	Reinf. concrete pipe (2) __" (sanitary or storm)
821	Linear foot	Reinf. concretepPipe (3) __" (sanitary or storm)
821	Linear foot	Reinf. concrete pipe (4) __" (sanitary or storm)
821	Linear foot	Reinf. concrete pipe (5) __" (sanitary or storm)

Excavation and related Work will be paid for under their appropriate items, Items 810 to Item 814, inclusive. When shown on the Plans or ordered by the Engineer, specials, i.e., wyes, tees, elbows, etc., and their inherent additional cost shall be incorporated in and made part of the Unit Price bid for the pipe.

ITEM 822 REINFORCED CONCRETE ELLIPTICAL PIPE

821.01 Definition
821.02 Description
821.03 Material
821.04 Pipe Installation
821.05 Joints
821.06 Lateral Connections
821.07 Method of Measurement
821.08 Basis of Payment

822.01 Definition. Reinforced concrete elliptical pipe shall be designated and classified as follows:

Reinforced Concrete Elliptical Pipe (Class HE-II) ASTM C507 as Item 822 Concrete Elliptical Pipe (2)

Reinforced Concrete Elliptical Pipe (Class HE-III) ASTM C507 as Item 822 Concrete Elliptical Pipe (3)

Reinforced Concrete Elliptical Pipe (Class HE-IV) ASTM C507 as Item 822 Concrete Elliptical Pipe (4)

822.02 Description. This item shall cover the labor, Materials and incidentals necessary for the installation of reinforced concrete elliptical pipe as shown on the Plans or as required by the Engineer and shall include the furnishing of the pipe, pipe specials, cement, sand and water; handling, storing, distributing and installing the Sewer ready for testing; the furnishing of all testing Materials, testing the Sewers for tightness and remedying all defects. The pipe shall be installed according to the type of reinforced concrete elliptical pipe shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

822.03 Material. Reinforced concrete elliptical pipe shall conform to ASTM C507, except Table II. Other material Specifications will be found elsewhere within these Specifications.

822.04 Pipe Installation. The pipe shall be backfilled in accordance with Item 810. The material, on which the pipe lays, shall be firm and shall be so formed as to prevent any subsequent settlement or movement of the pipe. The lower portion of the pipe shall be in contact with the shaped bedding throughout its full length.

All pipes shall be laid starting at the lower end, with the spigot or tongue ends downgrade from the bell or groove ends. The pipes shall be laid true to line and grade and their ends fully entered so their inner surfaces are reasonably flush, even and form a smooth and uniform invert.

Line and grade shall be set using a laser level unless otherwise approved by the Engineer.

At the close of each Day's Work, and at such other times when pipe is not being laid, the end of the pipe shall be protected with a close fitting stopper.

822.05 Joints. Storm Sewer Joints are to be filled with approved bituminous joint filler or cement mortar. The mortar shall be composed of one part Portland cement and two parts sand (701.04 and 703.03).

822.06 Lateral Connections. Lateral connections to concrete pipe must be made in neatly cored holes and joined with rubber seals and stainless steel banding. Connectors shall meet ASTM C-923 such as NPC Kor-N-Tee or Approved Equal.

822.07 Method of Measurement. The pipe measurement shall meet the requirements as set forth in 820.07 as each part may apply.

822.08 Basis of Payment. Payment will be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
822	Linear foot	Concrete elliptical pipe(2) "____" x "____"
822	Linear foot	Concrete elliptical pipe (3) "____" x "____"
822	Linear foot	Concrete elliptical pipe (4) "____" x "____"

Excavation and related Work will be paid for under their appropriate items, Items 810 to Item 814, inclusive.

ITEM 823 PRESTRESSED CONCRETE CYLINDER PIPE

823.01 Description
823.02 Materials
823.03 Victualic Couplings
823.04 Installation
823.05 Method of Measurement
823.06 Basis of Payment

823.01 Description. This item shall consist of providing all the necessary labor, Materials, tools, machines and Equipment required to furnish and lay underground prestressed concrete cylinder pipe and fittings of the various sizes as shown on the approved Plans. This Work includes furnishing and laying the pipe in the trench and jointing it, furnishing and placing joint restraints and concrete thrust blocks, flushing, testing and disinfecting the line in place; and all other Work required for the furnishing and laying of the pipe lines and connections complete and ready for service as shown on the Plans and as covered in the Specifications.

Included in this item is the furnishing and installing of all fittings required for satisfactory completion of the Project including bends, tees, reducers, joint restraints, all concrete used in thrust blocks, blow-offs, sleeves, closure pieces, branch connections, connections to other lines or fittings, special castings for the installation of valves, any other fittings or specials, all fittings and pipe, except corporation stops and taps, for flushing, testing and disinfecting the line.

823.02 Materials. Prestressed concrete pipe and fittings shall conform to the requirements of the latest revision of AWWA C301. Pipe shall have the following features: a welded steel cylinder with steel joint rings welded to its ends; steel cylinder encased in concrete, reinforcing consisting of high-tensile wire wound around the outside of the core in one or more layers at a predetermined stress and securely fastened at its ends; a coating of dense mortar or concrete covering the core and wire, except surfaces of the joint rings; a self-centering joint with a watertight preformed rubber gasket. For embedded cylinder pipe, at least one third of the total core thickness shall be outside of the cylinder.

Embedded cylinder pipe shall be used in sizes 54 inches and larger. For pipe up to 48 inches, lined cylinder pipe shall be used. Fittings shall be per AWWA 301, Section 4.7.

Prior to manufacture of the pipe or fittings, the Contractor shall submit for the Engineer's approval, detailed Drawings and schedules per latest revision of Section 4.3.1 and 4.3.2 of AWWA C301 and the design calculations per latest

revision of Section 4.5.2 of AWWA C301 in sufficient detail to enable the Engineer to check the proposed design for conformance to these Specifications.

Joints for prestressed concrete pipe and fittings shall conform to AWWA C301. Restrained joints for concrete pipe shall be either clamp type, or snap ring type flexible joints or as approved by the Engineer prior to manufacture of the pipe.

Concrete blocking shall be required where shown on the Plans and/or directed by the Engineer.

Bevel pipe, outlet connections on straight pipe, victaulic couplings, closure pipe assemblies and other accessories required for prestressed concrete steel-cylinder water pipe may not necessarily be detailed on the approved Plans, but shall be furnished as required to satisfactorily install the new water main as shown on the Plans. Payment for these piping items shall be included in the Unit Price Bid for the concrete pipe.

Pipe closure pieces shall be provided at no extra cost to the Owner. Pipe closure pieces shall be designed by the manufacturer for the pressure required and shall be located in straight runs of pipe. Pipe closure pieces shall be completely encased in 6 inches of concrete after installation and pressure testing of the pipeline.

Any iron pipe and fittings furnished and installed with concrete pipe and fittings shall conform to Item 824. No separate payment will be made for iron pipe and fittings which are incidental to installation of the concrete pipe, such as branch connections to existing iron pipe lines, as all costs of such pipe and fittings are to be a part of the Unit Price Bid for furnishing and laying the concrete pipe and fittings. Payment for new iron pipe branch lines and hydrant leads shall be made at the Unit Prices Bid for these items measured in accordance with Item 824.

All pipeline Materials furnished shall be stamped, marked or identified with the name or tradename of the manufacturer, pipe class and specification designation, size and length dimensions,

All piping, fittings and appurtenances that come into contact with potable water shall be ANSI/NSF Standard 61 certified.

823.03 Victualic Couplings. Victaulic couplings shall be constructed of ductile iron conforming to ASTM A536 and painted with a protective coating. Bolts shall be Type 316 stainless steel, Grade B-8M, Class 2. Gaskets shall be Grade “E” EPDM.

The pipe couplings shall be mechanical type, to mechanically engage and lock the grooved (or shouldered) pipe ends in a positive couple and to allow for some degree of angular deflection and contraction and expansion.

Each coupling shall be constructed of malleable iron housing clamps in two or more parts, a single C-shaped composition sealing gasket with internal sealing lips projecting diagonally inward so that internal pressure serves to increase the tightness of seal when installed, and two or more track-head bolts as required to engage oval slots in the clamps to secure the bolt against turning and to assemble clamps. The couplings shall be Victaulic Style Number 44.

823.04 Installation. The Contractor shall install all concrete pipes and specials in accordance with the manufacturer's laying instructions and AWWA M9 Manual (Concrete Pressure Pipe) with particular attention to the items below which shall govern where stricter than the manufacturer's instructions. Pipe shall not be installed until the Engineer approves the bedding conditions.

Prior to the start of the Work four copies of a tabulated laying schedule per the requirements of the latest revision of Section 4.3.2 of AWWA C301 shall be submitted by the Contractor to the Engineer for approval. Pipe layout shall reflect the Contractor's planned schedule for operations.

Both the gauge of the cylinder and the gauge of the wire shall be included in the laying schedule in addition to the other required information. The Contractor shall be responsible for the completeness and accuracy of the laying schedule conforming to the construction Plans.

Joints:

(a) The bell and spigot surfaces to be jointed shall be completely cleaned immediately before making the joint.

(b) A lubricant supplied by the pipe manufacturer shall be applied to the sealing surfaces of the bell and spigot and the gasket. After lubrication, the gasket shall be installed in the spigot groove and the stretch in the gasket shall be equalized.

(c) After the pipe is lowered into place, the spigot and bell shall be aligned so that the spigot will squarely enter the bell.

(d) Before the joint is fully assembled, the position of the gasket in the bell shall be checked using methods recommended by the pipe manufacturer and approved by the Engineer.

(e) If the gasket is found to be in the correct position around the entire circumference of the bell, remove temporary joint stoppers, if used, and

the pipe shall be shoved completely home. If the gasket is not in the proper location, the joint shall be opened and reinstalled using a new gasket if necessary.

(f) Where a joint opening is required to make a grade or alignment adjustment, the joint shall be installed completely closed first, then opened as necessary on one side. Joint openings shall not be greater than seventy-five percent of the maximum opening recommended by the pipe manufacturer.

(g)Strap a diaper to the outside of the completed joint straddling the external joint recess. A grout mix consisting of Portland cement and sand in proportions recommended by the pipe manufacturer shall be poured to completely fill the external joint recess.

(h) All exterior exposed steel portions of the pipe, flanges, couplings, bolts and nuts shall be coated with two eight mil coats of high-build epoxy or bituminous coating.

(i) A sufficient quantity of joint lubricant, gaskets and joint diapers shall be maintained at the site of the work at all times.

(j) Gaskets that have been scored or otherwise damaged shall not be used.

Interior of Pipe - The interior of all pipes, fittings and other accessories shall be kept free at all times of dirt and other foreign matter. The pipe shall have all dirt and foreign matter removed from it on the Day it is installed.

Every precaution shall be used to protect the pipe against the entrance of dirt or foreign matter before it is placed in line. The open end of the last laid section of pipe shall be closed by a watertight plug at the end of the Day's Work or whenever the workmen are absent from the job.

Welded Joints - Welded joints shall be made only at the direction of the manufacturer and approval of the Engineer and then only by a certified welder approved by the manufacturer.

Restrained Joints - All elbows, tees and plugged ends shall have a sufficient number of restrained joints as recommended by the pipe manufacturer and as approved by the Engineer in order to prevent any movement of pipe during testing and during normal operations after testing. Restrained joints shall be carefully installed according to the manufacturer's instructions. The grout hole in the harness ring shall be installed in the top-most position and shall be filled with mortar grout before the diaper is filled when completing the joint.

Victaulic Couplings - Installation shall be in accordance to manufacturer's recommendations and procedures.

Concrete Thrust Blocks for Fittings - Where called for on the approved Plans, concrete thrust blocks shall be poured at bends and tees. Concrete used shall have a minimum strength of Class F concrete per Item 499. Thrust blocks shall extend from the fitting to undisturbed earth on the outside of the curve for all bends. Sides of the thrust blocks shall be formed, and shall be centered on the bend both horizontally and vertically. Tees shall be similarly blocked opposite the branch outlet. Size of thrust blocks shall appear on the Plans and shall indicate the area of the block bearing on undisturbed earth.

823.05 Measurement. The lengths for which payment will be made for furnishing and installing will be measured lengths along the centerline of the main line, or connecting or branch lines, in place from the shoulders of hub ends at which the new lines terminate, including the lengths of all pipe, fittings and valves in the various lines. For lines terminating in hydrants, measurement will be made to the hydrant centerline. The length at bends or curves will be measured along the centerlines to the point of intersection thereof.

823.06 Basis of Payment. The payment for all Work done under this Item shall be at the Unit Price bid per foot, which payment shall be full compensation for the furnishing of all labor, Materials, Equipment and other incidentals necessary to complete the items as shown on the approved Plans, as required by the City and as specified herein.

Payment will be made at the contract price for:

Item	**Unit**	**Description**
823	Linear Foot	___" PCCP and fittings
823	Each	___" Half bevel
823	Each	___" Full bevel

Excavation and related Work will be paid for under their appropriate items, Items 810 to Item 814, inclusive.

ITEM 824 DUCTILE IRON WATER PIPE

824.01 Description
824.02 Materials
824.03 Installation
824.04 Method of Measurement
824.05 Basis of Payment

824.01 Description. This item shall consist of providing all the necessary labor, Materials, tools, machines and Equipment required to furnish and install underground pipe and fittings of the various sizes as shown on the approved Plans. This Work includes furnishing and installing the pipe in the trench and jointing it, furnishing and placing joint restraints and concrete thrust blocks, flushing, testing and disinfecting the line in place; and all other Work required for furnishing and installing the pipe lines and connections complete and ready for service as shown on the Plans and as covered in the Specifications.

Included in this item is the furnishing and installing of all fittings required for satisfactory completion of the Project including bends, tees, reducers, joint restraints, all concrete used in thrust blocks, blow-offs, sleeves, closure pieces, branch connections, connections to other lines or fittings, special castings for the installation of valves, any other fittings or specials, all fittings and pipe, except corporation stops and taps, for flushing, testing and disinfecting the line.

824.02 Materials. All ductile iron pipe used in the Work shall be designed in accordance with AWWA C150 and manufactured in accordance with ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings and other requirements.

All pipe and fittings shall be cement lined and bituminous seal coated in accordance with AWWA C104 and shall have an outside coating of bitumastic enamel or Approved Equal.

The minimum wall thickness for pipe 24 inches or less in diameter shall be the greater thickness as given by Thickness Class 51 or Pressure Class 350, unless otherwise specified. The required Thickness Class for pipe larger than 24 inches in diameter shall be stated in the supplemental specifications.

Fittings shall have a minimum working pressure of 350 pounds per square inch, manufactured in accordance with ANSI/AWWA C110/A21.1 or ANSI/AWWA C153/A21.1.

All fittings shall be provided with ends made in accordance with AWWA C111. All fittings shall be cement lined and bituminous seal coated in

accordance with AWWA C104 and shall have an outside coating of bitumastic enamel or Approved Equal.

All ductile iron pipe and fittings for ductile iron pipe shall be provided with either push-on joint ends or mechanical joint ends manufactured in accordance with AWWA C111 as noted on the Plans.

All push-on joints shall have the plain end painted with a circular stripe to provide a guide for visual check to insure that joint is properly assembled. Gaskets for push-on joints shall be molded rubber. Restraining type push-on joints shall be subject to the Engineer's approval.

All mechanical joint fittings, except plugs, shall be furnished with ductile iron follower glands and shall include a restraining mechanism, which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases in lieu of standard mechanical joint glands.

Twist off nuts shall be used on the follower gland to insure proper actuating of the restraint devices. Mechanical joint follower glands shall be EBBA Iron Megalugs or Approved Equal.

Joint restraint devices shall have a working pressure of at least 250 pounds per square inch with a minimum safety factor of 2:1.

Anchor pipe and fittings may be approved for use in fire hydrant installations. Fabricated anchor pipe shall be made of ductile-iron pipe class 53. Anchor pipe and fittings shall be subject to requirements of pipe and fittings herein and must be approved by the Engineer prior to use.

All piping, fittings and appurtenances that come into contact with potable water shall be ANSI/NSF Standard 61 certified.

824.03 Installation. Ductile iron water main and appurtenances shall be installed in accordance with the latest revision of AWWA C600.

For convenience, the Contractor and the Inspector may utilize the pocket booklet "A Guide for the Installation of Ductile Iron Pipe" published by the Ductile Iron Pipe Research Association; however, in the case of disagreement the requirements of AWWA C600 or the decision of the Engineer shall govern. Pipe shall not be installed until the Engineer approves the bedding conditions.

Field pipe, where required, shall be cut with Equipment specially designed for cutting pipe. Cuts shall be made carefully, without damage to pipe or lining and with a smooth end at right angles to the axis of the pipe. Pipe shall not be cut by flame.

Push-on Joints:

(a) Prior to assembling the joints, the last 8 inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.

(b) Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.

(c) Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.

(d) Immediately prior to joint assembly, a thin film of approved lubricant shall be applied to the surface of the gasket that will come in contact with the entering spigot end of pipe.

(e) For assembly, the spigot shall be centered in the pipe bell and the pipe shall be pushed forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, the gasket shall be carefully checked for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets that have been scoured or otherwise damaged shall not be used.

(f) An adequate supply of gaskets and joint lubricant shall be maintained at the site at all times when pipe-jointing operations are in progress.

Restrained Joints - The Contractor shall anchor all hydrants and restrain all bends, valves, tees, plugs, and caps as shown on the Plans and in accordance to City of Dayton's Restrained Joint Length Table. Pipe shall be installed using restrained joints to prevent movement.

Restrained push-on joint pipe, mechanical joint retainer glands or other approved proprietary restraining devices shall be installed in strict accordance with the manufacturer's instructions which shall also be provided to the Engineer. The use of tie-rods is not an acceptable method of joint restraint.

After installation of any restrained joint in which there might be any movement before the restraint becomes effective, the new pipe or fitting shall be firmly pulled home to take up all slack in the joint.

The length of pipe with restrained joints called for in the Plans shall be considered a minimum for the specified test pressure and laying conditions. If the pipe line is tested at a higher pressure and/or without the stated minimum compacted pipe cover, additional restrained joints will be required and shall be furnished and installed by the Contractor at no additional cost to the City.

Concrete Thrust Blocks for Fittings - Where called for on the Plans, concrete thrust blocks shall be poured at bends and tees. Concrete used shall have a minimum strength of Class F concrete per Item 499.

Thrust blocks shall extend from the fitting to undisturbed earth on the outside of the curve for all bends. Sides of the thrust blocks shall be formed, and shall be centered on the bend both horizontally and vertically.

Tees shall be similarly blocked opposite the branch outlet. Size of thrust blocks shall appear on the Plans and shall indicate the area of the block bearing on undisturbed earth.

Polyethylene Encasement. If shown on the Plans, all buried ductile iron pipe, including straight pipe, bends, tees, adapters, closure pieces, valves and other fittings or specials, shall be provided with a minimum of one wrap of polyethylene encasement.

At all times, polyethylene wrapping (polywrap) shall be installed over the ductile iron piping for 5 feet from either side of each end when the piping is embedded or encased in concrete. Polyethylene wrapping shall also at all times be installed between fittings and concrete thrust blocks.

Polyethylene encasement shall be installed in accordance with AWWA C105, Method A. Preparation of the pipe shall include, but is not limited to, removing lumps of clay, mud, cinders, etc., prior to installation.

When tapping polyethylene encased ductile iron pipe, the procedures shall be as recommended in AWWA C105.

824.04 Method of Measurement. The lengths for which payment will be made for furnishing and installing will be measured lengths along the centerline of the main line, or connecting or branch lines, in place from the shoulders of hub ends at which the new lines terminate, including the lengths of all pipe, fittings and valves in the various lines.

For lines terminating in hydrants, measurement will be made to the hydrant centerline. The length at bends or curves will be measured along the centerlines to the point of intersection thereof.

824.05 Basis of Payment. The payment for all Work done under these items shall be at the Unit Price bid per foot, which payment shall be full compensation for the furnishing of all labor, Materials, Equipment and other incidentals necessary to complete the items as shown on the Plans, as required by the City and as specified herein.

Payment will be made at the contract price for:

Item	**Unit**	**Description**
824	Linear Foot	____" Ductile iron water pipe and fittings
824	Linear Foot	____" Ductile iron water pipe and fittings w/polywrap

Excavation and related Work will be paid for under their appropriate items, Items 810 to Item 814, inclusive.

ITEM 825 POLYVINYL CHLORIDE (PVC) SEWER PIPE

825.01 Definition
825.02 Description
825.03 Materials
825.04 Pipe Installation
825.05 Joints
825.06 Lateral Connections
825.07 Method of Measurement
825.08 Basis of Payment

825.01 Definition. PVC pipe shall be designated and classified as follows:

PVC Closed Profile Pipe, ASTM F1803 as Item 825 PVC Closed Profile Pipe

PVC Pipe, ASTM D3034, SDR 35 as Item 825, PVC Pipe SDR35

PVC Pipe, ASTM D3034, SDR 26 as Item 825, PVC Pipe SDR26

PVC Corrugated Pipe with Smooth Interior, ASTM F949 as Item 825 PVC Corrugated Pipe

PVC Closed Profile Pipe, ASTM F1803 as Item 825 PVC Closed Profile Pipe

825.02 Description. This item shall cover the labor, Materials, and incidentals necessary for the installation of gasketed joint PVC pipe as shown on the Plans or as required by the Engineer and shall include the furnishing of the pipe, pipe specials, elastomeric gaskets, handling, storing, distributing and installing the Sewer ready for testing; the furnishing of all testing Materials, testing the Sewer for tightness and deflection and remedying all defects. The pipe shall be installed according to the type of PVC pipe shown on the Plans, stated in the Proposal, and/or ordered by the Engineer.

825.03 Materials. PVC pipe shall conform to type shown on the detailed Plans and in the Proposal.

PVC D3034, SDR35 or SDR 26 shall comply with ASTM D3034.

PVC Corrugated Pipe shall comply with ASTM F949, pipe stiffness of 46 pounds per square inch.

PVC Closed Profile Pipe shall conform to ASTM F1803.

825.04 Pipe Installation. The manufacturer of the PVC pipe furnished shall provide installation instructions and literature to the Contractor so that the contractor will be aware of the Manufacturer's recommended procedure and practice of installing pipe and fittings. Care shall be taken to protect PVC pipe from prolonged exposure to heat or direct sunlight (ultraviolet rays) during construction. The trench shall be free of all standing water prior to installation of the pipe. The pipe shall be bedded and backfilled as described in Item 810.

The bottom of the trench or pipe bed shall be firm and shall be so formed as to prevent any subsequent settlement or movement. The lower portion of the pipe shall be in full contact with the shaped bed throughout its length.

All pipes shall be installed starting at the lower end. The pipes shall be installed true to line and grade. The pipe ends shall be fully entered so their inner surfaces are reasonably flush, even, and form a smooth and uniform invert. When elastomeric gasketed pipe is installed, the ends shall be entered to the manufacturer's reference mark.

Line and grade shall be set using a laser level unless otherwise approved by the Engineer.

Following installation the pipe is to be tested in accordance with Item 802. Deflection of the pipe diameter shall not exceed five percent. Installed pipe shall be tested for deflection thirty Days or more after the trench has been backfilled to finish grade at locations determined by the Engineer. The method of testing shall be approved by the Engineer. When mandrels are used to test the pipe deflection, no mechanical pulling device shall be used.

At the close of each Day's Work, and at such other times when pipe is not being installed, the end of the pipe shall be protected with a close fitting stopper.

825.05 Joints. PVC pipe joints shall be elastomerically gasketed conforming to ASTM D3212. Provide adapters approved by the Engineer to transition to another type of pipe, manhole or Structure. All adapters must be specifically manufactured for the type of joint being performed.

825.06 Lateral Connections. Lateral connections in new pipe may only be made using a manufactured PVC wye fitting. Connections to existing PVC sewers shall be made using an adapter included in the City's Qualified Products List.

825.07 Method of Measurement. The pipe measurement shall meet the requirements as set forth in 820.07.

825.08 Basis of Payment. Payment will be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
825	Linear foot	___" PVC pipe, SDR35
825	Linear foot	___" PVC pipe, SDR26
825	Linear foot	___" PVC corrugated pipe
825	Linear foot	___" PVC closed profile pipe

Excavation and related Work will be paid for under their appropriate items, Items 810 to Item 814 inclusive. When shown on the Plans or ordered by the Engineer, specials, i.e., wyes, tees, elbows, etc., and their inherent additional cost shall be incorporated in and made part of the Unit Price bid for the pipe.

ITEM 826 PRIVATE LATERAL (STORM OR SANITARY)

826.01 Description
826.02 Materials
826.03 Construction
826.04 Sewer Lateral Permit
826.05 Method of Measurement
826.06 Basis of Payment

826.01 Description. This item shall cover the labor, Materials and incidentals necessary for the installation, construction, reconstruction, relocation, raising, lowering and extending of new and existing Sewer laterals.

826.02 Materials. The material shall meet the requirements as follows:

Sanitary laterals shall be as set forth in 820.03, 824.02, 825.03 PVC D3034 SDR26, 834.03, and 835.02.

Storm laterals shall be as set forth in 820.03, 821.03, 824.02, 834.03, and 835.02.

New piping shall be the size indicated on the Plans and replacement of existing piping shall remain the same material and size unless ordered otherwise by the Engineer.

826.03 Construction. The construction shall conform to the provisions as set forth in 820.04, 821.04, 824.03, 825.04; 820.05, 821.05, 824.03, and 825.05. Connections shall be in accordance with 820.06, 821.06, 822.06, and 825.06. Plugs shall be used as set forth in Item 835.

826.04 Sewer Lateral Permit. A City permit must be obtained for each installation, repair, or reconnection of any sanitary or storm Sewer lateral.

The permit must be obtained at the One Stop Center, Department of Building Services. These permits are only issued to City of Dayton licensed plumbing contractors or excavators.

826.05 Method of Measurement. The length of pipe to be paid for will be the actual number of linear feet of pipe in place measured along a horizontal Projection of the house lateral centerline. The measurement of the

pipe shall be taken through Structures and specials, all of which shall be considered linear feet of house lateral.

826.06 Basis of Payment. Payment will be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
826	Linear foot	Sewer lateral
826	Each	Sewer lateral permit

No separate payment will be made for plugs or connections required to complete the lateral installation. The cost of such plugs or connections should be included in the price per foot bid for Item 826. No payment or compensation will be made for house laterals accidentally or deliberately broken during Sewer construction unless relocation was necessary.

ITEM 827 DOWNSPOUT DRAIN

827.01 Description
827.02 Materials
827.03 Construction
827.04 Method of Measurement
827.05 Basis of Payment

827.01 Description. This item shall cover the labor, Materials and incidentals necessary for the placement or replacement of downspout drains.

827.02 Materials. The Materials shall meet the requirements as set forth in the following ASTM Specifications:

ASTM C4 Clay Drain Tile
ASTM D2661, D2665, D2751, D3033, or D3034 SDR 26 Plastic Pipe.

Other Materials may be used with the approval of the Engineer. The mortar shall consist of one part Portland cement and two parts sand (701.04 and 703.03).

827.03 Construction. New or additional downspout drains shall extend from the property line to the street face of the curb, as shown on the Plans, specified in the Proposal or as directed by the Engineer. The drain shall be laid with the spigot end passing through the curb and the bell of the last section shall be connected to an existing drain or shall be covered with an approved stopper or plug. The joints shall be poured in place, with the downspout drain set at the indicated or directed line and grade. Where Sidewalk is over the new drain tile, the entire Sidewalk section between joints shall be replaced.

Existing downspout drains that will remain active shall be removed and replaced to the minimum extent necessary for the prosecution of the Work or contract. The replaced drains shall be constructed of the same size and as described above for new or additional downspout drains.

827.04 Method of Measurement. The downspout drains to be paid for will be the actual number of linear feet of drain in place measured horizontally along the drain center line within the limits described above or ordered by the Engineer.

827.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per linear foot, measured as provided above, and under the following:

Item	Unit	Description
827	Linear foot	Downspout drain

ITEM 830 MANHOLE

830.01 Description
830.02 Materials
830.03 Construction
830.04 Method of Measurement
830.05 Basis of Payment

830.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of manholes as shown on the approved Drawings or as directed by the Engineer. Neither the type nor location of manholes shall be changed without the permission of the Engineer.

830.02 Materials. The Materials shall meet the requirements the following Specifications:

Hydraulic Cement	Item 701
Aggregate	Item 703
Reinforcing Steel	Item 709
Concrete Pavement Incidentals	Item 705
Concrete Building Brick	ASTM C55
Concrete Masonry Units for Construction of Catch Basins and Manholes	ASTM C139
Precast Reinforced Concrete Manhole Sections	ASTM C478
Gray Iron Castings	ASTM A48 (Class 30)
Reinforced Propylene Plastic Manhole Steps	711.31

The separate or individual parts within this item shall be fabricated according to the sizes and shapes shown on the approved Drawings or the Water Department's Engineering Design Standards. Castings shall be considered correct if within 1/8 inch of drawing dimensions; however, the thickness of the casting shall be limited to within 1/16 inch of the drawing dimensions. All load bearing surfaces of castings shall be machined in a manner to insure an even bearing. An uneven bearing, as evidenced by rocking under a normal traffic loading, shall be sufficient reason for rejecting the castings.

The manufacturer's name shall be cast upon the castings in letters 1 inch in height and 1/8 inch in relief. "City of Dayton" shall also be cast upon the casting in letters 2 inches high. Manhole lids shall be vented unless otherwise indicated on the approved Plans.

830.03 Construction. Manholes shall be constructed with bottoms, sides and tops to accommodate all piping, openings, temporary stubs, embedment and castings unless specified otherwise by the Engineer. The bottom or channel of manholes shall be poured in place, concrete, smoothly shaped as shown on the standard Drawings, and shall accommodate all pipes entering the manholes. Pipes entering manholes shall be securely grouted in place. Class "D" concrete shall be used as defined in 499.03. Mortar shall be composed of one part Portland cement and two parts sand (701.04 and 703.03).

When manholes are constructed of 8 inch concrete masonry solid blocks, the blocks shall be laid on a 1/2 inch thick cement mortar bed with full mortar coverage over the laying surface. The blocks shall be fitted to the shape of connecting pipes and securely bonded with mortar. The blocks shall be laid in alternating courses with the joints bisecting the blocks in the course below. All interior and exterior surfaces shall be plastered with 1/2 inch thick mortar coat. When manholes are constructed of precast concrete ring sections, the joints shall be sealed around the entire perimeter. Stubs and/or connecting pipe shall be placed in the manhole walls to accommodate all pipes shown entering the manhole. The casting for the cover of each manhole shall be set in a full bed of mortar and adjusted to conform to the surface of the street or alley. When manholes are completed, they shall be cleared of scaffolding or forms and cleaned of surplus mortar or other foreign Materials.

Unless specifically stated otherwise on the Plans, the cone section of the manhole shall be concentric. For sanitary manholes, joints between precast sections shall conform to ASTM C443. Where precast bases are used for sanitary manholes, pipe connections shall conform to ASTM C923.

830.04 Method of Measurement. The manholes to be paid for will be the actual number of manholes constructed, fabricated or built of the various types shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

830.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
830	Each	Manhole, type "___ "

ITEM 831 CATCH BASIN

831.01 Description
831.02 Materials
831.03 Construction
831.04 Method of Measurement
831.05 Basis of Payment

831.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of the types of catch basins shown on the standard Drawings on file in the office of the Engineer. Catch basins shall be constructed at locations indicated on the approved Plans or as directed by the Engineer. Catch basin aprons shall be constructed at locations as indicated on the approved Plans or as directed by the Engineer. Neither the type nor location of catch basins shall be changed without the permission of the Engineer.

831.02 Materials. The Materials shall meet the requirements the following Specifications:

Hydraulic Cement	Item 701
Aggregate	Item 703
Reinforcing Steel	Item 709
Concrete Pavement Incidentals	Item 705
Concrete Building Brick	ASTM C55
Concrete Masonry Units for Construction of Catch Basins and Manholes	ASTM C139
Precast Reinforced Concrete Manhole Sections	ASTM C478
Gray Iron Castings	ASTM A48 (Class 30)
Reinforced Propylene Plastic Manhole Steps	711.31

831.03 Construction. Catch basins shall be constructed with bottoms, sides and tops to accommodate all piping, openings, temporary stubs, embedment and castings unless specified otherwise by the Engineer. The bottom shall be smoothly shaped as shown on the standard Drawings. The sides shall accommodate all pipes entering the catch basin. . Pipes entering catch basins shall be securely grouted in place. Class "D" concrete shall be used as defined in 499.03." Mortar shall be composed of one part Portland cement and two parts sand (701.04 and 703.03). Precast catch basins with “knockouts” for pipe openings are unacceptable.

When catch basins are constructed of concrete masonry blocks, the 8 inch solid blocks shall be laid on a 1/2 inch thick cement mortar bed with full mortar coverage over the laying surface. The blocks shall be fitted to the shape of connecting pipes and securely bonded with mortar. The blocks shall be laid in alternating courses with the joints bisecting the blocks in the course below. All interior and exterior surfaces shall be plastered with 1/2 inch thick mortar coat.

The castings used in catch basins shall be set in a full bed of mortar and adjusted to conform to the adjacent surfaces.

Catch basin aprons shall be 8 inches thick and constructed with #4 reinforcing steel and Class “D” concrete per City’s standard Drawings.

831.04 Method of Measurement. The catch basins to be paid for shall be the actual number of catch basins constructed, fabricated or built of the various types shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

831.05 Basis of Payment. Payment shall be made at the contract Unit Price per each, the number determined as provided above, and under the following:

Item	Unit	Description
831	Each	Catch basin, type "___ "
831	Each	Catch basin apron, type (__)

ITEM 832 MONOLITHIC CONCRETE STRUCTURE

832.01 Description
832.02 Materials
832.03 Construction
832.04 Method of Measurement
832.05 Basis of Payment

832.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of monolithic concrete Structures as shown on the approved Plans, in accordance with the details, and/or as specified.

832.02 Materials. The Materials shall meet the requirements the following Specifications:

Concrete for Structures	Item 511
Hydraulic Cement	Item 701
Aggregate	Item 703
Reinforcing Steel	Item 709
Concrete Pavement Incidentals	Item 705
Concrete Building Brick	ASTM C55
Concrete Masonry Units for Construction of Catch Basins	ASTM C139
Precast Reinforced Concrete Manhole Sections	ASTM C478
Gray Iron Castings	ASTM A48 (Class 30)
Reinforced Propylene Plastic Manhole Steps	711.31

832.03 Construction. Monolithic concrete Structures shall be constructed in accordance with the Drawings and Specifications. The Structures shall be constructed with bottoms, sides and tops able to accommodate all piping, openings, embedment, castings and appurtenances unless specified otherwise by the Engineer. The bottom shall be smoothly shaped as shown. Temporary wall connections incorporated in the Work shall include stubs. Steps for access to the Structure shall be Standard City of Dayton Manhole Steps. The castings and other similar devices shall be set as defined in 831.03.

832.04 Method of Measurement. The Structures to be paid for will be the actual number of Structures constructed, fabricated or built of the various types shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

832.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
832	Each	Junction
832	Each	Headwall
832	Each	Valve chamber
832	Each	Special, _____

The cost of excavation and backfill shall be totally included within this item; the excavation and backfill being the same as described in Item 810.

ITEM 833 LAMPHOLE

833.01 Description
833.02 Materials
833.03 Construction
833.04 Method of Measurement
833.05 Basis of Payment

833.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of lampholes as shown on the standard Drawings at the locations shown on the approved Plans or as directed by the Engineer.

833.02 Materials. The Materials shall meet the requirements as set forth in 830.02. In addition, the material shall be compatible with the main line Sewer.

833.03 Construction. Lampholes shall be constructed in accordance with the standard Drawings, as shown on the Plans or as directed by the Engineer. Joints shall conform to 820.05 and 821.05 (b), "Sanitary Sewer Joints," and 824.02, 825.05, "Joints." Backfilling shall be performed in a manner to prevent movement and insure a permanent true vertical position. The concrete at the top of the lamphole shall be placed in two pours; the first pour supports the casting in its proper position relative to the surface and the second pour prevents lateral movement of the casting.

833.04 Method of Measurement. The lampholes to be paid for will be the actual number of lampholes constructed, fabricated or built as shown on the Plans, stated in the Proposal and/or ordered by the Engineer.

833.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
833	Each	Lamphole

ITEM 834 CONNECTION

834.01 Description
834.02 Definition
834.03 Materials
834.04 Construction
834.05 Method of Measurement
834.06 Basis of Payment

834.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of necessary connections into Sewers and Sewer appurtenances.

834.02 Definition. A connection shall be the actual and necessary breaking or coring into a Structure, inserting a Conduit and sealing the void between the Conduit and Structure.

834.03 Materials. The Materials shall meet the requirements as set forth in 830.02. Resilient Materials for connectors and filler rings shall be manufactured from natural or synthetic rubber. Mechanical devices used as expansion rings, and tension bands and take up devices used for mechanically compressing the resilient portion of the connector against the pipe or manhole shall be made from a material or Materials in combination that will assure durability, strength, resistance to corrosion, and have properties that will ensure continued resistance to leakage. Castings used to mechanically compress resilient Materials shall conform to the requirements of ASTM A48 or ASTM A536. Bolt assemblies used with such castings shall be of high strength low alloy steel. The resilient Materials, the mechanical devices, the castings and bolt assemblies shall be in accordance with ASTM C923.

834.04 Construction. The connections shall be constructed at the locations shown on the Plans, as specified and/or as directed by the Engineer.

For sanitary Sewer connections and specified storm Sewer connections, the hole into the existing or new Sewer, manhole, Structure or other type unit shall be drilled with a diamond core or equivalent type drill designed for this purpose. The opening shall be sized to fit the pipe and connector assembly. The connector assembly shall be such that positive seal is accomplished at two locations: (1) between the connector and the Structure and the Structure wall and (2) between the connector and pipe. The seal between the connector and Structure wall may be made by either mechanical means or by casting the connector integrally with the Structure wall. The seal between the connector and

the pipe may be made by mechanical means or by compression of the resilient material against the outside of the pipe.

For other storm Sewer connections, a hole shall be broken into the existing or new Sewer, manhole, catch basin, Structure or other type unit by means of a pneumatic hammer or other approved method. The opening shall be large enough to receive the pipe with enough space to make a good mortar joint, both inside and outside of the connected unit, and care shall be taken not to crack the Sewer or Structure beyond the limits necessary when making the opening.

834.05 Method of Measurement. The connections to be paid for will be the actual number of connections incorporated in the Work as shown on the Plans, specified and/or ordered by the Engineer.

834.06 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
834	Each	Connection, size

ITEM 835 PLUG (STORM OR SANITARY)

835.01 Description
835.02 Materials
835.03 Construction
835.04 Method of Measurement
835.05 Basis of Payment

835.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction of plugs in new or existing Sewer lines.

835.02 Materials. The Materials shall meet the requirements as set forth in 830.02 in addition to other Materials that may be approved by the Engineer.

835.03 Construction. Plugs shall be constructed according to the types shown on the Plans, as specified or directed by the Engineer. The plugs shall support all dead and live (i.e., earth, vehicle, etc.) loads. The plugs shall be typed according to the following classifications:

Type "A" Sanitary Plug. This plug shall be a stopper or cap sealed into position, easily removed in the future without damaging the Conduit, and able to prevent leakage when tested according to Item 802.

Type "B" Storm Plug. This plug shall be a stopper or cap that future construction can easily remove without damaging the Conduit.

Type "C" Abandonment Plug. This plug shall be a unit of construction able to prevent backfill infiltration into the abandoned Conduit or Structure.

Type "D" Abandonment Watertight Plug. This plug shall be used with sanitary Sewers and where specified for storm Sewers. It shall be a unit of construction able to prevent backfill infiltration and water infiltration or exfiltration.

835.04 Method of Measurement. The plugs to be paid for will be the actual number of plugs incorporated in the Work as shown on the Plans, as specified, and/or as ordered by the Engineer. Plugs in pipes of 6 inches or less in diameter shall not be included within the measurement of this item, but shall be included within the cost of Item 810.

835.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
835	Each	___" Plug, type " "

ITEM 836 ADJUSTING SEWERAGE APPURTENANCE

836.01 Description
836.02 Materials
836.03 Construction
836.04 Method of Measurement
836.05 Basis of Payment

836.01 Description. This item shall cover the labor, Materials and incidentals necessary for the construction, reconstruction, raising, lowering and extending of existing Sewerage appurtenances. Defective material (existing or otherwise) shall be replaced with new material or its equivalent as approved by the Engineer.

836.02 Materials. The Materials used shall be as set forth in 826.02, 830.02, 833.02, and 835.02 or as directed by the Engineer. Mortar shall consist of one part Portland cement and two parts concrete sand (701.04 and 703.03).

836.03 Construction. Existing Sewerage appurtenances shall be rebuilt according to the line, grade and dimensions shown on the Plans and according to the requirements as set forth in 826.03, 830.03, 831.03, 832.03, 833.03, 834.04, and 835.03 insofar as they may apply or as may be ordered by the Engineer. Existing castings shall be carefully removed, cleaned, inspected and reused wherever possible. However, in all cases, the continuity, design and purpose of the Structure or unit shall remain the same for all adjusted Sewerage appurtenances.

Minor manhole adjustment (designated as "Manhole Adjusted") shall essentially extend or reduce the manhole neck and reset the casting at the proper grade (except, "self-adjusting manhole frames" shall be included within and made part of the surface cost and payment). In asphalt pavement all manhole castings shall be placed or adjusted in the same manner. The adjustment or placement shall be made in one Day. The manhole casting shall be excavated and raised so the top of castings are 1/4 inch below the level of the top of the asphalt. The remaining part of the opening between the casting and asphaltic concrete and base, shall be filled with zero slump Class "D" concrete, up to a point 3 inches below the level of the top of the asphalt, and then finished and edged. Before the concrete is placed in the opening the vertical surface of the asphalt cut through shall be coated with hot asphalt cement. The remaining part of the opening around the casting shall be filled with asphaltic concrete (Item 403) to a point 1 inch below the level of the top of the asphalt. The second course of asphaltic concrete required to fill the opening shall be placed at a later date.

Major manhole adjustment (designated as "Major Manhole Adjustment") shall require the rebuilding of the cone, wall, barrel or other major necessary part in order to set the casting at the proper grade.

Catch basin adjustment (designated as "Catch Basin Adjusted") shall be the extending of the walls and resetting the casting at the proper grade.

Construction of brick or concrete block masonry catch basins (i.e., alley drips) may be reset in either direction; this Work being included within "Catch Basin Adjusted".

Lamphole adjustment (designated as “Lamphole Adjusted") shall be the raising or lowering of the surface casting to the proper grade.

Special adjustment shall be the Work necessary to change Structures to plan line, grade and dimensions.

836.04 Method of Measurement. The adjusted Sewerage appurtenances to be paid for will be the actual number of units adjusted of the various types shown on the Plans, stated in the proposal and/or ordered by the Engineer.

836.05 Basis of Payment. Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
836	Each	Manhole Adjusted
836	Each	Major manhole adjustment
836	Each	Catch basin adjusted
836	Each	Lamphole adjusted
836	Each	Special adjustment

ITEM 837 SEWERAGE APPURTENANCE ABANDONED

837.01 Description
837.02 Materials
837.03 Construction
837.04 Method of Measurement
837.05 Basis of Payment

837.01 Description. This item shall cover the labor, Materials and incidentals necessary to abandon Sewerage appurtenances.

837.02 Materials. The Materials used shall be as set forth in 826.02, 830.02, 833.02, and 835.02.

837.03 Construction. Abandoned Sewerage appurtenances shall be demolished with care taken to preserve salvable material and remaining operative Equipment or other parts of Sewerage. Remaining operative facilities shall be continued and extended through the abandoned section and shall be thoroughly protected. Existing pipe and connections to be abandoned shall be sealed with an appropriate stopper as provided in Item 835. Any portion of the unit within 1 foot of the finished Subgrade shall be removed, torn down or demolished; except the units to continue in operation. Castings shall be carefully removed in a manner to prevent damage to the casting and they shall be delivered to the City's storage location as designated by the Engineer.

All the excavation necessary to complete this item shall be included totally within this item. All voids shall be filled and compacted according to Item 813. Disposal of material shall be at locations approved by the Engineer.

837.04 Method of Measurement. The Sewerage appurtenances abandoned to be paid for will be the actual number of units abandoned of the various types shown on the Plans, stated in the proposal and/or ordered by the Engineer.

837.05 Basis of Payment. Payment, including the cost of plugs, shall be made at the contract Unit Price bid per each, the number determined as provided above and under the following:

Item	Unit	Description
837	Each	Abandoned manhole
837	Each	Abandoned catch basin
837	Each	Abandoned lamphole
837	Each	Abandoned, special

ITEM 840 GATE VALVE

840.01 Description
840.02 Materials
840.03 Valve Boxes
840.04 Basis of Payment

840.01 Description. This item shall consist of providing all the necessary labor, Equipment and material required to furnish and install 4 inch through 24 inch gate valves, complete with valve boxes as shown on the approved Plans and as specified herein. These valves are intended for approximately level setting on buried pipelines in the water distribution system and are normally open, unless otherwise shown on the Plans.

All gate valves provided shall conform to the latest revision of AWWA C509 except as modified herein.

840.02 Materials. All gate valves, unless otherwise specified, shall meet the following design criteria and be manufactured of Materials meeting the following Specifications.

Gate valves shall be resilient-wedge type rated for 250 pounds per square inch cold water working pressure, have non-rising stem, open right (clockwise), and have mechanical joint ends unless otherwise specified or approved by the Engineer.

All ferrous components shall be ductile iron. The manufacturer name, valve size, and pressure rating shall be cast or stamped on the valve. Wedge shall be constructed out of ductile iron encapsulated with a nitrile, SBR rubber, EPDM elastomer or material as approved by the Engineer.

All internal and external surfaces shall be coated with a polyamide cured epoxy coating system applied over a sand blasted “new white metal surface” per SSPC-SP10 to a minimum of ten mils in compliance with AWWA C550.

Mechanical joint ends shall conform to the restrained joint requirements of 824.03 and shall be provided with all necessary accessories for installation, complete.

Bolting Materials shall develop the physical strength requirements of ASTM A307 and may have either regular square or hexagonal heads with dimensions conforming to ANSI B18.2.1.

Valves shall be supplied with 2 inch operating nuts constructed out of ductile iron.

Gate valves shall be bi-directional flow. Valves shall have smooth, unobstructed, oversized flow way.

Valves 12 inch and smaller shall be of vertical design. Valves 16 – 24 inches shall be of the vertical or horizontal design, as noted on the Plans or as required by the Engineer. For valve sizes 16 inch through 24 inch of the vertical design, lifting lugs shall be an integral part of the valve and the valve shall have flat bottom surfaces allowing valves to stand up right. Horizontal valves shall have totally enclosed extended gear cases and shall be designed for buried service.

All valves shall be ANSI/NSF Standard 61 certified.

840.03 Valve Boxes. Each valve used in buried service shall be provided with a valve box meeting the requirements of Item 842. No separate payment shall be made for these valve boxes as their cost is to be included in the Unit Price bid for Gate Valves.

When valves are located deeper than can be accommodated by standard shaft length, then extensions shall be furnished and installed per the requirements of 842.03 and 842.04.

840.04 Basis of Payment. The payment for all Work performed under this item shall be at the Unit Price as bid, which is full compensation for furnishing and installing the various types and sizes of valves specified including operation extension stems and valve boxes.

Payment shall be at the contract price for:

Item	**Unit**	**Description**
840	Each	____" Gate valve and appurtenances

ITEM 841 BUTTERFLY VALVE

841.01 Description
841.02 Materials
841.03 Valve Boxes
841.04 Basis of Payment

841.01 Description. This item shall consist of providing all the necessary labor, Equipment and material required to furnish and install butterfly valves complete with actuators and valve boxes of the type and size shown on the approved Plans and as specified herein. Valves and appurtenances, including actuators, shall be suitable for buried or submerged service in the water distribution system and are normally open, unless otherwise shown on the Plans.

841.02 Materials. Butterfly valves shall be manufactured in accordance to the latest revision of AWWA C504, Rubber-Seated Butterfly Valves, except as specifically modified herein. Valves shall be AWWA Class 150B designed for a nonshock shutoff pressure of 150 pounds per square inch unless otherwise shown on the Plans. Valves shall open right (clockwise) and be suitable for bi-directional flow. All valves shall be ANSI/NSF Standard 61 certified.

All butterfly valves, unless otherwise specified, shall meet the following design criteria and be manufactured of Materials meeting the following Specifications.

Bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12 or cast iron per ASTM A126 Class B and conform to AWWA C504 in terms of laying length and minimum body shell thickness.

Ends for use with ductile iron pipe shall have mechanical joint ends and furnished complete with restrained joint assemblies per Item 824. Ends for use with prestressed concrete pipe shall be shouldered and furnished complete with victaulic couplings per Item 823.

All internal and external surfaces shall be coated with a polyamide cured epoxy coating system applied over a sand blasted “new white metal surface” per SSPC-SP10 to a minimum of ten mils in compliance with AWWA C550.

Unless otherwise approved, shafts shall be 18-8 type 304 stainless steel, turned, ground and polished and secured to the valve disc by means of one or more tangential fitted stainless steel taper pins driven into reamed tapered holes and held snug by means of a locking nut or hex-mated to valve disc and designed to exclude water.

Valve discs shall be designed to seat at 90 degrees to the pipe axis. discs shall be cast iron ASTM A126 Class B with 316 stainless steel disc edge. Discs shall be secured to the shaft by stainless steel pins sized to transmit torque required and withstand stresses imposed under severe operating conditions.

Seats shall be Buna-N rubber located on the valve body. Butterfly valves for buried service shall be supplied with 2 inch operating nuts conforming to the requirements of AWWA C500, Section 3.16.

Actuators shall be of the self-locking worm gear design, suitable for buried or submerged service, and shall meet design requirements as specified in AWWA C504. Actuators shall deliver an output torque equal to that given in Table 4, AWWA C504. Actuators having an output torque rating less that given in Table 4 shall be permitted only if the manufacturer submits acceptable certified test results that substantiates that the maximum torque required to seat and unseat the valve under the most adverse design conditions is less than given in Table 4. The most adverse design conditions are considered to be the following: opening against the full design pressure of 150 pounds per square inch with dry downstream and closing against a velocity of 16 feet per second at the design working pressure of 150 pounds per square inch.

841.03 Valve Boxes. Each valve used in buried service shall be provided with a valve box meeting the requirements of Item 842. No separate payment shall be made for these valve boxes as their cost is to be included in the Unit Price Bid for Butterfly Valves.

When valves are located deeper than can be accommodated by standard shaft length, then extensions shall be furnished and installed per the requirements of 842.03 and 842.04.

841.04 Basis of Payment. The payment for all Work performed under this item shall be at the Unit Price as bid, which is full compensation for furnishing and installing the various sizes of valves specified including operation extension stems and valve boxes.

Payment shall be at the contract price for:

Item	Unit	Description
841	Each	____" Butterfly valve and appurtenances

ITEM 842 VALVE BOX

842.01 Description
842.02 Materials
842.03 Box Extensions
842.04 Shaft Extensions
842.05 Basis of Payment

842.01 Description. This item shall consist of furnishing all labor, Equipment and Materials to install valve boxes over buried valve operators at locations shown on the approved Plans, or as directed by the Engineer, and as specified herein.

No payment under this item will be made for valve boxes to be included with valves furnished and installed under the requirements of Items 840, 841 or 844. Payment under this item will only be made for valve boxes placed or replaced over existing valves.

842.02 Materials. Valve boxes shall be constructed of cast iron and shall be an adjustable three piece, screw type, with a 5 1/4 inch shaft that can be extended from 48 inch to 60 inch. Provide a round base and a cover with the word "WATER" cast in it. The Materials must be listed on the City's Qualified Products List.

842.03 Box Extensions. When valves are located deeper than can be accommodated by the standard shaft length on the valve boxes, extensions shall be fabricated from 6 inch diameter Schedule 40 PVC pipe conforming to ASTM D1785. The valve box extension shall be placed over the base and under the middle section and shall be of sufficient length to allow final adjustment of valve box height with the upper section in the normal manner.

842.04 Shaft Extensions. If valves are not installed with the operating nut within 72 inch of the ground surface, a permanent shaft extension shall be furnished and installed. The extension shaft shall have an operating nut with the same dimensions and markings as that of the valve and shall be capable of transmitting the operating torque specified for the valve. The extension shaft shall be mechanically attached to the operating nut.

842.05 Basis of Payment. The payment for all Work performed under this item shall be at the Unit Price as bid therefore, which shall be full compensation for all Work required to make a complete installation including the furnishing and installing of extension shafts and operating extension stems.

Payment shall be at the contract price for:

Item	Unit	Description
842	Each	Valve box

ITEM 843 FIRE HYDRANT

843.01 Description
843.02 Materials
843.03 Installation
843.04 Hydrant Relocation
843.05 Hydrant Removal
843.06 Hydrant Abandonment
843.07 Approved Models
843.08 Basis of Payment

843.01 Description. The Contractor shall furnish all labor, tools, material and Equipment necessary to furnish and install new fire hydrants at the locations shown on the approved Plans.

The item shall include all excavation, furnishing and installing the new fire hydrant complete with proper jointing, blocking, backfilling and all other incidental Work necessary to complete this item of Work. Hydrant watch valves and ductile iron hydrant leads, where necessary, are to be installed and paid for under Item 824 and Item 840.

All fire hydrants shall be a center stem post, compression type, made of cast iron or ductile iron, suitable for use where hydrants are subject to freezing temperatures, and conforming in all respects to AWWA C502, Dry-Barrel Fire Hydrants, except as specifically modified herein.

Hydrants shall be traffic type, furnished with a frangible break flange at the ground line, and a cast iron coupling or two-piece brass coupling on the stem at the ground line which shall be designed so that in case of breakage, only the flange and coupling need to be replaced to effect complete repair. This design must assure that the upper and lower sections of the hydrant will break apart cleanly without bending the stem and without damage to the working parts of the hydrant or the abutting parts of the standpipe sections; also that there will be no leaking or flooding.

The hydrant shall be designed so that, if broken at the joint, repairs may be made by the use of simple tools and the minimum number of parts, and without the necessity of excavating or shutting off the water supply to the hydrant.

The hydrant shall be designed so that the stem and main valve may be removed through the top of the standpipe without excavating. The interior of the barrel shall be free from sharp edges and internal obstructions.

The upper section of the standpipe which carries the nozzle shall be secured to the lower section in such a manner that the upper section may be

rotated 360 degrees with a minimum of eight positions of equal angles, without excavation or use of special tools.

Hydrant construction shall allow depth of bury to be increased without excavation.

843.02 Materials All Materials used in the construction of hydrants shall be of the best commercial quality in their respective classes.

All castings shall be clean and perfect, no plugging or patching allowed. The machine Work on all parts must be true to gauge so that all parts shall be interchangeable from one hydrant to another of the same make and size.

All fire hydrants shall be ANSI/NSF Standard 61 certified.

All fire hydrants shall conform to the following:

Main Valve. 5 1/4 inch valve opening.

Depth of Bury. 5 feet unless otherwise specified or shown on the Plans.

Hydrant Inlet. 6 inch Mechanical joint side inlet.

Barrel. Two section, designed to prevent frost heave. All body bolts and nuts to conform to ASTM A307 (Grade B) cadmium or zinc plated.

Color. Hydrant below ground line, and upper standpipe section shall be painted with two coats of #515 Ensign Yellow.

Hose and Pumper Nozzle Threads. City of Dayton, Ohio, Standard Thread Specifications, Revised 1974, available from the Department of Water.

Hose Nozzles. Diametrically opposite, 2 1/2 inches with Koroseal gaskets, 2 17/32 inches I.D. x 3 5/16 inches O.D. x 3/16 inch thick.

Pumper Nozzle and Cap. In horizontal line from hose nozzles, one, 4 inch with Koroseal gasket 4 1/16 inches I.D. x 5 1/8 inches O.D.

Direction of Opening. Hydrants shall open right (clockwise direction), indicated by arrow cast in bonnet or cap.

Operating Nut and Cap Nuts. Square, 1 1/4 inches in length, tapered from 7/8 inch top to 15/16 inch base.

Packing. "O" Rings against bronze.

Lubrication. Any lubrication of stem, if needed, will be by either a closed oil reservoir system or alemite fitting. Lubrication shall be effective in a range of -50°F to +125°F.

Drain Valve Mechanism. Quick operating; drain shall be completely closed within two opening turns of the hydrant valve.

Seat Ring. The main valve seat ring shall be bronze and positioned in the hydrant with straight threads.

Spare Parts. Two each of all seat wrenches, spanner wrenches or any other tools needed to service and repair the hydrant shall accompany delivery

843.03 Installation. Hydrants shall be furnished and installed at the locations shown on the approved Plans in accordance to the City of Dayton's Typical Fire Hydrant Detail.

All hydrants shall stand plumb. Hydrants shall have hose nozzles parallel with, and the pumper nozzle perpendicular to, the curb line.

Unless otherwise shown on the Plans or directed by the Engineer, fire hydrants shall be located within the Right-of-Way; a minimum of 2 feet and a maximum of 8 feet behind the back of curb line; or as directed by the Engineer. Hydrants shall be of the proper length to suit the depth of cover over the water lines at the locations shown on the Plans and the necessary extensions shall be furnished to obtain the proper length. The maximum extension allowed is 24 inches.

The pit or trench for the fire hydrant shall be so excavated that when the hydrant is installed, the base shall rest on undisturbed soil and the hydrant shall be set plumb with nozzle outlet approximately 18 inches from the ground line. Hydrants shall be set in accordance with existing or proposed grade line which shall be approximately 2 inches below the bottom of the break connection on the hydrant standpipe.

All fire hydrants shall be installed with oak wood blocking against undisturbed earth, as approved by the Engineer, and with approved restrained joints between the water main and the hydrant.

Backfilling and compaction of the branch pipe to the fire hydrant and the fire hydrant shall conform to Item 810. The area around the drain shall be backfilled with 3/4 inch washed round gravel. The cost of furnishing and placing backfill shall be included in Item 810.

Immediately before installation of a fire hydrant, the following procedure shall be followed: (a) the hydrant shall be thoroughly inspected; (b) the hydrant interior shall be thoroughly cleaned; and (c) the hydrant shall be closed as many times as may be necessary to determine if all parts are in proper working order, with valves seating properly and the drain valve operating freely.

After installation, fire hydrants shall be painted as directed by the Engineer.

843.04 Hydrant Relocation. Relocation of a fire hydrant shall be accomplished by removing the existing hydrant, installing new 6 inch ductile iron pipe and fittings as required to set the hydrant at the location and elevation shown on the Plans, or as directed by the Engineer, resetting hydrant, blocking and backfilling to complete the Work.

Payment for installing new ductile iron pipe and fittings as required by this paragraph shall be paid at the price Bid per linear foot under Item 824. The cost of furnishing and placing backfill shall be included in Item 810.

843.05 Hydrant Removal. Where shown on the approved Plans or directed by the Engineer, the removal of a fire hydrant shall be accomplished by closing the watch valve, removing the hydrant, and capping or plugging the water line at the watch valve. The plugging or capping shall be in accordance with Item 824. All removed hydrants shall be delivered to the Department of Water, Division of Water Distribution, unless otherwise directed by the Engineer. No additional payment will be made for this delivery.

843.06 Hydrant Abandonment. Where shown on the approved Plans or directed by the Engineer, the abandonment of a fire hydrant shall be accomplished by closing the watch valve, removing the hydrant and barrel 18 inches below grade, filling the barrel with a grout, and capping or plugging the water line at the watch valve. The plugging or capping shall be performed in accordance with Item 824. All abandoned hydrants shall be delivered to the Department of Water, Division of Water Distribution, unless otherwise directed by the Engineer. No additional payment will be made for this delivery.

843.07 Approved Models. Unless approved by the Director, the only fire hydrants approved for use in the City of Dayton are those listed on the City's Qualified Products List.

843.08 Basis of Payment. Fire hydrants shall be paid for at the contract Unit Price bid for each hydrant installed or relocated, complete and ready for use, or for each hydrant abandoned, which Unit Price and payment shall constitute full compensation for all Work required to make a complete installation or abandonment including the furnishing and installing of blocking, restrained joints, backfill and hydrant extensions.

Payment shall be at the contract price for:

Item	Unit	Description
843	Each	Fire hydrant, installed
843	Each	Fire hydrant, relocated
843	Each	Fire hydrant, removal
843	Each	Fire hydrant, abandoned

ITEM 844 WATER MAIN TAP

844.01 Description
844.02 Materials
844.03 Installation
844.04 Operation of Valves
844.05 Valve Box
844.06 Thrust Blocks
844.07 Basis of Payment

844.01 Description. This item covers the Contractor's requirements on tapping water mains for mainline extension, connection or replacement Work. The City shall make all taps and install the tapping sleeve and valve. The Contractor shall be responsible for excavating and backfilling the trench; and installing the valve box and a thrust block.

The provisions of this item do not apply where the City makes the tap and installs the tapping sleeve and valve on a private job. The City shall perform all Work within the public Right-of-Way and charge the Contractor for all labor, Equipment and material as defined on the work order.

The provisions of this item do not apply when the City cannot make the tap due to the size of the tap. The Contractor shall refer to the supplemental Specifications or notes on the approved Plans for details.

844.02 Materials. All tapping sleeves and valves shall be provided by the City at no cost to the Contractor.

All backfill material shall be provided by the Contractor as specified under Item 810 and Item 813.

844.03 Installation. The water main tap that includes the installation of the tapping sleeve and valve shall be done by the City at no cost to the Contractor.

The Contractor shall be responsible for excavation to expose the main to be tapped and for backfilling the trench in accordance to Item 810 and Item 813.

844.04 Operation of Valves. All valves that affect the flow of water through water lines in service are to be operated only by personnel of the Department of Water.

844.05 Valve Box. Each tapping valve used shall be provided with a valve box by the City of Dayton. The Contractor shall install the valve box.

844.06 Thrust Blocks. Concrete thrust blocks of the sizes shown on the approved Plans or designated by the Engineer shall be provided by the Contractor. Concrete for the thrust blocks is to be included in the Unit Prices bid under Item 844.

844.07 Basis of Payment. Payment shall include the Contractor's cost to provide all labor and Materials to excavate, backfill the trench, and install the valve box and thrust block. Work for street restoration shall be included in its respective Bid item.

Payment shall be at the contract price for:

Item	**Unit**	**Description**
844	Each	__" x __" Water main tap

ITEM 845 WATER SERVICE REPLACEMENT

845.01 Description
845.02 Materials
845.03 Installation
845.04 Basis of Payment

845.01 Description. This item covers the Contractor's cost for the replacement of water services where the City and Contractor cooperates in the replacement of the water service line. This shall cover all water service lines regardless of size.

Each water service line shall be replaced from the water main to the curb stop or valve, unless an existing service line is deemed reusable and can be reconnected to the new water main. The Contractor shall be responsible for excavating and backfilling the trench. The City shall make the tap and install the water service line.

845.02 Materials. All tapping and piping Materials shall be provided by the City at no cost to the Contractor. This shall include the curb box and permit for the water service.

All backfill material shall be provided by the Contractor as specified under Item 810.

845.03 Installation. All tapping and piping Materials shall be installed by the City at no cost to the Contractor.

All backfill material shall be installed by the Contractor as specified under to Item 810.

845.04 Basis of Payment. Water service replacement payment shall be in accordance to the method of replacement as follows:

Method A: Hole-hogging / pushing / pulling from main to curb stop or valve;

Method B: Open cut from the water main to the curb stop or valve; or,

Method C: Reuse of existing service line whereas Contractor excavates and restores at point of tie-in.

Payment shall include the Contractor's cost to provide all labor and Materials to excavate and backfill the trench and to install the curb box. Work for street restoration shall be included in its respective Bid item.

Payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
845	Each	Service replacement, method "__"

ITEM 846 WATER APPURTENANCE ADJUSTMENT

846.01 Description
846.02 Materials
846.03 Water Service Adjustments
846.04 Curb Box Adjustment/Relocated
846.05 Meter Pit Adjustment
846.06 Valve Box Adjustment/Replacement
846.07 Fire Hydrant Adjustment
846.08 Basis of Payment

846.01 Description. Water appurtenances include valve or curb boxes, meter pits, water services, or fire hydrants. This item shall cover the labor, Materials and incidentals necessary for the construction, reconstruction, reinstallation, cutting, raising and lowering existing water appurtenances. Defective material, existing or otherwise, shall be replaced with new material or its equivalent as approved by the Engineer.

846.02 Materials. Materials used for the adjustment of water services or meter pits shall meet the requirements in the Water Department's "Standards for Taps, Services, Meters, and Backflow Prevention."

Materials used for valve and curb box adjustment must be listed on the Water Department's Qualified Products List.

Fire hydrant adjustment Materials must be manufactured for the particular make and model of hydrant to be adjusted.

The Materials to be used shall be approved by the Engineer.

846.03 Water Service Adjustments. The water service adjustments to be paid for will be the actual number of units adjusted according to the following provisions:

(a) Prior to construction, the existing water service was active and is to remain active.

(b) The existing water service would (if the condition could exist) pass through Sewer piping, Structures or other type units in which a water service pipe would be objectionable as determined by the Engineer.

(c) The existing water service cannot be sprung slightly so as to miss the Sewerage construction.

Water services adjustments will not be paid for when cut and replaced purely for the Contractor's convenience. Water services may not be raised to clear a Sewer if the resultant depth of cover over the water service would be less than 3 1/2 feet.

When it becomes necessary to adjust a water service, the necessary piping Work will be performed by the City Water Distribution crew. The Contractor will expose the service as required to complete the adjustment and perform any additional backfilling required under this pay item.

846.04 Curb Box Adjustment/Relocated. This item will include the raising or lowering of the curb box top to match the proposed grade and the moving of the box to the property line if necessary.

When it is necessary to relocate the curb box, the Contractor shall excavate the service from the existing curb stop location to the proposed stop location. The City Water Distribution crew will perform the piping Work required to move the curb stop. The Contractor will then reset the curb box and complete the backfilling.

846.05 Meter Pit Adjustment. This item will include the raising or lowering of the meter pit to match the proposed grade and the moving of the pit if required to keep it out of the street Right-of-Way. All Work must be performed in conformance with the Water Department's "Standards for Taps, Services, Meters, and Backflow Prevention." This item also includes lowering the service piping as necessary to maintain a minimum of 48 inches of cover over the service.

A City permit must be obtained for a meter pit adjustment. That permit must be obtained at the One Stop Center, Department of Building Services. These permits are only issued to City of Dayton licensed plumbing contractors or excavators. The cost of this permit is included in this pay item.

846.06 Valve Box Adjustment/Replacement. This item will include the raising or lowering of the valve box to match the proposed grade and the replacement of any damaged valve boxes (whether damaged prior to or during construction).

When valves are located deeper than can be accommodated by the standard shaft length on the valve boxes, extensions shall be fabricated from 6 inches diameter Schedule 40 PVC pipe conforming to ASTM D1785. The valve

box extension shall be placed over the base and under the middle section and shall be of sufficient length to allow final adjustment of valve box height with the upper section in the normal manner.

If a valve is not installed with the operating nut within 72 inches of the proposed ground surface, a permanent shaft extension shall be furnished and installed. The extension shaft shall have an operating nut with the same dimensions and markings as that of the valve and shall be capable of transmitting the operating torque specified for the valve. The extension shaft shall be mechanically attached to the operating nut.

846.07 Fire Hydrant Adjustment. Fire hydrants may be adjusted to grade either using extensions or by resetting the hydrant to the proposed elevation. The maximum extension allowed on a hydrant is 24 inches. The minimum cover permitted over the hydrant branch is 4 1/2 feet. When it becomes necessary to lower the hydrant branch to achieve the minimum cover, payment for the lowering of that piping is included as part of this item.

846.08 Basis of Payment. With specific limitations as stated in the preceding provisions, payment shall be made at the contract Unit Price bid per each, the number determined as provided above, and under the following:

Item	Unit	Description
846	Each	Water service adjustment
846	Each	Curb box adjusted to grade
846	Each	Curb box relocated
846	Each	Meter pit adjustment
846	Each	Valve box adjustment
846	Each	Fire hydrant adjustment

ITEM 847 CUTTING AND PLUGGING (OR CAPPING) WATER MAIN

847.01 Description
847.02 Materials
847.03 Construction
847.04 Basis of Payment

847.01 Description. This item shall consist of providing all labor, Equipment and Materials to cut and plug or cap existing water mains at points designated on the Plans, removing abandoned pipe if required, placing temporary and/or permanent blocking, and backfilling.

847.02 Materials. The plugs and/or caps used in connection with the Work under this item for cast iron or ductile iron pressure pipe shall be either mechanical joint or slip joint as required and shall be manufactured in accordance with AWWA C110. Concrete pressure pipe shall be plugged or capped in accordance with the manufacturer's recommendation. The concrete used in providing the blocking shall have a minimum strength of Class F concrete per Item 499. Abandonment plugs shall be accomplished with Class F concrete or bricks and mortar as approved by the Engineer.

847.03 Construction. The Contractor shall cut the existing pipe at the point designated. The method of cutting shall be approved by the Engineer. After the plug or cap is installed, the Contractor shall install the required blocking to adequately brace the plug or cap. When one side of the water main is to remain in service, steel beams encased in concrete shall be utilized as blocking material. Blocking may be used temporarily against the abandoned pipe; however, the permanent blocking shall be installed such that future disturbances of the abandoned pipe shall not affect the permanent blocking. After the water line has been plugged or capped and the permanent blocking has been installed, the hole shall be backfilled as specified under Item 810.

847.04 Basis of Payment. The Unit Price Bid for cutting and plugging or capping water lines shall be full compensation for all labor, Materials and Equipment required to complete the Work as specified including concrete blocking, removal of abandoned pipe, and backfill. Replacement of pavement or Sidewalk shall be paid for under the appropriate items.

Payment shall be at the contract price for:

Item	Unit	Description
847	Each	Cut and plug (cap) ___" water line

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