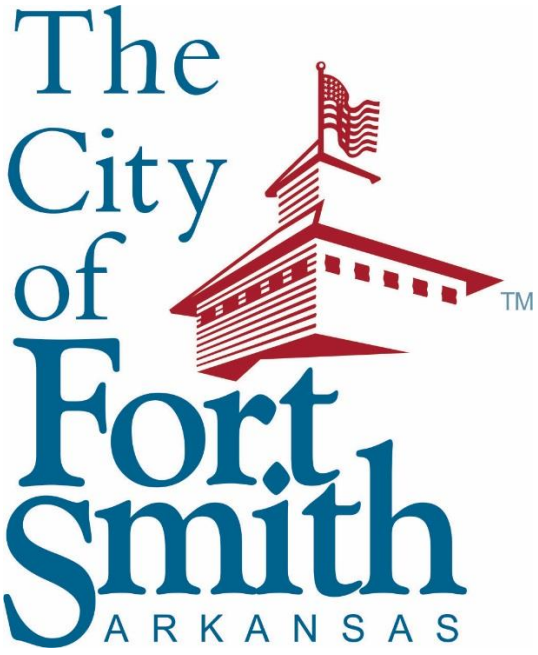
STANDARD SPECIFICATIONS

FOR

PUBLIC WORKS CONSTRUCTION



OCTOBER 2018 EDITION

STANDARD SPECIFICATIONS
FOR PUBLIC WORKS CONSTRUCTION

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101.01 ABBREVIATIONS AND DEFINITIONS

Whenever the following abbreviations are used in these specifications or on the plans, they are to be construed the same as the respective expressions represented:

A. INDUSTRY ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADEQ	Arkansas Department of Environmental Quality
AGC	Associated General Contractors of America
ArDOT	Arkansas Department of Transportation
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ARA	American Railway Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Services Association
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
COE	U.S. Army Corps of Engineers
CRSI	Concrete Reinforcing Steel Institute
FHWA	Federal Highway Administration
IMSA	International Municipal Signal Association
ITE	Institute of Traffic Engineers
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
SAE	Society of Automotive Engineers
UL	Underwriter's Laboratory
USC	United States Code

B. CONTRACT ABBREVIATIONS FOR CONSTRUCTION WORK

AC	Asphalt Cement	ASPH	Asphalt
ACHM	Asphalt Concrete Hot Mix	ASSY	Assembly
		AST	Asphalt Surface Treatment
ADJ	Adjusted	AUTO	Automatic
AGG	Aggregate(s)	BIND	Binder
ALUM	Aluminum	BIT	Bituminous
APPR	Approach	BLDG	Building(s)

BLKT	Blanket
BNG(S)	Bearing(s) BR Bridge(s)
BST	Bituminous Surface Treatment
C&G	Curb and Gutter
CA	Corrugated Aluminum
CEM	Cement
CF	Cubic Feet
CI	Cast Iron
CL	Class
CLVT(S)	Culvert(s)
CMP	Corrugated Metal Pipe
CNTL	Control, Controller
CO	Clean Out
CONC	Concrete
COND	Conduit
CONST	Construction
CONT	Continuous, Continuously
CORR	Corrugated
CRSE	Course
CS	Corrugated Steel
CU, cu	Cubic
CULV	Culvert
CY	Cubic Yard
DBL	Double
DI	Drop Inlet(s), Ductile Iron
DIA	Diameter
DWY(S)	Driveway(s)
ELEV	Elevation
EMUL	Emulsified
EXC	Excavation
EXP	Expansion
F	Fahrenheit
F&I	Furnish and Install
FDN	Foundation
FES	Flared End Section(s)
FNC	Fence(s)
FT	Foot or Feet
FURN	Furnish, Furnishing
GA	Gage, Gauge
GAL	Gallon
GALV	Galvanized
GR	Grade, Graded
GRVL	Gravel
GV	Gate Valve
HI	High Intensity
HMA	Hot Mix Asphalt
HMAS	Hot Mix Asphalt Stabilized
HP	Horsepower
I.D.	Inside Diameter
IN	Inch (es)
INST	Install, Installing, Installation
LAB	Laboratory
LB	Pound
LF	Linear Foot or Feet
LS	Lump Sum
MAINT	Maintenance
MATL	Material(s)
MAX	Maximum
MES	Mitered End Section(s)
MET	Metal
MG	1000 Gallons
MIN	Minimum
MOB	Mobilization
MOD	Modified
NO	Number(s)
NON MET	Non-Metallic
NON REINF	Non-Reinforced
NPDES	National Pollutant Discharge Elimination System
O.D.	Outside Diameter
OFF	Office
OH	Overhead
PC	Portland Cement
PI	Plasticity Index
PM	Plant Mixed
ppm	parts per million
PRCST	Precast
psi	pounds per square inch
PVC	Polyvinylchloride
PVMT	Pavement(s)
PVNG	Paving
R	Radius
R&D	Removal and Disposal
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
RDWY	Roadway(s)
RECON	Reconstruct(ed)
REFL	Reflectorized
REHAB	Rehabilitate, Rehabilitation
REINF	Reinforced, Reinforcing
RELOC	Relocate, Relocation
REMV	Removal, Removing, Removed
REPL	Replace, Replacing
RESTOR	Restoration
REBAR	Reinforcing Steel
RMC	Rigid Metallic Conduit
RNMC	Rigid Non-Metallic Conduit
ROW, R/W	Right-of-Way
SAN	Sanitary

sf	square feet	SY	Square Yard
SGNL(S)	Signal(s)	SYS	System, Systems
SHLD(S)	Shoulder(s)	TEMP	Temporary
SPEC	Special	TERM	Terminal
sq	Square	THERMPL	Thermoplastic
sta	Station (100feet)	TMBR	Timber
STAB	Stabilized, Stabilization	TN	Ton
		TRAF	Traffic
STKPL	Stockpile, Stockpiling	TRP	Triple
STL	Steel	TRMT	Treatment
STN	Stone	TRTD	Treated
STR(S)	Structure(s)	UNCL	Unclassified
STRL	Structural	UNTRTD	Untreated
SWPPP	Storm Water Pollution Prevention Plan	VERT	Vertical
		YD	Yard

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

Addenda. Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

Agreement. The written agreement between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Advertisement. The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

Award. The acceptance by the Owner of a proposal.

Bid. The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bid Bond. The security furnished with a bid to guarantee that the bidder will enter into the Contract if the bid is accepted.

Bid Item (Pay Item). A specifically described unit of work for which a price is provided in the Contract.

Bid Proposal Form. The approved form on which the Owner requires bids to be prepared and submitted for the work.

Bidder. An individual, partnership, corporation, or joint venture submitting a bid for the advertised work. (The terms "Bidder" and "Contractor" are frequently used synonymously.)

Calendar Day. Any day shown on the calendar, beginning and ending at midnight. If a day is not identified by any other modifier, it shall be considered a calendar day.

Change Order. A written order signed by the Owner and Contractor, covering contingencies, increases or decreases in contract quantities, and additions or alterations to

the plans or specifications, within the scope of the Contract and establishing the basis of payment and time adjustments for the work affected by the changes, issued on or after the Effective Date of the Agreement.

Construction Field Change. A written order issued by the Owner covering minor changes in the work, but which does not involve a change in the Contract Price or the Contract Time.

Contract. The written agreement between the Owner and the Contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the Work, the furnishing of labor and materials, and the basis of payment.

Contract Documents. The Contract Documents includes the Agreement; Addenda (which pertain to the Contract Documents); Contractor's Bid (including documentation accompanying the Bid and any Post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement; the Bonds; the Specifications and Special Conditions; the Drawings as the same are more specifically identified in the Agreement; together with all written modifications, Change Orders and Engineer's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics and the like that may be furnished by Owner to Contractor are not Contract Documents.

Contract Time. The number of calendar days or the dates stated in the Agreement to achieve Substantial Completion of the Work.

Contractor. The individual, partnership, corporation, or any combination thereof, or joint venture contracting with the Owner for performance of the prescribed work. (The terms "Contractor" and "Bidder" are frequently used synonymously.)

Defective. An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents or does not meet the requirements of any inspection, test or approval referred to in the Contract Documents, or has been damaged prior to final payment.

Effective Date of Agreement. The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

Engineer. The chief engineer of the contracting Department of the City of Fort Smith, or other person or firm designated by the Board of Directors, acting directly or through a duly authorized representative, who is responsible for engineering and administrative supervision of the Contract.

Equipment. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and tools and apparatus necessary for the proper construction and acceptable completion of the work.

Extra Work. An item of work not provided for in the Contract as awarded but found essential by the Owner for the satisfactory completion of the Contract within its intended scope.

Holidays. The City of Fort Smith observes the following legal holidays: New Year's Day, January 1; Martin Luther King's Birthday/Robert E. Lee's Birthday, 3rd Monday in January; Memorial Day, last Monday in May; Independence Day, July 4; Labor Day, 1st Monday in September; Veteran's Day, November 11; Thanksgiving Day and day after, 4th Thursday and Friday in November; Christmas Eve, December 24; and Christmas Day, December 25. If a holiday falls on Saturday or Sunday, the observed day shall be the Friday preceding the Saturday or the Monday following the Sunday.

Incidental item. Work shown on the plans but for which there is no bid item included. This work shall not be paid for separately; rather the cost of the work is considered to be included in the contract amount bid for the project.

Inspector. The Engineer's or Owner's authorized representative assigned to make detailed inspections of Contract performance.

Laboratory. The testing laboratory of the Owner or any other testing laboratory which may be designated by the Owner.

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

Materials. Any substances specified for use in the construction of the project and its appurtenances.

Modification. (a) A written amendment of the Contract Documents signed by both parties, (b) a Change Order, or (c) a Construction Field Change. A modification may only be issued after the Effective Date of the Agreement.

Milestone. A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work for which liquidated damages may or may not apply.

Notice of Award. The written notice by Owner to the apparent successful Bidder stating that upon timely compliance by the apparent successful Bidder with the conditions listed therein, Owner will sign and deliver the Agreement.

Notice to Proceed. A written notice given by Owner to Contractor fixing the date on which the Contract Time will commence to run and on which Contractor shall start to perform his obligation under the Contract Documents.

Owner. The City of Fort Smith, Arkansas with whom Contractor has entered in the Agreement and for whom the Work is to be performed.

Payment Bond. The approved form of security, executed by the Contractor and his/her Surety or Sureties, guaranteeing the payment of all legal debts of the Contractor pertaining to the construction of the project.

Performance Bond. The approved form of security, executed by the Contractor and his/her Surety or Sureties, guaranteeing complete performance of the Contract and all supplemental agreements thereto.

Plans. The approved Project Plans and Standard Drawings, profiles, typical cross sections, and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the Work to be performed. All documents are to be considered as a part of the plans whether or not noted in the Special Conditions. Working drawings and other Contractor submittals are not Plans as so defined. (The terms "Drawings" and "Plans" are frequently used synonymously.)

In the above definition, the following terms are defined as follows:
(a) Standard Drawings - The City of Fort Smith Standard Drawings.
(b) Project Plans - The Project Plans are specific details and dimensions peculiar to the Work and are supplemented by the Standard Drawings insofar as the same may apply.

Project. The specific improvements to be constructed together with all appurtenances and construction to be performed thereon at the prices quoted.

Registered Professional Engineer. An Engineer registered in the State of Arkansas by the Arkansas State Board of Registration for Professional Engineers and Land Surveyors. All details, drawings, calculations, and reports submitted by the registrant as required by these specifications shall be certified, signed, and stamped with the seal or facsimile thereof as authorized by the State Board.

Registered Professional Land Surveyor. A Land Surveyor registered in the State of Arkansas by the Arkansas State Board of Registration for Professional Engineers and Land Surveyors. All plats submitted by the registrant as required by these specifications shall be certified, signed, and stamped with the seal or facsimile thereof as authorized by the State Board.

Registered Scale Mechanic. A person registered with the Arkansas Bureau of Standards, Division of Weights and Measures, as being qualified by training and experience to make adjustments and repairs to commercial scales and performs such work as a skilled trade.

Right-of-Way. A general term denoting land, property, or interest therein, acquired for or devoted to a roadway or other public use.

Shop Drawings. All drawings, diagrams, illustration, schedules and other data which are specifically prepared by Contractor, Subcontractor, manufacturer, fabricator, supplier or distributor to illustrate some portion of the Work

Special Conditions. Additions and revisions to the standard specifications covering conditions peculiar to an individual project.

Specifications. The directions, provisions, and requirements contained in the Standard Specifications or as modified by the Special Conditions. Whenever the term “these specifications” is used in this book, it means the provisions set forth in the contract.

Standard Specifications. This printed book of Standard Specifications for Public Works Construction. Unless otherwise noted, the Edition in effect on the date of advertisement.

Station. A station when used as a definition or term of measurement will be 100 linear feet measured horizontally.

Subcontractor. An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for performance of a part of the Work.

Superintendent. The Contractor's authorized representative in responsible charge of the work, present at the work site at all times during the progress to supervise and direct construction, to receive and fulfill instructions from the Owner's representative, and to accept orders for changed and extra work.

Substantial Completion. The time at which the Work has progressed to the point where, in the opinion of the Owner, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended without further disruption to the public or occupants of the facility.

Surety. The company, other than the Contractor, executing a bond furnished by the Contractor.

Unit Price Work. Work to be paid for on the basis of unit prices.

Work. The furnishing of all materials, labor, equipment, tools, and incidentals necessary or convenient to the successful completion of the project and the carrying out of the duties and obligations imposed by the Contract.

101.02 EXPRESSIONS

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

SECTION 102
BIDDING REQUIREMENTS AND CONDITIONS

102.01 QUALIFICATIONS OF BIDDERS

The Owner may make such investigations as deemed necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is property qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

102.02 NOTICE TO CONTRACTORS

After the date is fixed for the bid opening for the work, the Owner will give notice of bidding to contractors. The advertisement will contain a description of the proposed work, and information to the bidder regarding access to proposal forms, plans, and specifications, and the amount and nature of the proposal guaranty.

102.03 CONTENTS OF PROPOSAL

Upon request, the Owner will furnish the prospective bidder with Plans and a Proposal form. The Proposal form will state the location and description of the contemplated construction and will show the estimate of the various quantities and kinds of work to be performed or materials to be furnished, and will have a schedule of items for which unit or lump sum bid prices are invited. The Proposal form will state the time in which the work must be completed, the amount of the proposal guaranty, and the date, time and place of the opening of proposals. The Proposal form will also include any special provisions or requirements that vary from or are not contained in the Standard Specifications.

All papers bound with or attached to the Proposal form are considered a part thereof and shall not be detached or altered when the Proposal is submitted.

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

The prospective bidder will be required to pay the Owner the sum stated in the advertisement for each copy of the Proposal form and each set of plans.

102.04 REJECTION OF BID PROPOSALS

The Owner reserves the right to refuse to award a Contract due to a lack of competency or adequate machinery, plant, other equipment or personnel as revealed by the investigation allowed under Subsection 102.01 "Qualification of Bidders." In performing the investigation, the Owner may request additional information on and evaluate the following factors:

A. Uncompleted work that, in the judgment of the Owner, might hinder or prevent the prompt completion of additional work if awarded.

B. Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of issuance of Proposals.

C. Misconduct which, in the opinion of the Owner, is of such a serious nature as to adversely affect the ability of the Contractor to perform future work.

D. Default under previous contracts.

E. Failure to reimburse the Owner for monies owed on any previously awarded contracts including those where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the Owner for monies owed.

F. Previous failure to execute a Contract and/or submit acceptable bonds for any subsequent advertisement of that project.

G. Unsatisfactory performance record as shown by past work for the Owner judged from the standpoint of workmanship and progress.

H. If the prospective bidder is the Contractor on a current Contract with the Department on which Liquidated Damages are being assessed due to failure to complete the work within the Contract time.

I. Default under previous contracts.

102.05 INTERPRETATION OF QUANTITIES IN PROPOSAL SCHEDULE

The quantities appearing in the schedule are approximate only and are prepared for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the Contract. The scheduled quantities of work to be done and materials to be furnished may each be increased, decreased, or omitted as hereinafter provided.

102.06 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL CONDITIONS, AND THE SITE OF THE WORK

The Owner will prepare plans and specifications giving such directions as will enable a competent Contractor to carry them out. The bidder is expected to examine carefully the site of the proposed work, the proposal, plans, specifications, supplemental specifications, special conditions, contract forms (including all addenda) before submitting a proposal. The submission of a bid shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the plans, specifications, supplemental specifications, special provisions, and contract. The failure or omission of any bidder to examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect to his bid.

When the Plans or Special Conditions include information pertaining to subsurface exploration, boring logs, soil survey information, or other preliminary investigations, such information was obtained by the Owner for design and estimating purposes only. This and other subsurface investigation information may be available and prospective bidders will be permitted to examine such information upon request. It is expressly understood and agreed that said information does not constitute a part of the Contract and represents only the best knowledge of the Owner as to the location, character, and depth of the materials encountered. This information is only included and made available so that prospective bidders may have access to subsurface information obtained by the Owner and is not intended to be a substitute for personal investigation, interpretation, and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated.

102.07 PREPARATION OF PROPOSAL

The proposal shall be submitted upon the forms furnished to the prospective bidder by the Owner. The bidder shall specify a unit price in words or figures, or both if required, for each pay item for

which a quantity is given and should also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose, and the total amount obtained by adding the amounts of the several items. These extensions and totals as calculated by the bidder are for information only; the total proposal amount will be the true sum of the products obtained by multiplying the approximate quantities by their respective unit bid prices. Any notes, comments, or amounts written outside the column headed "Unit Bid Price" will be disregarded when calculating the total proposal amount. All figures shall be in ink and legible. The unit bid price should not be carried beyond the cent ($0.01). Any figures on the unit bid price beyond the cent will be dropped.

Should a bidder need to change a unit bid price on the bid proposal schedule of items, the original entry shall be marked out and the new entry shall be initialed by the person signing the proposal or another officer of the firm. Should a bidder need to change an extension, subtotal, or total on the bid proposal schedule of items, the original entry should be marked out and the new entry should be initialed by the person signing the proposal or another officer of the firm. Changes are defined as any physical alterations to the original figures including, but not limited to erasures, cross-outs, line-outs, or liquid paper corrections (white-outs).

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation, or by an agent of the Contractor legally qualified and acceptable to the Owner. If the bidder's proposal is made by an individual, the name of the individual must be shown; by a partnership, the name of each partnership member must be shown; as a joint venture, the name of a member or officer of each of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation must be shown.

102.08 IRREGULAR PROPOSALS. Proposals may be considered irregular and may be rejected for the following reasons:

A. If changes are made to the entries for unit bid prices on the bid proposal schedule of items and they are not initialed by the person signing the proposal or an officer of the firm.

B. If the proposal does not contain a unit price or extension for each pay item listed except in the case of authorized alternate pay items or lump sum pay items.

C. If the proposal is not prepared and signed with ink.

D. If the proposal is not accompanied by the proper proposal guaranty.

E. If a proposal is received from an individual, firm, partnership, or corporation with an interest, as principal, in another proposal for the same project.

F. If any unit price entered on the Schedule of Items is illegible.

G. If the proposal is not submitted by the prospective bidder who purchased the original proposal.

H. If the proposal is on a form other than that furnished by the Owner; or if the form is altered except as authorized; or any part thereof is detached.

I. If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind that may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.

J. If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

K. Unbalanced proposals in which the prices for some items are out of proportion to the

reasonable costs representative of those items.

102.09 PROPOSAL GUARANTY

No proposal will be considered by the Owner unless it is accompanied by a guaranty in the form of either a bank draft, certified check, or cashier's check drawn on a solvent bank or trust company, or a bidder's bond duly executed by the Bidder as principal and having as surety thereon a surety company approved by the Owner. The guaranty shall be made payable to the City of Fort Smith, Arkansas and shall be in an amount not less than five (5) percent of the bid.

102.10 DELIVERY OF PROPOSALS

Each proposal must be submitted in a sealed envelope bearing on the outside the name of the Bidder, his address, his Arkansas Contractor's license number, the name of the project for which the bid is submitted. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed to the contracting Department of the City of Fort Smith and be identified as a bid proposal. In the event that the second envelope is not identified as a bid proposal, the Owner will not be responsible for consideration of the proposal if it is not recognized as such by the time designated for receipt of proposals. Any proposal received after the time stated in the proposal form for receipt of proposals will not be accepted and will be returned unopened to the bidder.

102.11 WITHDRAWAL/MODIFICATION OF PROPOSALS

A. A bidder may withdraw or modify a proposal after it has been deposited with the Owner, provided a request for withdrawal or modification, as described herein, is received by the contracting Department of the City of Fort Smith before the closing time set for receipt of proposals. Opened proposals may not be withdrawn within 60 days after the actual date of the opening of proposals.

B. A request to withdraw or modify a proposal before bid opening must be legible and in one of the following forms.

(1) Written Request. Written requests for withdrawal of the bid proposal shall be signed by the bidder. Proposals withdrawn in this manner may be modified and resubmitted, but the modifications must be legible and must satisfy all other criteria for changes listed in this Section. Failure to resubmit a modified proposal before the time set for bid opening will result in no bid on behalf of the company that has withdrawn its bid.

(2) Facsimile Communication. Proposals may be modified by facsimile communications at any time prior to the scheduled closing time for receipt of bids, provided such facsimile communications is received by the contracting Department of the City of Fort Smith prior to closing time, and provided further, the Owner is satisfied that a written confirmation of the facsimile modifications over the signature of the Bidder was mailed prior to the closing time. The facsimile communication should not reveal the bid price but should provide the addition or subtraction or other modification so that the final price or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two days from the closing time, no consideration will be given to the facsimile modification.

102.12 PUBLIC OPENING OF PROPOSALS

Proposals will be opened and read publicly at the time and place indicated in the Advertisement For Bids. Bidders, their authorized agents, and other interested parties are invited to be present.

102.13 DISQUALIFICATION OF BIDDERS

Only one proposal from an individual, firm, partnership, or corporation, whether under the same or under different names, will be considered. Should it appear to the Owner that any bidder is interested, as principal, in more than one proposal for any one project, all such proposals in which the bidder is interested will be rejected.

A bidder may, however, submit a proposal as principal and also quote as a subcontractor to other principals on the same project provided the quotation as a subcontractor does not exceed 60% of the total bid, and by so doing will not thereby be liable for disqualification.

Furthermore, it is not the intent of this specification to disqualify any proposal because of quotations made by any one subcontractor to more than one principal. Should there be reasonable grounds for believing that collusion or a combination exists, all proposals may be rejected and bidders or participants in such combination or collusion will not be considered in future proposals for the same work.

102.14 MATERIAL GUARANTY

The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

102.15 PROJECT WITHDRAWAL

The City of Fort Smith reserves the right to withdraw a project previously scheduled for letting. In the event of such withdrawal, potential bidders will be notified by the Owner, time permitting. In any case, an announcement will be made before opening bids for such withdrawn project and the unopened bids will be returned to the bidders.

102.16 SUBCONTRACTORS

The bid proposal shall contain the names and addresses of all major material suppliers and subcontractors listing the description of work to be performed by each subcontractor. Acceptance or rejection of the listed subcontractors or suppliers shall be in accordance with subsection 108.01 "Subletting of Contract."

SECTION 103
AWARD AND EXECUTION OF CONTRACT

103.01 CONSIDERATION OF PROPOSALS

After the proposals are opened and read, they will be compared on the basis of the bid total, which is the summation of the products obtained by multiplying the approximate quantities shown in the Proposal by the unit bid prices. Errors found in the bidder's extensions will be corrected before release of the final summation. The results of such comparisons will be immediately available to the public.

The Owner reserves the right to reject any or all proposals, to waive technicalities, or to advertise for new proposals.

103.02 AWARD OF CONTRACT

If it is the opinion of the Owner that the Owner's best interest would be served thereby, the contract shall be awarded, within 60 calendar days after the opening of the proposals, to the lowest bid submitted by a responsible Bidder. The responsibility of the Bidder shall be determined according to the competency investigation provided for in subsection 102.01 "Qualification of Bidders." A preference of 5% shall be granted to the lowest qualified bid for a Bidder that qualifies as a Firm Resident in the City pursuant to Ordinance No. 50-15. The maximum monetary amount of any preference granted, regardless of the bid amount or percentage of preference, shall be One Hundred Thousand Dollars ($100,000.00). The successful bidder will be notified by letter of the bid acceptance and of the award of the Contract.

The lowest bid shall be determined by deducting any permitted deductive alternates desired to be exercised by the Owner from the base bid. If the determined lowest base bid is greater than the funds appropriated (the funds currently available for the project as determined by the Owner prior to opening of any bids) but is in excess of the amount appropriated by no more than 25% of the amount appropriated, the Owner may negotiate an award with the apparent responsible low Bidder. At any time, the language of this subsection 103.02 shall be interpreted in accordance with controlling Arkansas state law.

103.03 CANCELLATION OF AWARD

The City of Fort Smith reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the City of Fort Smith.

103.04 RETURN OF PROPOSAL GUARANTY

All proposal guaranties in the form of checks, except those of the three lowest bidders, will be returned within three days following the opening and verification of the proposals. The retained proposal guaranties of the three lowest bidders will be returned after the Contract has been executed, or if no award has been made within the allowable time after the date of opening of the bids, upon demand of the Bidder at anytime thereafter, so long as they have not been notified of the acceptance of their bid.

103.05 REQUIREMENT OF PERFORMANCE BONDS, PAYMENT BONDS, MAINTENANCE BONDS, AND LIABILITY INSURANCE.

A. BONDS. Prior to or simultaneously with the execution of the Contract, the successful bidder shall furnish bonds with approved sureties in the amounts and for the purposes noted below:

(1) Performance and Payment bond or bonds in a sum equal to the full amount of the Contract as security for faithful performance of the contract and for the payment to all persons and entities performing labor on the project or furnishing materials in connection with the project; and,

(2) Guarantee (maintenance bond) in a sum equal to an amount not less than fifty (50) percent of the total construction cost of the project, which bond shall be in effect for a period of twelve (12) months (except as to bonds for Engineering Department projects which shall be in effect for a period of twenty-four (24) months) after substantial completion on the project as security for the satisfaction of the guarantee and warranty of in-service operation of all materials, equipment and work as described in subsection 108.12 "Warranty and Guarantee."

The bonds shall be in the forms prescribed by the bidding documents and shall be signed by a licensed Arkansas Resident or Non-Resident Agent of the Surety who shall attach to each bond a Power of Attorney supporting the Agent's signature.

In event the surety or bonding company fails or becomes financially insolvent, the Contractor shall, within five days of such failure, or insolvency, file a new bond in the amount designated by the Owner. The Owner reserves the right to refuse bonds from sureties with a record of unsatisfactory performance under previously accepted bonds.

B. INSURANCE. Before any Work at the site is started, Contractor shall deliver to Owner certificates (and other evidence of insurance requested by Owner) which Contractor is required to purchase and maintain as stated below.

(1) Contractor's Liability Insurance:

(a) Contractor shall purchase and maintain such commercial general liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance and furnishing of the Work and Contractor's other obligations under the Contract Documents, whether it is performed or furnished by Contractor, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

1. Claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. Claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
3. Claims for damages because of bodily injury, sickness or disease, or death of any person other that Contractor's employees;
4. Claims for damages insured by personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or (ii) by any other person for any other reason;
5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom;
6. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

(b) The insurance required by this paragraph shall include the specific coverages,

and be written for not less than the limits of liability and coverages specified or required by Law, whichever is greater.

1. Workers' compensation: Statutory

2. Employer's Liability:
   $100,000 Each person

3. Commercial General Liability:
   Bodily Injury (including completed Operations and products liability)
   $1,000,000 Each occurrence
   $2,000,000 Annual Aggregate
   Property Damage
   $1,000,000 Each occurrence
   $2,000,000 Annual Aggregate
   or a combined single limit of $5,000,000

4. Commercial Automobile Liability:
   Bodily Injury
   $500,000 Each person
   $1,000,000 Each occurrence
   Property Damage
   $500,000 Each occurrence
   or a combined single limit of $1,000,000

5. The insurance specified above, except Workers' Compensation and Employer's Liability, shall be endorsed to include the Owner as additional insureds thereunder.

(c) The commercial general liability insurance shall include completed operations insurance and premises/operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed, or renewal refused until at least thirty days' prior written notice has been given to Owner by certified mail. All such insurance shall remain in effect until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with section 108.12 "Warranty and Guarantee." In addition, Contractor shall maintain such completed operations insurance for at least two years after final payment and furnish Owner with evidence of continuation of such insurance at final payment and one year thereafter.

(d) The property damage liability coverage under this policy shall contain no exclusion (commonly referred to as XC&U exclusion) relative to blasting, explosion, collapse of buildings, or damage to underground property. This policy shall provide Broad Form Property Damage coverage.

(e) Owner, its officers, employees, and volunteers, must be expressly covered as insured with respect to liability arising out of the activities by or on behalf of the named insured in connection with this project. The Contractor's insurance shall be primary as respect to Owner, its officers, employees and volunteers. Any other coverage (insurance or otherwise) available to Owner, its officers, employees and volunteers shall be excess over the insurance requirements contained herein.

(2) Contractual Liability Insurance: The commercial general liability insurance required above shall include contractual liability insurance applicable to Contractor's obligations under subsection 107.15 "Responsibility for Damage Claims." The insurance required by this paragraph shall be written for not less than the limits of liability and coverages specified.

(3) Property Insurance: Contractor shall purchase and maintain property insurance upon the Work at the Site to the full insurable value thereof. This insurance shall be completed value form, shall include the interests of Owner, Contractor, Subcontractors, all of whom shall be listed as insured or additional insured parties, shall insure against the perils of fire and extended coverage and shall include "at risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and shall include damages, losses, and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property including but not limited to fees and charges of engineers, architects, attorneys, and other professionals. If not covered under the "all risk" insurance, Contractor shall purchase and maintain similar property insurance on portions of the Work stored on and off the Site or in transit when such portions of the Work are to be included in an Application for Payment.

(4) Waiver of Rights:

(a) Owner and Contractor waive all rights against each other for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to subsection 103.05B (3) and any other property insurance applicable to the Work, and also waive all such rights against the Subcontractors, and all other parties named as insured in such policies for losses and damages so caused. Each subcontract between Contractor and Subcontractor shall contain similar waiver provisions by the Subcontractor in favor of Owner, Contractor, and all other parties named as insureds. None of the above waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by the Owner as trustee or otherwise payable under any policy so issued.

(b) Owner and Contractor intend that any policies provided in response to section 103.05B (3) shall protect all of the parties insured and provide primary coverage of all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage, the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds; and if the insurers require separate waiver forms to be signed by any Subcontractor, Contractor shall obtain the same.

(c) Acceptance of Insurance: If Owner has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by Contractor in accordance with section 103.05B on the basis of its not complying with the Contract Documents, Owner shall notify Contractor in writing thereof within ten days of the date of delivery of such certificates and other evidence of insurance to Owner in accordance with section 103.05B. Contractor will provide to the Owner such additional information in respect of insurance provided by him as the other may reasonably request.

Failure to furnish the required proof of Liability Insurance with the submission of the Contract signed by the successful bidder shall be just cause for the

cancellation of the award and forfeiture of the proposal guaranty, which shall become the property of the City of Fort Smith, not as a penalty, but in liquidation of damages sustained. Failure to furnish notice of cancellation or change in the policy will result in the temporary suspension of work as provided in subsection 108.07 "Temporary Suspension of Work." Temporary suspension shall remain in effect until proof that the required insurance is in effect is received by the Owner. If no proof of insurance is received within 20 calendar days of the Suspension Order, the Owner may proceed with written notice of default according to subsection 108.11 "Default and Termination of Contract."

103.06 EXECUTION AND APPROVAL OF CONTRACT

The Contract shall be signed by the successful bidder and returned, together with the required bonds and proof of liability insurance, within 10 business days after written notice of award has been issued. If the Contract is not executed by the Owner within fifty (50) days following receipt of the signed Contract, bonds, and proof of insurance, the bidder shall have the right to withdraw the bid without penalty. The Contract will not be considered effective until it has been fully executed by all parties to the Contract.

103.07 FAILURE TO EXECUTE CONTRACT

Failure to execute the Contract and file acceptable bonds and proof of liability insurance within 10 days after the written notice of award has been issued to the bidder shall be just cause for the cancellation of the award and forfeiture of the proposal guaranty, which shall become the property of the City of Fort Smith, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder, or the work may be re-advertised and constructed under contract or otherwise, as the Owner may decide. The low bidder who fails to execute the Contract and submit acceptable bonds and proof of liability insurance will not be permitted to bid on any subsequent advertisement of that project.

SECTION 104
SCOPE OF WORK

104.01 INTENT OF CONTRACT

The intent of the Contract is to provide for the construction and completion in every detail of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the Work according to the Plans, Specifications, and terms of the Contract.

Work shown on the plans, but which has no pay item included in the Bid proposal, shall be considered an incidental item and the cost thereof shall be considered included in the contract amount bid for the project.

104.02 IF AND WHERE DIRECTED ITEMS

The Plans and the proposal may specify one or more items to be incorporated into the Project "if and where directed" by the Owner. The Owner shall have sole discretion in determining whether and to what extent such items will be incorporated into the Project. The Owner may order incorporation of such items at any location within the Project and at any time during the work. These items may or may not be located on the Plans. The estimated quantities set out in the proposal for such items are presented solely for the purpose of obtaining a representative bid price. The actual quantities employed may be only a fraction of, or many times the estimated quantities. The Contractor shall make no claim for additional compensation because of any increase, decrease, or elimination of such items.

104.03 CHANGES IN CHARACTER OF WORK AND DIFFERING SITE CONDITIONS

A. GENERAL. The Owner reserves the right to increase or decrease the extent of the Work or to change the location, gradient, or the dimensions of any part of the Work. Such changes shall not be considered as a waiver of any conditions of the Contract nor invalidate any of the provisions thereof. The Contractor shall perform the work as increased or decreased and no claim shall be made by the Contractor for any loss of anticipated profits because of any alteration or variation between the approximate quantities and the quantities of work as done.

If the altered or added work is of sufficient magnitude as to require additional time to complete the project, such time adjustments may be made in accordance with the provisions of subsection 108.08(d) “Determination of Time of Completion and Extension of Contract Time.”

B. SIGNIFICANT CHANGES IN THE CHARACTER OF WORK. The Owner reserves the right to make, in writing, at any time during the Work, such changes in quantities and such alterations in the Work as are necessary to satisfactorily complete the Project. Such changes in quantities and alterations shall not invalidate the Contract nor release the Surety, and the Contractor agrees to perform the work as altered.

If the alterations or changes in quantities do not significantly change the character of the work to be performed under the Contract, the altered work will be paid for as provided elsewhere in the Contract.

If the alterations or changes in quantities significantly change the character of the work under the Contract an adjustment, excluding loss of anticipated profits, will be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Owner may

determine to be fair and equitable.

The term "significant change" shall be construed to apply only to the following circumstances:

(1) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction, or

(2) When an item of work is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any adjustment due to an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

C. DIFFERING SITE CONDITIONS. During the progress of the Work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract or if unknown 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, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions. If the Engineer determines 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, an adjustment, excluding loss of anticipated profits, will be made by the Owner and the Contract modified in writing accordingly. The Owner will notify the Contractor of the determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment that results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

No Contract adjustment will be allowed under this clause for any effects caused on unchanged work.

104.04 EXTRA WORK

The Contractor, when directed, shall perform unforeseen work which is not shown on the plans or in the specifications for which there is no quantity and price included in the Contract, whenever it is deemed necessary or desirable to further complete the Work as contemplated. Such extra work shall be performed according to the specifications and as directed. However, before payment for any extra work is made, a Change Order shall be signed by both contracting parties, or a written order procured from the Owner directing the Contractor to do the work on a Force Account basis as provided in subsection 109.05 “Extra and Force Account Work.”

104.05 CLAIMS FOR ADJUSTMENT AND DISPUTES

If, in any case, the Contractor deems that additional compensation is due for work or material not clearly covered in the Contract or not ordered by the Owner as extra work, as defined in subsection 104.04, the Contractor shall notify the Engineer in writing of intention to make claim for such additional compensation before beginning the work on which the claim is based. If such notification is not given and the Engineer is not afforded proper time and facilities by the Contractor for keeping accurate account of the actual costs of the work, the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the Engineer has kept account of the cost of the work shall not in any way be construed as proving or substantiating

the validity of the claim. If the claim, after consideration by the Owner, is found to be just and adequately supported, an adjustment will be made to the Contract. If the Contract does not contain a pay item for which the adjustment can be made, the adjustment will be made according to subsection 109.05 "Extra and Force Account Work."

Nothing in this subsection shall be construed as establishing any claim contrary to the terms of subsection 104.03.

Contractor shall carry on the Work and maintain the progress schedule during all disputes or claims with Owner. No work shall be delayed or postponed pending resolution of any disputes or claims, except as Contractor and the Owner may otherwise agree in writing.

All claims shall be in sufficient detail to enable the Owner to determine the basis for entitlement and the costs incurred, excluding loss of anticipated profits, organization or overhead expense, or interest. All claims shall include a detailed factual statement providing all necessary dates, locations, items of work affected, amount of compensation requested, and a breakdown of that amount. If an extension of time is also sought, the specific days for which it is sought and the basis for such claim.

When submitting a claim, the Contractor must certify in writing that the claim is made in good faith, supporting data are accurate and complete to the Contractor's best knowledge and belief, and that the amount of the claim accurately reflects the Contract adjustment for which Contractor believes Owner is liable. Subcontractor claims shall not be considered except as submitted and certified by Contractor as Contractor's claim.

104.06 CLAIMS LIMITATIONS

The Contractor acknowledges and agrees that in no event shall a claim be submitted to the Owner after the receipt of the Final Payment for the Project and the Contractor acknowledges and agrees that any claim submitted after receipt of the Final Payment shall be deemed waived by the Contractor.

104.07 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK

The Contractor, with the approval of the Engineer, may use on the Project such stone, gravel, sand, or other material, determined suitable by the Engineer, as may be found in the planned excavation and will be paid both for the excavation of such materials at the corresponding contract unit price and for the pay item for which the excavated material is used. However, the Contractor shall replace with other acceptable material at no cost to the Owner all of that portion of the excavation material so removed and used that was needed for use in the embankments, backfills, approaches, or otherwise. No charge for the material so used will be made against the Contractor. The Contractor shall not excavate or remove any material from within the roadway location that is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the Engineer.

Planned excavation, for the purposes of this subsection, is defined as all excavation shown on the plans and/or as changed by the Engineer for any purpose other than obtaining additional material lying within the planned typical sections and slopes. Planned excavation also includes any excavation made beyond the ends of the Project for the purpose of blending the new construction into the existing roadway.

Unless otherwise provided, any material from any existing structures designated salvageable that is to remain the property of the owner, may be used temporarily by the Contractor in the erection of the new structure. Such material shall not be cut or otherwise damaged. Material thus used and subsequently cut or damaged by the Contractor's action or inaction shall be replaced in kind with new material of like dimension at no cost to the Owner.

104.08 FINAL CLEANING UP

Upon completion of the Work and before acceptance and final payment will be made, the Contractor shall remove from the right-of-way, from any temporary plant sites, and from any temporary equipment and material storage sites, all construction equipment, falsework, discarded material, rubbish, debris, temporary structures, footings, and all surplus material. The Contractor shall restore in an acceptable manner all property, both public and private, that has been damaged during the prosecution of the work and shall leave the waterways unobstructed and the roadway in a neat and presentable condition throughout the length of the work under contract.

No burning will be permitted on City of Fort Smith property, right-of-way, or easement without an approved burn permit issued by the City of Fort Smith Fire Department and concurred with by the Engineer. It is the Contractor's responsibility to determine prior to bidding whether or not a burn permit will be approved and issued. When perishable material is burned, it shall be under the constant care of a competent watcher. Burning shall be accomplished at such times and in such manner that the surrounding vegetation, adjacent property, or anything designated to remain on the right-of-way will not be jeopardized. Contractor shall cease all burning when meteorological conditions are unsuitable for burning operations. Materials and debris that cannot be burned shall be removed from the right-of-way and disposed of at locations off the project.

Contractor shall have proposed dump sites for waste material approved by the City of Fort Smith prior to disposition of any waste onto these sites.

The materials, labor, equipment, and expense of the final cleaning up of the Project will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items in the Contract.

SECTION 105
CONTROL OF WORK

105.01 AUTHORITY OF THE ENGINEER

As the direct representative of the Owner, the Engineer has immediate charge of the engineering details of each construction project; is responsible for the general administration of the Project; and has the authority to reject unacceptable material or work and to suspend any work that is being improperly performed.

The Owner, with input from the Engineer, will decide all questions that may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions that may arise as to the interpretation of the plans and specifications; and all questions as to the acceptable fulfillment of the Contract by the Contractor.

The Engineer, with concurrence by Owner, will have the authority to suspend the work wholly or in part due to the failure of the Contractor to correct conditions unsafe for the workers or the general public; for failure to carry out provisions of the Contract; for failure to carry out orders; for such periods as deemed necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the Work; or for any other condition or reason deemed to be in the public interest.

Any unresolved disputes arising under the Contract shall be submitted by the Contractor in writing to the Engineer. Disputes claiming additional compensation shall contain the information set forth in subsection 104.05 "Claims for Adjustment and Disputes." The Engineer shall render a written decision within 60 calendar days of receipt of the Contractor's letter and information. Should a dispute not be resolved by the written decision of the Engineer, subsequent appeal by the Contractor shall be submitted in writing within 60 calendar days of the decision of the Engineer, and shall be addressed directly to the Department Director.

105.02 PLANS AND SUBMITTALS

A. PLANS. Plans will show lines, grades, details of all structures, typical cross sections, and a summary of items appearing on the proposal. Work may be provided for on the Plans that is not located within the limits of the project as shown on the plan sheets. Work of this nature may include but is not limited to removal of existing items, obliteration, grading, base and surfacing, transitions, etc., and is considered a part of the project. The Plans will be supplemented by such working drawings or sketches issued by the Engineer as are necessary to adequately control the Work.

B. SUBMITTALS. Shop drawings, mix designs, vendor data, testing reports, certifications and working drawings for structures shall be furnished by the Contractor as required herewith. They shall consist of such data and detailed plans as may be required to adequately control the work and are not included on the plans furnished by the Owner. They shall include stress sheets, shop drawings, erection plans, falsework plans, cofferdam plans, or any other supplementary plans or similar data required of the Contractor.

All submittals shall be submitted to the Engineer for informational and record purposes or for approval as specified for the item of work involved. Contractor shall, in writing, call Engineer's attention to any deviation that the submittal may have from the requirements of the Contract Documents. The Contractor should anticipate a review period of 15 - 30 calendar days from receipt by the Engineer of submittals. The review of submittals by the Engineer will be limited to checking for general agreement with the plans and specifications, and shall in no way relieve the Contractor of responsibility for errors and omissions contained therein, nor shall such review or approval operate to waive or modify any provisions contained in the Specifications or Drawings. It is mutually agreed that the

Contractor shall be responsible for agreement of dimensions and details as well as conformity of its submittal with the Contract plans and specifications.

Where a Shop Drawing or sample is required by the Specifications, no related work shall commence until the submittal has been reviewed and approved by Engineer.

The contract price will include the cost of furnishing all required working drawings, record drawings and other submittals.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS

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

In the event the materials or the finished product in which the materials are used or the work performed does not conform with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the Contractor's expense to the satisfaction of the Engineer.

105.04 COORDINATION OF PLANS, SPECIFICATIONS, AND SPECIAL CONDITIONS

The bidding and contract documents include various divisions, sections, and conditions which are essential parts for the work to be provided by the successful Bidder. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, the following precedence will govern:

1) Addenda
2) Contract Documents
3) Special Conditions
4) Plans/Drawings
5) Standard Specifications
6) Reference Standards

Change Orders will take precedence over items 3 through 6 only. Detailed drawings shall have precedence over general drawings.

Neither the Contractor nor the Owner shall take advantage of any apparent error or omission on the Plans or in the Specifications. The party discovering such error or omission shall notify the other party when the discovery is made. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the Plans and Specifications.

105.05 COOPERATION BY CONTRACTOR

The Contractor will be supplied with a maximum of five sets of approved Plans and Contract Documents. Additional copies will be furnished, upon request, at the cost of reproduction.

Contractor shall keep one complete set of plans available on the project site at all times. Contractor shall keep one record copy of all Specifications, Plans, Drawings, Addenda, Modifications, Shop Drawings and samples, in good order and annotated to show all changes made during the construction process. These shall be available to Engineer for examination and shall be delivered to Engineer upon completion of the Work.

The Contractor shall give the Work the attention necessary to facilitate the progress thereof and shall

cooperate fully with the Owner, Engineer, inspectors, and other Contractors. Failure to cooperate may result in default according to subsection 108.11 "Default and Termination of Contract."

The Contractor shall have on the Project at all times a competent superintendent capable of reading and thoroughly understanding the Plans and Specifications and thoroughly experienced in the type of work being performed, who shall not be replaced without written notice to the Owner except under extraordinary circumstances. Contractor shall not employ on the Project any Superintendent against whom Owner may have reasonable objection. The Superintendent shall receive instructions from the Engineer and shall have full authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, labor, equipment, tools, and incidentals as may be required. Such Superintendent shall be furnished regardless of the amount of work sublet.

105.06 COOPERATION WITH UTILITIES AND PROTECTION OF UTILITIES

The Engineer has researched known substructure records which describe the location of utility substructures and has indicated on the Plans those substructures, except service connections, which may affect the work. The Owner and Engineer do not guarantee that all existing utilities are shown on the Plans or that utilities are shown in their exact locations.

Utility valves, manholes, vaults, or pullboxes which are buried shall be conspicuously marked in a fashion acceptable to Engineer by Contractor to allow their location to be determined by Engineer and utility personnel under adverse conditions (inclement weather or darkness).

When underground main distribution conduits such as water, sewer, electric power, gas, telephone or cable television are shown on the Plans, the Contractor, for purposing of preparing his bid, shall assume that every property parcel will be served by a service connection for each type of utility.

When feasible, the utility companies shall complete their necessary installations, relocations, repairs, or replacements before commencement of work by Contractor. When demolitions, clearing and/or grubbing, or relocations and other such work to be done by the Contractor is required to be done before the utility company can complete their work, the Contractor shall coordinate his work with the utility company. Contractor shall schedule his work such that it does not delay the ability of the franchise utility to access the work area and complete their work. This includes the Contractor providing access to work area for the utility company by clearing and grubbing, relocating fences, providing access roads, etc. ahead of the utility companies work.

When the Special Conditions or Plans indicate that a utility installation is to be relocated, altered, or constructed by others, the Owner will conduct negotiations with the utility owners and the work will be paid for by separate contract between the Owner and franchise utility, unless otherwise provided for in the Special Conditions.

The Contractor shall consider in the bid all of the permanent and temporary utility facilities and appurtenances in their present, relocated, or proposed positions as specified in the Contract and as revealed by site investigation. No additional monetary compensation will be allowed for any delays, inconveniences, or damages sustained due to any interference from the utilities or appurtenances or from the operations of relocating them.

The Contractor shall take necessary precaution to protect all utilities located with the work areas. Repairs to damaged utilities caused by the Contractor will be corrected at the Contractor's expense.

The damaged facilities shall be restored to a condition similar or equal to that existing before the damage occurred.

The Contractor shall contact the various utility companies through Arkansas One-Call Center, (800) 482-8998, no less than two (2) working days and no more than ten (10) days prior to beginning

work to have them locate their facilities within the proposed areas of work.

The Contractor shall verify the location and depth of those utilities which the Contractor or Engineer believes may affect or be affected by the Contractor's operations sufficiently in advance of the work so that relocations can be made, if necessary, without impacting the Contractor's completion schedule. Full compensation for such work will be considered as included in the prices bid for other items of work.

105.07 COORDINATION AND COOPERATION BETWEEN CONTRACTORS

The Owner reserves the right at any time to contract for and perform other or additional work on or near the work covered by the Contract.

When separate contracts are let adjacent to or within the limits of any one project, the work of each Contractor shall be conducted so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other.

It is understood and agreed that the Contractor considered in the bid the status of the existing Contract or Contracts at the time of bidding and will arrange to coordinate and schedule the work jointly with the other affected Contractors in order to complete the work within the time allowed in the Contract.

Contractors involved shall assume all liability, financial or otherwise, in connection with their own Contracts and shall protect and save harmless the City of Fort Smith from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

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

105.08 CONSTRUCTION STAKES, LINES, AND GRADES

The Engineer shall provide engineering surveys to establish reference points consisting of control points and bench marks which in the Engineer's judgment are necessary to enable the Contractor to proceed with the Work. These stakes and marks shall constitute the field control with which the Contractor shall be responsible for accurately establishing other necessary controls and performing the work. Contractor shall provide the necessary surveys, templates and equipment required in executing the Project.

The Contractor will be held responsible for the preservation of all stakes and marks. If any of the construction stakes or marks are destroyed or disturbed by the Contractor, the cost of replacing them will be deducted from the payment for the Work.

Before beginning work, the Contractor must be satisfied as to the correctness and meaning of all stakes, measurements, and marks. No claim will be entertained as a result of alleged inaccuracies unless the Contractor notifies the Engineer thereof in writing in time for the Engineer to verify or check such stakes or marks before the work is begun.

105.09 DUTIES OF THE INSPECTOR

Inspection personnel will be authorized to inspect all work performed and all materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or

manufacture of the materials to be used. The inspection personnel will not be authorized to alter or waive the provisions of the Contract and will not be authorized to issue instructions contrary to the Plans and Specifications, or to act as supervisor for the Contractor. The inspection personnel shall, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

105.10 INSPECTION OF WORK

All materials and each part or detail of the Work shall be subject to inspection by the Engineer. The Engineer and inspectors shall be provided acceptable access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is necessary to make a complete and detailed inspection. Neither observations by Engineer nor inspection, tests or approvals by others shall relieve Contractor from his obligation to perform the work in accordance with the Contract Documents.

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

Any work performed or materials used without inspection by the Engineer may be ordered exposed, and/or removed and replaced, at no cost to the Owner unless the Engineer or inspector failed to inspect after having been given reasonable notice that the work was to be performed.

When any unit of government, political subdivision, railroad corporation, or other agency is to pay a portion of the cost of the Work covered by the Contract, its respective representatives shall have the right to inspect the Work. Such inspection shall in no sense make any unit of government, political subdivision, railroad corporation, or other agency a party to the Contract, and shall in no way interfere with the rights of either party thereunder.

105.11 REMOVAL OF UNACCEPTABLE OR UNAUTHORIZED WORK

All work that does not comply with the requirements of the Contract will be considered unacceptable. Unacceptable work, whether the result of poor workmanship, use of unacceptable materials, damage through carelessness, negligence, or any other cause, found to exist before the final acceptance of the Work, or during the warranty period specified in subsection 108.12 "Warranty and Guarantee", shall be removed and replaced in an acceptable manner at no cost to the Owner.

Work performed contrary to any instructions of the Engineer; work performed beyond the lines shown on the plans or as established, except as herein specified; or any extra work performed without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so performed may be ordered removed or replaced at no cost to the Owner.

Should the Contractor fail to comply with any order of the Owner, the Owner will have the authority to cause unauthorized work to be removed and unacceptable work to be corrected or removed and replaced and to deduct the costs from any moneys due or to become due the Contractor.

105.12 MAINTENANCE DURING CONSTRUCTION

The Contractor shall maintain the Work during construction and until the Project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate

equipment and forces, to the end that the Work is kept in satisfactory condition at all times.

The Contractor shall maintain the existing roads and easements within the limits of the project, including shoulders, bridges, and culverts, from the date work is begun until the project has been completed and accepted. This maintenance of existing roads and easements, including shoulders, bridges, and culverts, is the ordinary day to day maintenance, including minor repairs, temporary asphaltic concrete patching, and mowing of grass and weeds. Major repairs or reconstruction of existing roads, including shoulders, bridges, and culverts, will be the responsibility of the State, County, or City, unless such are made necessary by the Contractor's operations.

Contractor shall maintain a temporary asphaltic concrete patch over backfilled pipe trenches, subject to traffic, during the course of the project to the satisfaction of the Engineer. The temporary patch shall be permanently repaired or removed as soon as Contractor's operations allow. Should areas of temporary pavement fail and become hazardous, Contractor shall repair at Engineer's direction.

Contractor shall install and maintain fencing completely around all openings that constitute a fall hazard, such as trenches, vertical excavations, channels, culverts and inlets, until such time that the structure is completed and/or permanent fencing or railing is installed. Fencing shall, as a minimum, be constructed of four foot high orange mesh fencing attached to barricades, or posts driven into the ground, so that the mesh fencing is taut, without appreciable sagging, and access to opening is not easily gained.

Contractor shall maintain all sewer systems in continuous operation during construction. Sewage flow shall be confined to closed conduits to avoid public nuisance and health hazard. Temporary diversion of sewage to storm drains or stream channels will not be permitted. If Contractor so elects, he may construct temporary pump or gravity sewer bypasses. Bypasses shall be of sufficient capacity to handle peak flows without storage.

Contractor shall coordinate with the Engineer and with City of Fort Smith-Utilities Department to schedule any shutdown on water lines. Forty-eight (48) hours advance notice is required for the closing of any water valves. For water service lines, the Contractor shall notify, 48 hours in advance, all water system customers who which will be affected by the planned water service work. The Contractor shall notify water system customers in writing, which must include the date, time of day, and duration of planned water shut-offs.

Contractor shall keep all work areas free from accumulated waste materials, rubbish and other debris resulting from the work. At the completion of the Work, the Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, equipment and surplus materials, and shall leave the site clean. Contractor shall restore to original condition those portions of the site not designated for alteration by the Contract.

The Contractor shall furnish all labor, equipment and means required and shall carry out effective measures wherever and as often as necessary to prevent his operations from producing dust in amounts that are damaging to property, cultivated vegetation, or domestic animals, or which causes a nuisance to persons living or occupying buildings in the vicinity. To prevent tracking of dirt onto existing roadways, at all points of ingress and egress from the construction areas, Contractor shall provide a crushed stone or gravel drive extending a minimum of fifty feet from the edge of the existing street pavement. Dirt tracking onto existing travel lanes or parking areas due to any construction activities shall be removed at the end of the work shift by the use of a vacuum sweeper or other type of sweeper that minimized the creation of dust. Use of dry broom sweepers will not be allowed. The Contractor shall be responsible for any damage resulting from dust originating from his operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Owner.

In the case of a Contract for the placing of a course upon a course or subgrade previously

constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

The Contractor shall be responsible for the maintenance of existing drainage ditches and channels within the right-of-way limits, including construction easements if any, from the date any work is begun on the Project to the date of its final acceptance. This is not a requirement that the Contractor improve existing drainage ditches and channels, except as shown on the Plans or as directed by the Engineer. The Contractor shall maintain the waterways in such condition that damage to the Work or to abutting property will not result from the Contractor's operation. Obstruction of natural flow in waterways by stockpiling or storing materials, or by placement of equipment or supplies without provision for adequate by-passing of such natural flow, will not be permitted. Collections of sediment or debris that prohibits or inhibits normal function of drainage facilities shall be removed promptly.

All costs of maintenance work during construction and before the Project is accepted will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items in the Contract.

105.13 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE

If the Contractor, at any time, fails to comply with the provisions of subsection105.12 the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Owner may immediately proceed to maintain the project and the entire cost of this maintenance will be deducted from moneys due or to become due the Contractor on the Contract.

105.14 AUTHORIZED CHANGES

All changes to the Plans performed in the field shall be reviewed, approved and authorized by the Owner prior to proceeding with the work. Any changes to the Plans without authorization may result in removal of such item at the Contractor’s expense and/or nonpayment for the work, at the discretion of the Owner.

Verbal authorized changes to the Plans in the field will not be considered for additional quantities or compensation, unless they are followed by written documentation within 24 hours. Any authorized changes to the Drawings which are approved by the Owner for additional compensation shall be in written form indicating all items of work involved and the cost for each item, and will be submitted to the Owner prior to proceeding with the work involved.

105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

If the Contractor desires to use a material, method or type of equipment other than those specified in the Contract, authority from the Owner to do so must be requested. The request shall be in writing and shall include a full description of the materials, methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change.

Prior to proposing any substitute material, method or type of equipment, the Contractor shall satisfy itself that the material, method or type of equipment proposed is, in fact, equal to that specified, that such material or type of equipment will fit into the space allocated, that such material or type of equipment affords comparable ease of operations, maintenance and service, that the appearance, longevity and that by reason of cost savings, reduced construction time, or similar demonstrable benefit, the substitution material, method or type of equipment will be in Owner’s interest.

The burden of proof of equality of a proposed substitution for a specified material, method or type of equipment shall be upon the Contractor. Contractor shall support its request in writing with

sufficient test data and other means to permit the Owner to make a fair and equitable decision on the merits of the proposal. Contractor shall submit drawings, samples, data and certificates for proposed substitute materials. Any material or type of equipment by a manufacturer other than those specified or brand name or model number or of generic species other than those specified will be considered a substitution. The Owner will be the sole judge of whether or not the substitution is equal in quality, utility and economy to that specified.

Approval of a substitution shall not relieve the Contractor from responsibility for compliance with all requirements of the Contract. Contractor shall bear the expense for any changes in the parts of the Work caused by any substitutions.

Substitutions will not be permitted in those instances where the product is intended to accommodate artistic design, specific function or economy of maintenance.

No change will be made in basis of payment for the construction items involved nor in contract time as a result of an authorized change in methods or equipment under these provisions.

SECTION 106
CONTROL OF MATERIAL

106.01 QUALITY REQUIREMENTS

The materials used in the work shall meet all quality requirements of the Contract. Quality control, to insure that materials and workmanship, prior to and after, being incorporated into the work meets the requirements of the Contract, is the sole responsibility of the Contractor. Testing required for Contractor's quality control, certificates of compliance, mix designs and manufacturing of materials, and as needed for Contractor's operations shall be provided by the Contractor and the costs therefore will not be paid separately but full compensation will be considered included in the contract unit prices bid for associated items.

All Quality Assurance testing, to insure that the materials and workmanship as a final product meets the requirements of the Contract, will be accomplished and paid for by the Owner. The costs for any retesting required in areas failing to meet the specified requirements shall be paid for by the Contractor.

The materials furnished and used shall be new, except as may be provided elsewhere in these specifications, on the plans or in the Special Conditions. The materials shall be manufactured, handled, and used in a workmanlike manner to ensure completed work in accordance with the plans and specifications.

106.02 SOURCES OF SUPPLY

To expedite the inspection and testing of materials, the Contractor shall notify the Engineer of proposed sources of materials before delivery. The Contractor shall furnish without charge such samples as may be required. Inspection and tests may be performed by the Engineer or Owner's designated testing firm, but it is understood that such inspections and tests, if made at any point other than the point of incorporation in the work, in no way shall be considered as a guarantee of acceptance of such materials nor of continued acceptance of material presumed to be similar to that upon which inspections and tests have been made.

The Contractor shall assume full responsibility for ordering materials of the quality and quantity required and for the delivered costs of such materials. Materials needed in the work shall be furnished by the Contractor unless otherwise stated in the Contract.

106.03 SAMPLES, TESTS, AND CITED SPECIFICATIONS

All materials will be inspected and tested by the supplier or Contractor as required by these specifications before incorporation in the Work. Work in which untested materials are used without the approval or written permission of the Engineer shall be treated as provided in subsection 105.11 "Removal of Unacceptable or Unauthorized Work."

Whenever a reference is made in the specifications to a Federal Specification, or to a specification or test designation of the American Association of State Highway and Transportation Officials, the American Society for Testing and Materials, American Water Works Association, or any other recognized national organization, it shall mean the year of adoption or latest revision of the specification or test designation in effect on the day the advertisement for bids is dated. When a specific reference is made to a dated specification or test designation, the revision in effect on that date shall apply.

When requested, the Contractor shall furnish a complete certified statement of the origin, composition, and/or manufacture of materials that are to be used in the Work.

106.04 CERTIFICATION OF COMPLIANCE

The Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificates of Compliance stating that such materials or assemblies fully comply with the requirements of the Contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the Project must be accompanied by a Certificate of Compliance and clearly identified.

Materials or assemblies used on the basis of Certificates of Compliance may be sampled and tested and if found not in conformity with Contract requirement will be subject to rejection whether in place or not.

The form and distribution of Certificates of Compliance shall be as approved by the Engineer.

106.05 PLANT INSPECTION

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

A. The Engineer shall have the cooperation and assistance of the Contractor and of the producers of materials for the Work.

B. The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

C. Adequate safety measures shall be provided and maintained.

It is understood that the Owner reserves the right to retest all materials prior to incorporation into the Work which have been tested and accepted at the source of supply after the sample have been delivered and to reject all materials which, when retested, do not meet the requirements of these specifications or contract documents.

106.06 STORAGE OF MATERIALS

Materials shall be so stored as to assure the preservation of their quality and fitness for the work and in accordance with requirements of the Specifications; or if not covered in the Specifications, in accordance with the manufacturer’s recommendations. Stored materials, even though approved before storage, may again be inspected before their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Portions of the right-of-way not required for public travel may be used for storage purposes and for the placing of the Contractor's plant and equipment, if approved by the Engineer, but any additional space required therefor must be provided by the Contractor, and at no cost to the Owner. Private property shall not be used for storage purposes without written permission of the owner or lessee, and if requested by the Engineer, copies of such written permission shall be furnished. All storage sites shall be restored to their original condition by Contractor at his expense. Construction materials may not be stored in the roadway for more than five (5) days after unloading.

106.07 HANDLING MATERIALS

All materials shall be handled in such manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the Work in tightly covered vehicles so constructed as to prevent loss or segregation of materials after loading and measuring so that there may be no inconsistencies in the quantities of materials intended for incorporation in the Work as loaded and the quantities as actually received at the place of operations.

106.08 UNACCEPTABLE MATERIALS

All materials not conforming to the requirements of the specifications at the time they are used shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

106.09 OWNER-FURNISHED MATERIAL

The Contractor shall furnish all materials required to complete the Work, except those specified to be furnished by the Owner. Material furnished by the Owner will be delivered or made available to the Contractor at the points specified in the Special Provisions.

The cost of handling and placing all materials after they are delivered to the Contractor will not be paid for separately, but full compensation therefor will be considered included in the contract unit price(s) bid for the item(s) with which they are used.

The Contractor will be held responsible for all material delivered by the Owner through this arrangement. Deductions will be made from any moneys due the Contractor to make good any shortages and deficiencies, from any cause whatsoever; for any damage that may occur after such delivery; and for any demurrage charges.

106.10 SALVAGED MATERIALS

All salvaged materials in reusable condition, including pavement millings, water and drainage pipe, valves, fittings and other items, remain the property of the City of Fort Smith. Contractor shall deliver items to location directed by Engineer or designated in specifications. Items not considered of value shall be disposed of the Contractor at his expense.

106.11 AUTOMATICALLY CONTROLLED EQUIPMENT

Whenever a breakdown or malfunction of the automatic controls occurs on scales, scale printers, batch plants, or mixing plants, the equipment may be operated manually or by other methods for a period not to exceed two working days, provided that such alternate methods of operation produce results otherwise meeting the Specifications.

SECTION 107
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.01 LAWS AND REGULATIONS TO BE OBSERVED

A. The Contractor shall keep fully informed of all Federal and State laws, all local laws, ordinances, and regulations, and all orders and decrees of bodies or tribunals having any jurisdiction or authority which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. Further, the Contractor shall at all times observe and comply with all such laws, ordinances, regulations, quarantines, orders, and decrees; and shall protect and indemnify the City of Fort Smith and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.

All work pertaining to Electrical, Plumbing, and/or Building Crafts shall be performed in strict accordance with governing Federal, State, City, and Local Codes and Ordinances, with particular attention to the current editions of the Arkansas State Plumbing Code and the National Electrical Code as adopted by the National Fire Protection Association.

B. The Contractor shall comply with applicable Federal, State, and local laws governing safety, health, and sanitation. The Contractor shall provide safeguards, safety devices, and protective equipment and take any other action necessary to protect the life and health of employees on the project and the safety of the public and to protect property in connection with the performance of the work covered by the Contract.

Attention is directed to Federal, State, and local laws, rules, and regulations concerning construction safety and health standards, and to subsection 205.03 "Trench or Excavation Safety Systems" of these specifications.

C. If the release of a suspect hazardous substance has occurred, the Contractor shall notify the Engineer as soon as possible, but no more than 72 hours after knowledge of the release. This will not relieve the Contractor or responsible parties of the obligation to notify other appropriate agencies and will not relieve responsible parties of any liability. Upon notification, the Contractor shall provide the Engineer with the following information: a written description of the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken in accordance with Federal and State regulations to mitigate the release.

Commonly used materials which could be potentially hazardous substances if they are spilled or enter waterbodies are: asphalt materials, concrete, cement, paint, solvents, petroleum products, fertilizers, concrete curing compound, lime, linseed oil, asphalt additives, and concrete additives. This list is not all inclusive.

Notification should be made if, at any time, there is an indication of a spill. Indicators could be:

(1) Leaking or empty containers, surface staining, chemical odors, vegetation damage, etc.

(2) Oil, grease or petrochemical substances which produce residue, coat the banks and/or bottoms of a waterbody, or produce a visible, colored film on the surface.

(3) Distinctly visible solids, scum, or foam of a persistent nature, or slime, bottom

deposits, or sludge banks in a waterbody.

D. Unless specified elsewhere in these specifications, the work involved or the delay or cost incident to compliance with these regulations will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the various items of the Contract.

107.02 PERMITS, LICENSES, AND TAXES

The Contractor shall procure all permits and licenses, pay all charges, fees and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work, unless otherwise stated elsewhere in these specifications. These costs will not be paid for directly, but will be considered included in the contract unit prices bid for the various items of the Contract.

The City of Fort Smith will obtain any railroad and Arkansas Highway and Transportation Department permits when required.

The Contractor shall obtain and pay for all permits, design fees and related costs resulting from a request by the Contractor to substitute materials or designs for those shown on the drawings or specified in these specifications.

107.03 PATENTED DEVICES, MATERIALS, AND PROCESSES

Contractors employing any design, device, material, or process covered by letters of patent or copyright shall provide for such use by suitable legal agreement with the patentee or owner. Contractors and their Sureties shall indemnify and save harmless the City of Fort Smith, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright, and shall indemnify the City of Fort Smith for any costs, legal expenses, and damages that it may incur by reason of any infringement, at any time during the prosecution of or after the completion of the work.

107.04 RESTORATION OF SURFACES OPENED BY PERMIT

The right to construct or reconstruct any utility service in the highway or street, or to grant permits for such work, at any time, is hereby expressly reserved by the City of Fort Smith or the proper authorities of the political entity in whose jurisdiction the work is done and the Contractor shall not be entitled to any damages either for the digging up of the street or for any delay occasioned thereby.

Any individual, firm, or corporation wishing to make an opening in the roadway must secure a permit from the proper authority. The Contractor shall allow parties bearing such permits, and only those parties, to make openings in the roadway. When ordered by the Owner, the Contractor shall make in an acceptable manner all necessary surface repairs due to such openings and such necessary work will be paid for as extra work, or as provided in these specifications, and will be subject to the same conditions as original work performed.

107.05 SANITARY PROVISIONS

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of the employees as may be necessary to comply with the requirements of the State and local Boards of Health, or of other bodies or tribunals having jurisdiction.

107.06 PUBLIC SAFETY AND CONVENIENCE

The Contractor's work shall at all times be conducted so as to assure the least possible obstruction

to vehicular and pedestrian traffic. The safety and convenience of the general public and the residents along the roadway and the protection of persons and property shall be provided for by the Contractor as specified under Section 120 "Traffic Control and Maintenance", as applicable.

The Contractor shall not create a public nuisance while performing the various operations of the Work. Excessive noise between the hours of 10 p.m. and 6a.m., and dust from haul and access roads may be considered by the Engineer to be a public nuisance.

The Contractor will be responsible for maintaining U.S. mailboxes within the project limits in such a manner that the public may receive continuous mail service according to U.S. Postal Service regulations. Unless otherwise provided, upon completion of the project, mailboxes will be replaced as near as practicable to their original location.

107.07 RAILWAY-HIGHWAY PROVISIONS

All work on railroad property shall be accomplished in strict compliance with the Plans, these Specifications, and such Special Provisions as are appropriate to the Contract.

All work to be performed by the Contractor in construction on the railroad right-of-way shall be performed at such times and in such manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the Railway Company. The Contractor shall use all care and precaution to avoid accidents, damage, or unnecessary delay or interference with the Railway Company's trains or other property.

Plans for all sheeting or cofferdams for foundation work adjacent to operated track, and plans of falsework, staging, protective sheeting, or other temporary construction near the operated track shall be approved by the Railway Company. The Contractor shall construct the work according to the approved Plans.

107.08 WORK WITHIN REGULATED FLOODWAYS

A. All work within regulated floodways shall be accomplished within the requirements of all permits issued by the Federal Emergency Management Agency (FEMA), Corps of Engineers (COE), or other applicable agencies, and with Section110 "Protection of Water Quality and Wetlands."

(1) Responsibility for FEMA Permit - Within regulatory floodways all permanent and temporary fills/structures must be in accordance with FEMA and local governmental requirements. The Owner obtains all required permits and/or variances for essential work in the regulated floodway before the Contract is awarded. The Owner will apply for Contractor requested variances which it determines are necessary. The Contractor should be aware that requested temporary fills/structures may not be approved or may require mitigation.

(2) Corps of Engineers Section 404 Permit Requirements - Placement of temporary fills/structures within a regulatory floodway may also require alteration of the existing COE 404 Permit described in Section 110. The Contractor should refer to Section 110 and the Contract Documents for further details, restrictions, and requirements of COE 404 Permits.

(3) Compensation and Extension of Contract Time - The Contractor will not be granted additional compensation or contract time due to requested floodway variances that are considered by the Owner to be for the convenience of the Contractor. If, however, due to no fault of the Contractor, a floodway variance is deemed by the Owner to be necessary, additional contract time and/or compensation may be considered according

to the provisions of subsection 104.05 "Claims for Adjustment and Disputes."

B. CONTRACTOR'S PERMIT CONDITIONS. All permits issued to the Contractor by the U.S. Coast Guard, COE, or other applicable agencies, for the convenience of the Contractor in accomplishing the Work, shall be complied with in full and the Project will not be accepted until the permittor has accepted the work covered by permit. The Contractor will be responsible for obtaining a release from the permittor before acceptance.

107.09 USE OF EXPLOSIVES

Explosives may be used only when authorized in writing by the City of Fort Smith Fire Department and if determined necessary by the Engineer, or as otherwise stated in the Special Conditions. The Engineer's approval of the use of explosives shall not relieve the Contractor from his liability for claims caused by his blasting operations.

When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall comply with all laws and ordinances regarding the use of explosives; further, the Contractor shall be responsible for all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and in accordance with the Occupational Safety and Health Act of 1970, 29USC§651 etseq., and the Safety and Health Regulations for Construction promulgated thereunder, but not closer than 1,000 feet from the road or from any building or camping area or place of human occupancy.

The Contractor shall notify each public utility company having structures in proximity to the site of the Work of any intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from damage.

The Contractor shall provide, 48 hours prior to the time of blasting, written notification to each resident and owner of each structure located within a reasonable proximity to the site of the blasting operations.

107.10 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE

The Contractor shall be responsible for the preservation from injury or damage resulting directly or indirectly from the Contract work of all public and private property, crops, trees, vegetation, monuments, fences, signs and markers along and adjacent to the project, and shall use every precaution necessary to prevent damage to water lines, sewers, and other underground structures, to poles, wires, cables, and other overhead structures, whether shown on the plans or not; shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location, and shall not move them until directed. The Contractor shall not willfully or maliciously injure or destroy trees or shrubs and shall not remove or cut them without proper authority.

The Contractor shall be responsible for all damage or injury to property of any character during the prosecution of the Work, resulting from any act, omission, neglect, or misconduct in the manner or method of executing the work, or at any time, due to defective work or materials, and said responsibility will not be released until the project has been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or as a result of any act, omission, neglect, or misconduct in the execution of the work, or in

consequence of the nonexecution thereof, the Contractor shall restore, or bear the expense of restoring, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or shall make good such damage or injury in an acceptable manner. Failure to do so within a reasonable period of time will constitute noncompliance, and the Owner may cause the entire cost of the restoration to be deducted from moneys due or to become due the Contractor on the Contract.

107.11 LOAD RESTRICTIONS

The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads being maintained for the traveling public. A special permit will not relieve the Contractor of liability for damage that may result from construction equipment operations. The operation of equipment of such weight or so loaded as to cause damage to structures or the roadway or to any other type of construction will not be permitted.

When hauling materials over the base or surface courses under construction, the Contractor shall limit the hauling as necessary to prevent damage. No loads will be permitted on bases, pavements, or structures before the expiration of the specified curing period controlling such operations.

The Contractor shall be responsible for repair of all damage resulting from construction operations. No separate payment will be made for such repairs.

107.12 OPENING SECTION OF ROADWAY TO TRAFFIC

Whenever any roadway, or portion thereof, is in an acceptable condition for travel, it shall be opened to traffic, as may be directed, and such opening shall not be held to be in any way an acceptance of the roadway, or any part of it, or as a waiver of any of the provisions of these specifications and the Contract. Necessary repairs or renewals made on any section of the roadway opened to travel under instructions from the Engineer, due to defective material or work, or to natural causes, other than normal wear and tear, pending completion and acceptance of the roadway, shall be performed at no cost to the Owner.

If the Contractor is dilatory in completing shoulders, drainage structures, or other features of the work, the Engineer may give notification in writing and establish therein a reasonable period of time in which the work should be completed. If the Contractor is dilatory or fails to make a reasonable effort toward completion in this period of time, the Engineer may take action as provided in subsection105.01 "Authority of the Engineer." On such sections that are so ordered to be opened, the Contractor shall conduct the remaining construction operations so as to cause the least obstruction to traffic and shall not receive any added compensation due to the added cost of the work by reason of opening such section to traffic.

107.13 CONTRACTOR'S RESPONSIBILITY FOR WORK

Until final acceptance of the Project by the Owner's Board of Directors, the Contractor shall have the charge and care thereof and shall take every precaution against injury, theft, or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries, thefts, or damages to any portion of the work occasioned by any of the above causes before final acceptance, and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, of the public enemy, or of governmental authorities.
In case of suspension of work from any cause whatever, the Contractor shall be responsible for the Project and shall take such precautions as may be necessary to prevent damage to the Project, provide for normal drainage and maintenance of the traveled way, and shall erect any necessary temporary structures, signs, or other facilities. During such period of suspension of work, the

Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under the Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.
The costs for maintenance of the traveled way during suspensions required by the Contract documents shall be included in the contract price bid. Costs incurred for maintenance and protection of the work during all other suspensions of work shall be borne by the Contractor.

In case of errors or negligence on the part of the Contractor, any expenses incurred by the Owner for engineering, inspection, testing, design, or evaluation relative to correction of the work will be assessed against the Contractor.

107.14 RIGHT-OF-WAY AND EASEMENTS

The Owner is responsible for the securing of all necessary rights-of-way and easements in advance of construction within the limits indicated on the plans. If the Contractor believes that any delay in the Owner's furnishing the right-of-ways or easements entitles him to an extension of the Contract Time, Contractor may make a claim as provided in subsection 108.08 "Determination of Time of Completion and Extension of Contract Time."

Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workmen to the right-of-ways, easements, and areas specified in the Contract Documents, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment.

Acquisition of right-of-way by the Owner does not include areas required by the Contractor for material sources (borrow, gravel, topsoil, sod, etc.), plant sites, equipment storage, stockpiles, disposal of waste or excess material, or any other areas required for the proper prosecution of the work.

107.15 RESPONSIBILITY FOR DAMAGE CLAIMS

The Contractor shall indemnify and save harmless the City of Fort Smith and its officers and employees from all suits, actions, or claims of any character, and the legal expenses incurred regarding same, brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the Work; or because of any act or omission, neglect, or misconduct of the Contractor; or because of any claims or amounts recovered from any infringement of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workman's Compensation Act," or any other law, ordinance, order, or decree; and so much of the money due the Contractor under and by virtue of the Contract as may be considered necessary by the Owner for such purpose may be retained for the use of the Owner; or in case no money is due, the Surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Owner; except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that adequate protection is provided by public liability and property damage insurance.

In any and all claims against the City of Fort Smith or any of its agents or employees by any employee of the Contractor, and Subcontractor, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damage, compensation or benefits payable by of for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

It is specifically agreed between the parties executing the Contract that it is not intended by any of the provisions of any part of the Contract to create the public or any member thereof a third party beneficiary thereunder, or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the Contract.

107.16 PERSONAL LIABILITY OF PUBLIC OFFICIALS

In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the Contract, there shall be no liability upon the officers or employees of the City of Fort Smith, either personally or as officials of the City of Fort Smith, it being understood that in all such matters they act solely as agents and representatives of the City of Fort Smith.

107.17 NO WAIVER OF LEGAL RIGHTS

Final acceptance according to subsection 108.09.B "Acceptance" shall not preclude or estop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the Work, nor shall the Owner be precluded or estopped from recovering from the Contractor or the Surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill obligations under the Contract. A waiver on the part of the Owner of any breach of any part of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the Owner for any or all of the following: fraud or such gross mistakes as may amount to fraud, the Owner's rights under any warranty or guaranty, or any latent defects in the work.

SECTION 108
PROSECUTION AND PROGRESS

108.01 SUBLETTING OF CONTRACT

If the bidder intends to sublet any portion of the Work, the bidder shall furnish a list of subcontractors as a material part of his sealed proposal on the form provided, listing the description of work to be performed by each subcontractor. The experience, past performance, and ability of each proposed Subcontractor will be considered in the evaluation of bids. Upon request, the bidder shall furnish experience statements, with reference to any requested Subcontractor, prior to Notice of Award. If there being no objection in writing by the Owner to the listed subcontractors prior to the award of the Contract, the subcontractors will be deemed acceptable to the Owner. If bidder does not intend to sublet any part of the work, he shall insert the word "NONE" on the form provided. The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or any portion thereof, of his right, title, or interest therein, without prior written consent of the Owner and of the surety. The Contractor shall not remove and/or substitute the listed subcontractors without prior written consent of the Owner.

Consent to sublet, assign, or otherwise dispose of any portion of the contract shall not be construed to relieve the Contractor of his liability under the contract and bonds.

The Owner will not recognize any subcontractor on the Work as a party to the contract. Nothing contained in any subcontract shall create any contractual relation between the subcontractor and the Owner. The Contractor will be held responsible for the progress of the subletted work in accordance with the contract progress required.

108.02 PRECONSTRUCTION CONFERENCE

A preconstruction conference, when applicable, will be held for each contract within fourteen (14) days after the execution of the Contract and prior to the start of work. The Engineer will notify the Contractor, utility companies, and other interested parties of the date and place for the conference.

108.03 NOTICE TO PROCEED

The Contract Time will commence to run on the day indicated in the Notice to Proceed. Commencement of work by Contractor will not be allowed prior to receipt of the Notice to Proceed.

The Contractor shall begin the work to be performed under the Contract not later than ten (10) calendar days after the Notice to Proceed date. If the Contractor is unable to begin the work within this time period, the Engineer shall be so notified in writing. Unless the Engineer gives written approval for the delay in beginning the work, contract time will be assessed according to subsection108.09 "Determination of Contract Time and Extension of Contract Time."

The Owner allocates its resources to a contract based on the total time allowed in the Contract. The Contractor may propose an accelerated work schedule indicating an early completion date; however, the Owner cannot guarantee the Owner's resources will be available to meet the accelerated schedule. If an accelerated work schedule is approved, no additional compensation or extension of time will be allowed if the Contractor is unable to meet the accelerated schedule due to the unavailability of the Owner's resources or for other reasons beyond the Owner's control.

108.04 PROSECUTION AND PROGRESS

Contractor shall be responsible for planning, scheduling and reporting the progress of the work to ensure timely completion of the Contract.

For Contracts under $2 million, or where specified in the Special Conditions, the following schedule requirements shall apply: Prior to or at the Preconstruction Conference, the Contractor shall submit two copies of his proposed schedule of operations for acceptance by the Engineer. The proposed Schedule shall be a bar chart or schematic (arrow) diagram showing the work stages and operations for all major activities required by the Contract, including the starting and completion date of each part, and shall include dates of any proposed road closure, and any significant or required milestone events. Unless approved by the Engineer, activities shown on the Schedule shall not exceed 15 working days in length. The Schedule shall be of sufficient detail to allow day-to-day monitoring of Contractor's progress.

For Contracts over $2 million, the following Critical Path Schedule requirements shall apply: Prior to or at the Preconstruction Conference, the Contractor shall submit a preliminary network analysis system defining the Contractor's planned operations during the first sixty calendar days after the date of the Notice to Proceed. The Contractor's general approach to the remainder of the Project shall be indicated. Within 30 calendar days of the Notice To Proceed, the Contractor shall submit a complete network analysis system, consisting of logic diagrams, computer mathematical analysis, calendar, and narration, to cover the Contractor's anticipated time schedule for the complete Project. As a minimum, the network analysis system shall include the following features:

A. Shall be time-scaled in calendar days with activities plotted on their early start and finish dates. Unless approved by the Engineer, activities shown on the Schedule shall not exceed 30 working days in length

B. Network diagram shall show the order and interdependence of activities and the proposed sequence in which the work is to be accomplished as planned by the Contractor in coordination with all subcontractors. The sequence and logic shall be clear. The critical path activities shall be prominently distinguished.

C. Network diagram shall show for each activity the preceding and following activity, activity description, the total float, and the duration of the activity.

D. Activities shown shall include, in addition to construction activities, such tasks as submittal review and delivery times for long-lead time items, franchise utility work, subcontractor work, and owner-furnished equipment delivery.

The Contractor shall submit monthly updated Schedules with their pay estimate requests. The Contractor shall indicate on such updated Schedule actual construction progress, extra work added to Contract, and any proposed changes to the operation sequence. If the progress of the Work is significantly behind schedule, the updated Schedule shall also reflect any revised operation sequence, changes in equipment, labor forces, or working shifts, or other pertinent factors by which insufficient progress will be made up to allow the Contract completion within the time set forth in the Contract, including time extensions granted to date.

All submitted schedules and updated schedules shall be reviewed and accepted by the Engineer. If after review, the Engineer determines that the schedule is not acceptable per the requirements listed above, the Contractor shall make adjustments and resubmit the schedule within 30 calendar days. Failure of the Contractor to submit an acceptable Schedule or monthly updated Schedule as required will be grounds for Owner to withhold an additional ten percent on the monthly progress payments, in addition to the normal retention, until Contractor is in compliance. Additional money withheld will be paid, upon compliance, in the next scheduled monthly estimate.

Acceptance of Contractor's schedules by Engineer shall not be construed as relieving Contractor of the obligation to complete the Work within the Contract Time; or as granting, rejecting, or in any other way acting on Contractor's requests for adjustments to the date for completing Contract Work,

or claims for additional compensation. Such requests shall be processed in strict compliance with other relevant provisions of the Contract.
No measurement or direct payment will be made for Contractor costs relating to preparation and submission of schedules, updates and revisions thereto, the cost being considered as included in the prices paid for Contract items.

Contractor shall carry on the work and maintain the progress schedule during all disputes or claims with Owner. No work shall be delayed or postponed pending resolution of any disputes or claims, except as Contractor and the Owner may otherwise agree in writing.

Float time is not for the exclusive use or benefit of either the Owner or Contractor. Extension of time for performance may be granted, as allowed in subsection 108.08, for delays caused solely by action or inaction by the Owner to the extent that equitable time adjustment for the activity affected exceeds the total float of the project, or where an impact on the contract completion date can be shown.

108.05 LIMITATION OF OPERATIONS

The Contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic and utility services. Due regard shall be given to the location of detours, bypasses, and to the provisions for handling traffic and utility services. No work shall be opened up to the prejudice or detriment of work already started. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience. For roadway overlay projects and drainage projects, each individual street or section of drainage must be completed, including all site restoration, within 45 days of the start of work operations within that street or section, unless otherwise authorized by the Engineer.

Except in connection with the safety or protection of persons or the work or property at the site, and except as otherwise indicated in the Contract Documents, all work that requires inspection shall be performed during City of Fort Smith regular working hours, and Contractor will not permit overtime work or the performance of work on Saturday, Sunday, or any legal holiday as designated in subsection101.01.C "Definitions" without Engineer's written consent. Contractor to submit a written request to the Engineer for non-regular working hours 48 hours in advance of the start of such work.

108.06 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT

The Contractor shall at all times provide sufficient materials, equipment, and labor to guarantee the completion of the Project according to the Plans and Specifications within the contract time. The Contractor shall advance the Work so that the available time is appropriately utilized in order to complete the Work within the contract time.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or by any subcontractor who, in the opinion of the Engineer, does not perform work in a proper and skillful manner, or is intemperate, belligerent or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the Work, the Owner may suspend the work by written notice and withhold moneys due until such orders are complied with.

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

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the Contract, the Contractor is free to use any methods or equipment that are demonstrated to the satisfaction of the Engineer as being capable of accomplishing the Contract work in conformity with the requirements of the Contract.

When the Contract specifies that the construction be performed by using certain methods and/or equipment, such methods and/or equipment shall be used unless others are authorized by the Engineer in accordance with subsection 105.15 "Substitution of Materials and Equipment."

108.07 TEMPORARY SUSPENSION OF WORK

The Engineer will have the authority to suspend the work wholly or in part for such period or periods necessary, due to unsuitable weather or other conditions unfavorable for the suitable prosecution of the work. If it should become necessary to stop work for an indefinite period, the Contractor shall store all materials in such manner that they will not obstruct or impede the traveling public nor become damaged in any way, and shall take every reasonable precaution to prevent damage or deterioration of the work performed; provide suitable drainage of the roadway by opening ditches and shoulder drains; maintain water and sewer services; maintain the traveled way; erect temporary structures where directed; etc.

If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within fifteen (15) days of the receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Owner agrees that the cost and/or time required for the performance of the Contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Owner will make an adjustment (excluding profit) and modify the Contract in writing accordingly. The Owner will notify the Contractor of a determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

No Contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of the Contract.

108.08 DETERMINATION OF TIME OF COMPLETION AND EXTENSION OF CONTRACT TIME.

A. GENERAL. The time allowed for the completion of the Work included in the Contract will be stated in the Proposal and Contract, and will be known as the "Contract Time". The contract time will be specified as a fixed completion date or as calendar days.

The Contractor shall take into consideration all normal conditions considered unfavorable to the normal progress of the Work and place a sufficient work force and equipment on the project to ensure completion of the Work within the contract time.

The Engineer will determine the date upon which the Contract is substantially complete and time assessment will cease. In the event cleanup is necessary or items found at the final inspection are to be corrected, the Contractor shall complete this work in a timely manner or the Engineer will resume time charges.

B. FIXED COMPLETION DATE. When the contract time is specified as a fixed date, it will be the date on which all work on the project shall be substantially complete.

C. CALENDAR DAYS. When the contract time is on a calendar day basis, it shall consist of the number of calendar days specified in the contract, counting from the effective date on the notice to proceed, including all Sundays, holidays, and non-working days. All calendar days elapsing between the effective dates of any orders of the Engineer to suspend work and to resume work for suspensions not the fault of the Contractor shall be excluded. If the last day of the contract time falls on a Sunday or on legal holiday, such day shall be omitted from the computation.

D. EXTENSION OF CONTRACT TIME. The Contract Time may only be changed by a Change Order. Any claim for an extension in the Contract Time shall be based on written notice delivered to the Engineer within fifteen days of the occurrence of the event giving rise to the claim. This request must contain specific dates and the detailed circumstances relative to the time extension desired. The Contractor's contention that insufficient time was specified is not a valid reason for an extension of time.

All extensions of time will be documented by Change Order.

Any extended time for completion shall be in full force and effect the same as though it were the original contract time.

An extension of time will be considered, based upon documented evidence submitted by the Contractor, if:

(1) The Engineer suspends the work according to subsection 108.07.

(2) The Contract requires the furnishing of critical materials and the Contractor experiences a delay in delivery because of Federal priorities for defense needs or because of nationwide shortages. Additional contract time may be allowed in an amount equal to the actual lost time resulting from such delay. To obtain additional contract time, the Contractor shall document and file with the Engineer all evidence pertaining to the original agreement with the material supplier or manufacturer. This evidence must indicate that delivery would be made at or before the time the materials would be needed in the normal sequence of construction operations for incorporation in the work. In the event that no prior agreement has been made for furnishing a critical material, and the Contractor is unable to locate a supplier or manufacturer that can deliver the material when needed, the Engineer shall be advised of this situation in writing, indicating the date that delivery will be made and the date of the original request for such material. In either of these situations, when work has progressed to the point that critical materials not delivered are delaying progress of the project, the Contractor may make a written request to the Engineer for additional contract time.

(3) If delays beyond the Contractor’s control are caused solely by action or inaction of

the Owner based upon the effect of delays to the Project as a whole and will not be granted for non-controlling delays to minor included portions of work, unless it can be shown that such delays did, in fact, delay the progress of the Project as a whole.

(4) Preparatory work to be performed by the Owner or by others specified in the Contract has not been accomplished and the delay is not the fault of the Contractor.

(5) Inaccessibility to a portion of the work due to utility conflict or franchise utility work will be considered as an adverse working condition, for time exceeding that specified in the Contract for the franchise utility work, based upon the effect of delays to the Project as a whole and will not be granted for non-controlling delays to minor included portions of work, unless it can be shown that such delays did, in fact, delay the progress of the Project as a whole.

(6) The Change Order involves extra work which effects delay to the Project as a whole and will not be granted for non-controlling delays to minor included portions of work, unless it can be shown that such extra work did, in fact, delay the progress of the Project as a whole.

(7) All the Work, or the portion of the Work which is the currently controlling operation, is suspended due to unsuitable weather or to such conditions as are considered unfavorable to the suitable prosecution of the work, if the following conditions are satisfied:

(a) The weather must actually cause a delay to the completion of the project and the delay must be beyond the control and without the fault or negligence of the Contractor, and/or

(b) The Engineer orders the suspension of the work in the interest of public safety or health or due to specification requirements.

The Contractor is to provide written notification to the Engineer of the occurrence of adverse weather delay days and resultant impact to normally scheduled work, within 10 calendar days of each occurrence, when such weather prevents work on critical activities for 50 percent or more of the Contractor's scheduled work day. No compensation will be made for monetary damages due to weather delay(s).

(8) The work was delayed because of conditions not described herein that were beyond the control and without fault of the Contractor.

108.09 ACCEPTANCE

A. SUBSTANTIAL COMPLETION. When the Contractor considers the entire Project ready for its intended use the Contractor shall notify the Engineer. The Engineer shall then make an inspection of the Project to determine the status of completion. If the Engineer considers the Project substantially complete and can be utilized for its intended use without further disruption to the public or occupants of the facility, excepting minor corrections (punch list items) and clean-up, the Engineer will fix the date of Substantial Completion. On the date of the Notice of Substantial Completion, the contract time will be stopped. There shall be developed a list of items to be completed or corrected before final acceptance and payment. Thereafter, the Contractor shall complete all work on the "punch list" and required clean-up within 30 calendar days or other time as agreed to by the Contractor and the Engineer.

B. FINAL ACCEPTANCE. Upon notice from the Contractor of presumptive completion of the entire project, including receipt of record drawings and all required documentation, the

Engineer will make a final inspection with the Contractor. If all construction and final clean-up provided for and contemplated by the Contract is found to have been satisfactorily completed, that inspection shall constitute the final inspection and the Engineer will so advise the Owner's Board of Directors. The Contractor will then be notified in writing of the acceptance of the contract as of the date of the final acceptance by the Board of Directors.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will advise the Contractor of the work requiring correction. The Contractor shall immediately make the required corrections. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed.

108.10 FAILURE TO COMPLETE WORK ON TIME

Time is an essential element of the Contract and it is important that the Work be pressed vigorously to completion. The cost to the Owner of the administration of the Contract, including engineering, inspection, and supervision, will be increased as the time occupied in the Work is lengthened. The public is subject to detriment and inconvenience when full use cannot be made of the Project.

A. The Owner shall be entitled to recover from the Contractor all ascertainable damages arising from the delay in completion. Said damages shall include, without limitation, all engineering, inspection, supervision, and legal expenses directly incurred by the Owner because of such delay.

B. Additionally, Contractor agrees that the Owner and/or public will suffer other damage or financial loss if the Work is not completed on time or within any time extensions allowed in accordance with subsection 108.08 above. Contractor and Owner agree that proof of the exact amount of any such damage or loss is difficult to determine. Accordingly, Contractor agrees to pay the sums stated in the proposal and Contract as liquidated damages and not as penalty for each calendar day or part thereof that the Work remains uncompleted after the contract time has expired.

C. Should the amount otherwise due the Contractor be less than the amount of such damages provided for in either (a) or (b) above, the Contractor and the Surety shall be liable to the Owner for such deficiency.

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

108.11 DEFAULT AND TERMINATION OF CONTRACT

The Owner will give written notice of delay, neglect, or default to both the Contractor and the Surety if the Contractor:

A. Fails to begin the Work under the Contract within the time specified in the Notice to Proceed, or

B. Fails to perform the work with sufficient workers, equipment, or materials to assure prompt completion of the Work, or

C. Performs the work negligently or unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable or unsuitable, or

D. Discontinues the prosecution of the work, or

E. Fails to resume work that has been discontinued within 10 calendar days after notice to do so, or

F. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or fails to provide a replacement bond within 10 calendar days, containing all the guarantees of the original bond, if the Surety should be declared in default and/or liquidation, or

G. Fails to settle all valid claims for materials, labor, or supplies in an expedient manner, or

H. Allows any final judgment to stand unsatisfied for a period of 10 calendar days, or

I. Makes an assignment for the benefit of creditors, or

J. Fails to appropriately cooperate with the Owner, the public, or others associated with the Work or to provide proper superintendence of the Work, or

K. Fails to comply with contract requirements, or

L. Is a party to fraud, or

M. For any other cause whatsoever, fails to carry on the work in a manner acceptable to the Owner.

If the Contractor or Surety, within a period of 10 calendar days after written notice from the Owner, does not proceed according to the notice, the Owner will, upon written notification from the Engineer of the facts relative to delay, neglect, or default, and the Contractor's failure to comply with the written notice, have full power and authority, without violating the Contract, to take the prosecution of the work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment associated with the Project as may be suitable and acceptable and may enter into an agreement for the completion of the Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of the Contract.

All costs and charges incurred by the Owner due to any of the above will be deducted from any moneys due or which may become due the Contractor. If such expense exceeds the sum that would have been payable under the Contract, the Contractor and the Surety shall be liable and shall pay to the Owner the amount of such excess.

The Owner may, by written order, terminate the Contract or any portion thereof after determining that for reasons beyond either Owner or Contractor control the Contractor is prevented from proceeding with or completing the Work as originally contracted for, and that termination would be in the public interest. Reasons for termination may include, but need not be necessarily limited to: executive orders of the President relating to prosecution of war or national defense; national emergency that creates a serious shortage of materials; orders from duly constituted authorities relating to energy conservation; and restraining orders or injunctions obtained by third-party citizen action resulting from national or local environmental protection laws or where the issuance of such order or injunction is primarily caused by acts or omissions of persons or agencies other than the Contractor.

When contracts, or any portion(s) thereof, are terminated before completion of all items of work in the Contract, payment will be made for the actual number of units or items of work completed at the contract unit price, or as mutually agreed for items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Reimbursement for organization of the work (when not otherwise included in the Contract) and moving equipment to and from the project will be considered where the volume of work completed is too small to compensate the Contractor for these expenses under the contract unit prices, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained by the Contractor for the Work, that have been inspected, tested, and accepted by the Engineer, and that are not incorporated in the Work may, at the option of the Owner, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Owner.

Termination of a contract or a portion thereof shall not relieve the Contractor of responsibilities for the completed Work, nor shall it relieve the Surety of its obligation for and concerning any just claims arising out of the work performed.

108.12 WARRANTY AND GUARANTEE

The Contractor shall obtain and assign to the Owner all transferable manufacturer's warranties or guarantees on all materials and equipment as required in these specifications. The Contractor shall guarantee satisfactory in-service operation of all materials and equipment furnished for the project, and all completed Work under the contract, including repair of all defects or failures, regardless of cause of defect or failure unless caused by engineering design. All warranties and guarantees shall be for a period of one year after the Date of Substantial Completion for all projects excepting Engineering Department projects, and two years after the Date of Substantial Completion for Engineering Department projects, or such longer period of time as may be prescribed by Law or Regulation or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents. If, within the above time frames, any Work is found to be defective Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions, either correct such defective Work, or, if it has been rejected by Owner, remove it from the Site and replace it with non-defective Work. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect, and consequential costs of such removal and replacement including but not limited to fees and charges or engineers, architects, attorneys, and other professionals) will be paid by Contractor.

In special circumstances where a particular item of Equipment or portion of the project is placed in continuous service before Substantial Completion of all Work, the warranty period for that item or portion may start to run from the earlier date if so provided in the Specifications or by Written Amendment.

108.13 TERMINATION OF CONTRACTOR'S RESPONSIBILITY

The Contract will be considered complete when all work has been finished, the final inspection made by the Engineer, the Project accepted by the Board of Directors, and all the provisions of the contract have been fulfilled. The Contractor's responsibility shall then cease, except as may be required by law or as set forth in the contract payment and performance bonds and insurance policies.

SECTION 109
MEASUREMENT AND PAYMENT

109.01 GENERAL

Measurement and payment for contract work will be made only for and under those pay items included in the bid form. All other work and materials will be considered incidental to and included in the payment of the pay items in the bid form.

109.02 MEASUREMENT OF QUANTITIES

Work acceptably completed under the Contract will be measured by the Engineer according to the United States Standard measures. Only actual quantities will be paid for unless otherwise specified. Unless otherwise specified, the following listed methods will be used:

A. For computing volumes of excavated materials, such as excavation, embankment, borrow, soil aggregate, etc., specified for measurement by the cubic yard, the average end area method will be used.

B. Structures will be measured to the neat lines as shown on the plans or as finally constructed at the direction of the Engineer.

C. Items that are measured by the linear foot, such as pipe culverts, water and sewer lines, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed.

D. In determining the area for items bid on a square yard or acre basis, except as noted below, the longitudinal measurement will be made along the actual surface of the item and not horizontally, and transverse measurements shall conform to the dimensions shown on the plans or as directed by the Engineer.

In determining the area for clearing and/or grubbing items bid on an acre basis, the longitudinal and transverse measurements will be made on a horizontal basis. The area will be computed to the nearest 0.01 acre.

In determining the area for all seeding, sodding and mulch cover items bid on an acre basis, when the area is a strip of varying width running approximately parallel to the centerline of the roadway, the longitudinal dimension will be measured horizontally and the transverse dimension will be measured parallel to the surface of the area seeded and/or mulched. For other areas of seeding and mulch cover items, all measurements will be made parallel to the surface of the area seeded and/or mulched. The area will be computed to the nearest 0.01 acre.

E. Materials that are specified for measurement by the ton shall be hauled in approved vehicles bearing a plainly legible identification number and weighed on accurate scales, bearing a current Arkansas Bureau of Standard decal, furnished by the Contractor and inspected by a registered scale mechanic at least once a year and before their use after each move. Scales shall be located at the loading point or other approved location.

The scales shall be an automatic weighing system, with digital or springless dials, and equipped with an automatic ticket printer. An automatic ticket printer is defined as a device connected to the weighing system in such manner that it automatically detects the weight determined by the system. It shall store and recall the TARE weight when the operator enters the truck identification. It shall print the following information on the ticket:

(1) Gross, Tare, and Net weights.
(2) Identification of the truck.
(3) Current date.
(4) For asphalt mixtures, the time of loading or weighing.
(5) A unique ticket number (may be preprinted on the tickets).

The NET weight should be computed by the weighing system; however, it may be computed manually and keyed in for printing.

When the net weight of the material is determined by batch weights, the scales used shall meet all applicable requirements specified for truck scales, including automatic ticket printing, except that the GROSS and TARE weights will not be required.

The ticket shall accompany each load delivered to the project. In addition to the items shown above that must be printed by the ticket printer, the following information shall also be shown on each ticket:

(1) Identification of the project.
(2) Identification of the material being delivered.
The ton shall be the short ton of 2000 pounds.

Vehicles used to haul materials measured by weight shall be weighed empty for each load, or shall be weighed daily or from time to time during the day as the Engineer may direct, to establish the tare weight of each load. The scales furnished shall be capable of weighing the entire loaded vehicle at one time.

Deduction will be made for the weight of moisture in aggregates in excess of 5% of the oven-dry weight of the material.

F. Asphalt cements, liquid asphalts, and asphalt emulsions will be measured by the gallon or by the ton in distributors, transfer tanks, supply tanks, or tank cars as may be appropriate; or may be measured by other methods specified under the individual item. Volumetric measurements of asphalt cements and liquid asphalts will be corrected to 60ºF using correcting tables from Chapter 11, Section 1, of the American Petroleum Institute's Manual of Petroleum Measurement Standards. Volumetric measurements of asphalt emulsions will be corrected to 60º F using the expansion coefficient factor of 0.00025 per degree Fahrenheit. Water added to dilute emulsified asphalt will not be included in the pay quantity.

Volumetric measurements made in the various types of tanks, including distributors, may be based on calibration of the tanks made by the Engineer, a private laboratory approved by the Owner, or by the manufacturer. If the calibration has not been made by the Engineer, the Owner reserves the right to verify the calibration before the use of the distributor or tank. In the case of railroad tank cars or distributors, the outage table furnished for each tank by the manufacturer may be used in lieu of actual calibration of the tank.

The Contractor shall furnish, at no cost to the Owner, all necessary equipment, materials, and assistance for such calibration or verification. The Contractor shall furnish the Engineer with an outage table, obtained from the shipper, for each railroad tank car containing asphalt material received and unloaded on the project. When shipment is made by tank truck, the Contractor shall furnish the Engineer with a copy of the delivery ticket for each load showing the gallons at the temperature when loaded, but in no case shall such delivery ticket be used as a sole basis of payment in lieu of measurement through a calibrated distributor or tank. Pay quantities will include only the material actually used on the work at the direction of the Engineer.

G. Timber will be measured by the 1000 foot board measure, [M.F.B.M.]. Measurements will be based on nominal width and thickness based on applicable grading rules.

H. The term "gage" (or "gauge"), when used in connection with the measurement of plates, will mean the U.S. Standard Gage. Wire and wire mesh for concrete reinforcing will be specified by wire size number as shown in AASHTO M32.

I. Cement, lime, and flyash will be measured by the ton.

J. A station when used as a definition or term of measurement will be 100 linear feet measured horizontally.

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

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

109.03 SCOPE OF PAYMENT

Payments to the Contractor will be made for the actual quantities of contract items completed and accepted according to the Plans and Specifications and if, upon completion of the construction, these actual quantities show either an increase or decrease from the quantities given in the proposal schedule, the contract unit prices will still prevail, except as provided in subsections109.04 or 109.05.

The Contractor will receive and accept the compensation herein provided as full payment for furnishing all materials, labor, equipment, tools, and incidentals necessary to the completed Work; for performing all work contemplated and embraced under the Contract; for all loss or damage arising out of the nature of the work, or from the action of the elements, or from any unforeseen difficulties or obstructions that may arise or be encountered during the prosecution of the Work until its final acceptance by the Board of Directors; for all risks of every description connected with the prosecution of the Work; for all expenses incurred by, or in consequence of, the temporary suspension or discontinuance of the work as herein specified; for any infringement of patent, trade mark, or copyright; for all costs of permits, licenses, fees, and taxes; and for completing the work in an acceptable manner according to the Plans and Specifications.

The payment of current or final estimate, or of retained percentage, shall in no degree prejudice or affect the obligation of the Contractor, at no cost to the Owner, to repair, correct, renew, or replace any defects or imperfections in the Work, or in the strength of or quality of materials used therein or thereabouts, or relieve the Contractor from the payment of all damages due to such defects. No retained percentage payable under the Contract, or any part thereof, shall become due and payable, if the Owner so elects, until the Owner is satisfied that the Contractor has fully settled or paid for all materials and equipment used in or upon the Work, and for all labor done in connection therewith.

Any overpayments made to the Contractor or Surety, from whatever cause, are due and payable to the Owner upon receipt by the Contractor or Surety of a request setting forth the particulars, regardless of pending claims or intention of the Contractor or Surety to file a claim.

In the case of a lump sum contract or bid item, when required by the Special Provisions or requested by the Owner, the Contractor shall submit to the Owner within fifteen (15) days after award of contract, a detailed schedule of values to be used only as a basis for determining progress payments on that contract or bid item. This schedule of values should equal in total the lump sum bid and shall in such form and sufficiently detailed as to satisfy the Owner that it correctly represents reasonable apportionment of the lump sum.

109.04 PAYMENT AND COMPENSATION FOR ALTERED QUANTITIES

When alterations in plans or quantities of work are ordered and performed as provided in subsection104.03 (a) "Changes in Character of Work and Differing Site Conditions" or 104.02 "If and Where Directed Items," and when such alterations result in an increase or a decrease of the quantity of work to be performed, the Contractor shall accept payment in full at the contract unit prices for the actual quantities of work accomplished, except as provided in subsection 104.02 or 104.03, and no allowance will be made for anticipated profits, organization or overhead expense, or interest. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

109.05 EXTRA AND FORCE ACCOUNT WORK

A. EXTRA WORK. Extra work performed shall be agreed upon by both the Owner and the Contractor and shall be documented by an approved Change Order before the work is performed. When the Owner deems it impractical to handle extra work on a unit price basis, payment specified in the Change Order may be by any method agreed upon by both the Owner and the Contractor. Mutual agreement between the Owner and the Contractor as to the amount to be paid and method of payment for Extra Work may be based on an estimate of the costs of performing the work; detailed information such as required for Force Account work; or any other logical method to which both parties agree which estimates costs incurred, excluding loss of anticipated profits and organization or overhead expense. Estimates of cost for extra work submitted for approval shall include detailed information as determined sufficient by the Engineer to analyze the estimate. Percentages used for overhead and profit shall be the same as those allowed under item B. "FORCE ACCOUNT" below.

B. FORCE ACCOUNT. Work ordered and accomplished by Force Account shall be documented by a signed Construction Field Change prior to beginning the work. Payment for work accomplished on a Force Account basis, shall be made according to the following:

(1) Labor - For all labor and foremen employed on the specific operation, the Contractor will receive the current local rate of wage, or the wage stipulated in the Contract, for each and every hour that said labor and foremen are actually engaged in such work, to which will be added an amount equal to 20% thereof for overhead and profit. Only the actual amount of insurance and payroll taxes imposed by law and paid by the Contractor on the labor used will be allowed. No charge shall be made by the Contractor for organization or overhead expense. The number of laborers and foremen employed in the work shall be subject to approval by the Engineer, and the number so employed shall not exceed the number the Engineer deems most practical and economical for the work.

(2) Materials - For all materials used, if furnished by the Contractor, the Contractor will receive the actual cost of such materials, including freight, hauling, and handling charges, as shown by original receipted bills or certified statements, to which cost will be added a sum equal to 15% thereof for overhead and profit.

(3) Equipment - For any Contractor owned machinery or special equipment (other than small tools) which has been authorized by the Engineer, the Contractor shall receive the rental rates specified in the Construction Field Change authorizing the work. The hourly rental rates shall be established by the Engineer based upon the prevailing commercial rates in the area. The established hourly rental rate shall be equal to the monthly rate for the basic equipment plus the monthly rate for applicable attachments, both divided by 176.

Equipment that must be rented or leased specifically for extra work required by the Construction Field Change shall be authorized in writing by the Engineer. The Contractor shall be paid the invoice price for the rented or leased equipment.

When it is necessary to obtain equipment from sources beyond the project limits exclusively for extra work of less than one month duration, the cost of transferring the equipment to the site of the work and return will be allowed as an additional item of expense. Where the move requires the use of a hauling unit, the move-in allowance will be limited to the rental rate, as computed above, for the hauling unit plus operator wages. In the event that the move-out is to a different location, payment will in no instance exceed the amount of the move-in. Move-in allowance shall not be made for equipment brought to the project for extra work but which is subsequently retained on the project and utilized for completion of other contract items or related work.

Time will be recorded to the nearest one quarter hour for purposes of computing compensation to the Contractor for equipment utilized under these rates.

The equipment rates as determined above shall be full compensation for providing the required equipment and no additional compensation will be made for other costs such as, but not limited to, fuels, lubricants, replacement parts, or maintenance costs. Cost of repairs, both major and minor, as well as charges for mechanic's time utilized in servicing equipment to ready it for use before moving to the project, and similar charges will not be allowed. To the Contractor’s actual cost shall be added the sum of 5% for the Contractor’s profit and overhead with no further compensation therefor.

(4) Specialized Work - Whenever the Contractor is required to perform extra work of a specialized nature (electrical, plumbing, landscaping, etc.) for which he is not properly equipped, he may upon approval of the Owner have the work performed by a local firm or specialist who is proficient in the type of work to be performed. Payment for this work shall be the Contractor’s actual cost as evidence by copies of invoices from the subcontractor. To the Contractor’s actual cost shall be added the sum of 5% for the Contractor’s profit and overhead with no further compensation therefor.

(5) General - The compensation as herein provided shall be received by the Contractor as payment in full for extra work done on a Force Account basis, and shall include the proper supervision of the work as well as furnishing small tools and equipment required by the labor employed, without additional compensation other than provided in clauses (1), (2), (3), and (4) of this subsection.

The amount of credit to be allowed by Contractor to Owner for any such Construction Field Change which results in a net decrease in cost will be the amount of the actual net decrease plus a deduction in overhead and profit by an amount equal to 10% of the net decrease. When both additions and credits are involved in any one change, the adjustment in overhead and profit shall be computed on the basis of the

net change.

The Contractor's representative and the Inspector shall compare records of the extra work done on a Force Account basis, at the completion of certain units of the work or at intervals considered most practical. Copies of those records shall be made in duplicate, upon suitable forms provided for this purpose, and signed by both the Inspector and Contractor's representative, one copy each being forwarded to the Engineer and to the Contractor. All claims for extra work done on a Force Account basis, shall be submitted to the Engineer by the Contractor upon certified statements, to which shall be attached original receipted bills or certified statements covering the cost of and the freight charges on all materials used in such work, and said statements shall be filed not later than the tenth day of the month following that in which the work was actually performed, and shall include all labor, equipment, and material accounts properly chargeable to the work. Payment will then be made on the next regularly scheduled estimate following receipt of all required documents.

109.06 PARTIAL PAYMENT

A. CURRENT ESTIMATES. The Project Superintendent, or his designee, and the Engineer's representative shall make measurements of, and come into agreement as to, the actual quantity of work completed on a daily basis. The Engineer will make in writing, at monthly intervals, an estimate of the materials in place and the amount of work performed during the preceding period and the value thereof at the contract unit prices based upon the quantities agreed to during the daily measurement. This estimate will be prepared with the Contractor so that all pay estimate quantities are agreed upon before the estimate is signed and recommended for payment. Payment for lump sums will be made in proportion to the amount of work accomplished, as determined by the Engineer. Payments made on current estimates shall be subject to correction on any subsequent current estimate and/or on the final estimate.

From each progress estimate, five (5) percent will be deducted and retained by the Owner, and the remainder less the amount of all previous payment will be paid to the Contractor. When the work is substantially complete, the retained amount may be further reduced below five (5) percent, at the discretion of the Owner, to only that amount necessary to assure completion.

The Owner may withhold any current estimate or portion thereof if the Contractor is negligent or delinquent in submitting any required forms or documents, or if a timely response is not given to a request made by the Owner for information, price quotations, or other data pertinent to the prosecution of the work.

B. MATERIALS ESTIMATES. At the request of the Contractor, the Engineer may at any time submit a materials estimate which will include the value of all aggregates, signal materials, precast concrete products, pipe culverts, utility piping and appurtenances, piling, bridge railing, guard fence, reinforcing steel, structural steel, steel wire mesh, or other approved manufactured or commercially produced materials, delivered on the job site or placed in an approved, bonded warehouse, but not incorporated into the work at the time of such estimate, provided the total value of such materials, including freight charges, appearing on any one estimate is not less than Ten Thousand Dollars. All estimates in which materials allowances are made shall be approved by the Engineer in writing before payment and the Contractor shall be responsible for the storage, safekeeping, and delivery in acceptable condition of all materials for which payments have been allowed.

Materials estimates will be allowed only for those materials that will be permanently incorporated into the work. The quantities allowed on a materials estimate will not exceed

the plan quantities or quantities established by approved change order. Payments made on materials estimates will be deducted as the material is incorporated into the work.

To request payment for stockpiled materials for which the Contractor has paid in full, prior to incorporation into the Work, the Contractor shall submit the following documentation:

(1) Written request for advance payment for stockpiled material, signed by the Contractor.

(2) Documentation of the quantity and cost of the material.

(3) For commercially produced or manufactured material, receipted (paid) bills or invoices, signed by a duly authorized Officer of the firm supplying the materials and properly notarized.

(4) For materials produced by the Contractor, detailed statements showing the delivered cost of the material. Such statements shall also include receipted (paid) bills or invoices for royalty payments and/or a Certification of Ownership signed by a duly authorized Officer of the firm supplying the material and properly notarized.

(5) Certification by the Contractor that the material meets the Specification requirements for the stage of production at which the material is stored.

109.07 SURPLUS MATERIALS

Materials purchased or produced according to the Plans or Contract, actually delivered and on hand and surplus to the needs of the Project through any act or omission of the Owner, may at the Owner's discretion, be purchased by the Owner. Payment will be made through the current or final estimate and shall be based on actual delivered cost to the Contractor as shown by receipted, paid bills, or by an approved certified statement of cost of production. All materials paid for as provided above shall be placed in the possession of the Owner at the site and become the property of the Owner.

109.08 ACCEPTANCE AND FINAL PAYMENT

After Contractor has completed all punch list corrections to the satisfaction of the Engineer and delivered all guarantees, Bonds, and other documents as required by the Contract Documents, and after Engineer has indicated that the Work is acceptable, the Engineer will prepare the final pay estimate indicating recommendation of final payment and will present it to the Owner's Board of Directors for acceptance of the project and release of final payment.

Before delivery of the final payment to the Contractor, the Engineer shall receive from the Contractor a written acceptance of the final estimate as payment in full for the work done. The final estimate shall be considered as the final payment even though it may be a zero amount. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

The making and acceptance of final payment shall constitute a waiver of all claims by Contractor against the City of Fort Smith.

No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations under this contract or the performance and payment bond. based upon the effect of delays to the Project as a whole and will not be granted for non-controlling delays to minor included portions of work, unless it can be shown that such delays did, in fact, delay the progress of the product as a whole.

SECTION 110
PROTECTION OF WATER QUALITY AND WETLANDS

110.01 GENERAL

This work shall consist of measures taken to prohibit the degradation of water quality and wetlands. The purpose is to limit, control, and contain fill materials, soil erosion, sedimentation, and other harmful wastes resulting from construction operations that could result in harm to the wetlands and waters of the United States. These requirements apply even if Corps of Engineer (COE) Section 404 or National Pollutant Discharge Elimination System (NPDES) Permits are not required for the project.

This Section applies to all activities under the Contract. The Contractor should be aware that requested modifications to the Contract and/or individual permits may not be approved.

The Contractor shall comply with all applicable Federal, State, and local permits and requirements on sites outside of the right-of-way limits utilized by the Contractor for the benefit of the project. While the primary enforcement of these requirements for locations off of the right-of-way rests with the applicable regulatory government agency, the City retains the right and authority to inspect and enforce Contractor compliance should violations come to the attention of the City.

110.02 RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall comply with the requirements of the Federal Water Pollution Control Act, 33 USC § 1251 et seq., the Arkansas Water and Air Pollution Control Act, Ark. Code Ann. § 8-4-101 et seq., and the regulations, orders, or decrees issued pursuant thereto. In the event of conflict between these regulations, orders, or decrees and the provisions shown on plans, the more restrictive requirements shall apply.

110.03 COE SECTION 404 PERMIT FOR CITY OF FORT SMITH RIGHT-OF-WAY AND CONTRACTOR FACILITIES.

A. GENERAL. All requirements of this subsection shall apply to those Contractor's activities covered by the Owner's COE Section 404 Permit on or off the right-of-way. COE Section 404 of the Federal Water Pollution Control Act, as amended, establishes a permit program for the regulation of discharges for dredged or fill material and excavation in wetlands and other waters of the United States.

B. RESPONSIBILITY FOR INITIAL PERMIT. The Owner will obtain all required COE Section 404 Permits for essential work on the right-of-way before the Contract is awarded. Contract documents will detail the location and amount of permanent and/or temporary fills, excavation, and clearing activities allowed under this permit.

C. CONTRACTOR REQUESTED PERMIT MODIFICATIONS. The Contractor shall submit a request on a form provided by the Owner to the Engineer for any activity involving wetlands or waters of the U.S. on or off the right-of-way and not covered by the Owner's COE Section 404 Permit prior to performing the activity. The Contractor shall be prepared to prove there is no practicable alternative to the COE Section 404 Permit change being requested. A determination will be made by the Engineer within 10 business days concerning the necessity or practicability of the request. The Owner will then apply for permit modifications which it determines to be necessary or practicable. The Contractor should be aware that COE review of proposed modifications to a COE Section 404 Permit may require 60-120 calendar days. These requested changes may be denied or modified by the Owner or COE. Requested modifications which require mitigation will be denied by the

Owner. If the Owner declines to consider a Permit modification request by the Contractor for an off right-of-way activity, the Contractor may apply for his own COE Section 404 Permit

D. COMPENSATION AND EXTENSION OF CONTRACT TIME. The Contractor will not be granted additional compensation or contract time due to requested modifications of the COE Section 404 Permit that are considered by the Engineer to be for the convenience of the Contractor. If, however, due to no fault of the Contractor, a COE Section 404 Permit modification involving on right-of-way activities is deemed by the Engineer to be necessary, additional contract time and/or compensation may be considered according to the provisions of subsection 104.05 "Claims for Adjustment and Disputes."

110.04 NPDES PERMIT FOR CONTRACTOR FACILITIES OFF THE RIGHT-OF-WAY

The National Pollutant Discharge Elimination System (NPDES) requires a permit to discharge storm water associated with industrial activity or construction sites into the waters of the United States. The Arkansas Department of Environmental Quality (ADEQ) issues these permits.

Contractor's operations on lands located off the right-of-way, such as borrow pits, plant sites, waste sites, or other facilities, may require an NPDES permit. If so, the Contractor shall be responsible for submitting the Notice of Intent, developing a Storm Water Pollution Prevention Plan, implementing the plan, stabilizing the land, submitting the Notice of Termination, and complying with all requirements in the permit and any revisions or additions to it.

110.05 NPDES PERMIT FOR CITY OF FORT SMITH PROPERTY AND RIGHT-OF-WAY

The Owner will obtain an NPDES Permit for all disturbed City of Fort Smith property, right-of-way lands and easements. The Owner's Storm Water Pollution Prevention Plan (SWPPP) will contain the temporary and permanent erosion and sedimentation control devices for the right-of-way.

110.06 STANDARD CONDITIONS

A. GENERAL. The following conditions are required on all projects for the protection of water quality and wetlands:

(1) Compliance with all conditions of the COE Section 404 permit, NPDES permit, Short Term Activity Authorization (STAA), Section 7 of Endangered Species Act, and Section 401 Water Quality Certification.

(2) To the maximum extent practicable, discharges of dredged or fill material into waters of the United States shall be avoided or minimized through the use of other practicable alternatives.

(3) Construction activities shall not cause unacceptable interference with navigation.

(4) No activity shall substantially interrupt the movement of the species of aquatic life native to the waterbody, including those species which normally migrate through the area.

(5) Under a Nationwide Section 404 Permit, no activity shall occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in

official study status. Individual permits shall be obtained for activities occurring in these rivers.

(6) No storage of petroleum, other chemical products, waste materials, trash, etc., shall be allowed within 100 feet of a wetland or waterbody boundary or elevation as shown on the plans. The Engineer reserves the right to limit the storage of any material within the floodplain of a stream to preclude the possibility of an unlawful discharge to the stream.

(7) To move clean water around the construction area without causing additional turbidity or sediment, the use of construction staging, cofferdams, pipe culverts, lined channels, sandbagged material, barrier wall, or other suitable materials or methods, as approved by the Engineer, shall be utilized for directing or confining water from the work area. This water shall be returned to the water body downstream from the construction site. The options utilized should consider the minimization of sedimentation and turbidity as a primary objective.

(8) If material or debris resulting from Contractor operations enters a waterway, it is considered an unpermitted fill material under the COE Section 404 Permit and the Engineer shall determine whether it may remain. If it is determined that the material is to be removed from the waterway, the Engineer will approve the Contractor's method of removal. Options or removal should consider the minimization of turbidity as a primary objective.

(9) No asphaltic material shall be disposed of in wetlands or waters of the United States.

(10) Temporary bridges or other structures shall be used whenever it is necessary to ford any body of water on the project more than twice in any six month period.

(11) Equipment shall not be operated in any body of water on the project except when required to construct channel changes or structures.

(12) Cofferdams needed for work in water shall be constructed from non-erodible materials.

(13) Materials excavated during bridge construction shall be placed on dry land outside the channel banks of all streams, at least 10 feet from the channel banks of a perennial stream, and at least 25 feet from the channel banks of a 5 Cubic Feet/Second (CFS) or larger stream. This includes channelized streams and relief channels. This material shall be properly contained or stabilized to minimize erosion and degradation of water quality and be removed before the beginning of the wet season.

B. WETLAND AREAS. Wetland areas on and off the right-of-way shall be preserved and protected whenever possible. Work in or near wetlands shall be performed in a manner that will minimize harm to the wetlands. The Contractor shall be responsible for the protection of adjacent wetlands.

Clearing of wetlands shall be limited to the minimum necessary for the completion of the project.

Wetland areas inside or outside the construction limits will not be used for storage, parking, access, borrow material, haul roads or any other construction support activity unless specifically approved in advance by the Engineer and according to the applicable COE Section 404 Permit.

When heavy equipment is working in wetlands, appropriate measures such as placing the equipment on mats, shall be taken to minimize soil disturbance.

Material shall not be wasted or temporarily stockpiled in wetlands.

C. TEMPORARY FILL. Unless otherwise provided, temporary work ramps or haul roads, when permitted, shall provide sufficient waterway openings to allow the passage of expected high flows during the time the ramp or haul road is in place.

Temporary fills or structures, if washed downstream, are considered to be unauthorized fill under the COE Section 404 Permit and the Engineer shall determine whether it may remain.

If it is determined that the material is to be removed from the waterway, the Engineer will approve the Contractor's method of removal. When considering options for removal, the Contractor shall consider the minimization of turbidity as a primary objective. Replacement of washed fill may require a Section 404 permit change or an additional permit.

All temporary fill placed within the channel banks of a stream, within 10 feet of the channel banks of a perennial stream, and within 25 feet of the channel banks of a 5 Cubic Feet/Second (CFS) or larger stream, shall be constructed using a riprap of the size specified in subsection 904.02.A(2), or larger material. This includes channelized streams and relief channels. A minimal amount of clean stone or gravel may be placed on top of the temporary fill in order to obtain a smooth working surface. The clean stone or gravel utilized shall have less than twelve percent passing the 0.075 mm (# 200) sieve. Upon removal, salvaged material that meets the requirements of subsection 904.02.A(2) will be paid for when reused in areas which require the utilization of riprap.

Unless specifically authorized under the COE Section 404 Permit as temporary or permanent fill material, bridge demolition rubble may not be dropped into a waterbody or wetland.

All fill material shall be free from toxic pollutants in harmful amounts.

All temporary fills must be removed and the affected areas returned to their preexisting elevation.

All temporary fill in any body of water or wetland shall be properly contained or stabilized to minimize erosion and degradation of water quality.

D. EROSION AND SEDIMENT CONTROL. The Contractor shall install, construct, repair, and maintain erosion and sedimentation control items as shown on the Plans or as directed by the Engineer in accordance with Section 140 “Storm Water Pollution Control.”

110.07 POLLUTANTS

A. GENERAL. The Contractor shall employ best management practices to prevent pollution by spills. Pollutants such as chemicals, fuels, lubricants, asphalt, raw sewage, concrete drum wash water, and other harmful wastes shall not be discharged into or alongside any waters of the United States, but shall be disposed of in accordance with governing State and Federal regulations. Storage of these materials shall not be allowed within 100 feet of a wetland or waterbody.

B. SPILL PREVENTION.

(1) Good Housekeeping - The quantity of materials stored on the project should be limited, as much as practical, to that quantity required to perform the work in an orderly

sequence and should be stored in a neat, orderly manner in their original containers with the original manufacturer's label.

Manufacturer's recommendations for proper use and disposal of materials shall be followed. All disposal shall be according to all local, State and Federal regulations in a permitted landfill or permitted disposal facility.

The Contractor should inspect daily to ensure proper use and disposal of materials.

(2) Hazardous Products - Hazardous products shall be kept in original containers with their original labels unless they are not re-sealable or are damaged.

Material Safety Data Sheets shall be retained and shall be available to all personnel at all times.

If surplus products must be disposed of, manufacturer's recommendations and local, State, and Federal regulations shall be followed.

(3) Product Specific Practices - The Contractor shall limit the amount of petroleum products and other chemicals in work areas adjacent to wetlands, waterbodies, and other sensitive areas. The following product specific practices shall be followed on-site:

(a) Petroleum Products - All on-site vehicles shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers that are clearly labeled. All asphalt substances used on-site shall be applied according to manufacturer's recommendations and/or Owner specifications. Construction of berms, or other similar measures, may be required for storage/refueling areas as a best management practice to restrict spill areas.

(b) Fertilizers - Fertilizers shall be applied only in the manner and amounts required by the specifications. Material shall be stored in a covered area and shall not be exposed to precipitation. Partially used bags shall not be discarded, but removed and disposed of properly. No storage of these materials shall be allowed within a wetland or floodplain.

(c) Paints and Solvents - All containers shall be tightly sealed and stored when not required for use. Excess material and waste shall not be discharged, but shall be properly disposed of according to manufacturers' instructions and/or State and Federal regulations. No storage of these materials shall be allowed within a wetland or floodplain.

(d) Concrete Trucks - Concrete trucks shall be allowed to discharge surplus concrete or drum wash water on site only in areas designated in the SWPPP. Discharge areas shall not be in or where the discharge can be washed into wetlands or waterbodies.

(e) Concrete Curing Agents - Concrete curing agents shall be applied only in the manner and amount required by the specifications. Excess material shall not be allowed to run off the area being treated.

C. SPILL REPORTING AND CLEANUP PRACTICES. All spills shall be reported as described in subsection 107.01.C.

In addition, the practices below shall be followed:

(1) All spills shall be cleaned up immediately after discovery or contained until appropriate cleanup methods can be employed.

(2) The spill area shall be contained and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

(3) Manufacturer's recommended methods for spill cleanup shall be followed along with proper disposal methods in accordance with local, State, and Federal regulations referred to previously.

Further, where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR §§ 110, 117, or 302, occurs on the right-of-way during a 24-hour period, the following action shall be taken by the Engineer:

(a) A report shall be submitted to the Arkansas Department of Environmental Quality within five calendar days of the knowledge of the release. The report shall include a written description of the release (including the type and estimate of the amount of material released); the date that such a release occurred; the circumstance leading to the release; and the corrective actions taken.

(b) The Stormwater Pollution Prevention Plan must be modified within 14 calendar days of knowledge of the release by addition of the above information. Review and modification of the plan must be made to identify measures to prevent the reoccurrence of such releases, and to respond to such releases.

If the spill occurs on a site off of the right-of-way, the Contractor shall follow the reporting procedures as described above.

110.08 CONTRACTOR NEGLIGENCE

If the Contractor violates the requirements of a COE Section 404 Permit, NPDES Permit, STAA, or any other requirement of these specifications, and fails to properly maintain, install and/or construct erosion and sediment control items, the Owner may take, but is not limited to, one or more of the following actions:

A. Cessation of other project related work,

B. Withholding of Contractor payments,

C. Suspension of the Project,

D. Default of the Contract.

All work required due to the violation of provisions of COE Section 404, NPDES Permits, or other requirements of these specifications which results from Contractor negligence, carelessness, or failure to perform work as scheduled, shall be performed by the Contractor at no cost to the Owner. In addition, the Contractor will be assessed the amounts of any and all fines and penalties assessed against and costs incurred by the Owner which are the result of the Contractor's failure to comply with a COE Section 404 Permit or NPDES Permit.

Failure to comply with the conditions of the COE Section 404 Permit may result in the COE issuing

a cease and desist order for all permitted activities. To obtain a new Section 404 Permit from the COE may require 60-120 calendar days processing time.

The Owner will not be responsible for any delays or costs due to the Contractor's failure to comply with the above special conditions. The Contractor will not be granted additional compensation or contract time due to loss of Permits for noncompliance.

In the event that pollutant spills occur which are the result of the Contractor's actions or negligence, the clean-up shall be performed by the Contractor at no cost to the Owner.

110.09 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

All Contractor costs incurred in complying with this section will not be paid for directly, but shall be included in the unit prices bid for other items of work unless specifically included as a pay item in the Contract.

SECTION 120
MAINTENANCE OF TRAFFIC AND TRAFFIC CONTROL

120.01 GENERAL

This item shall be accomplished according to the plans, this specification, subsections 105.12 "Maintenance During Construction," 107.06 "Public Safety and Convenience," and the MUTCD. It is also applicable to the furnishing, installing, maintaining and removal of temporary culverts and structures and to those traffic control devices and operations required to delineate and barricade temporary hazards that are a result of the Contractor's operations and which are not otherwise specified on the plans.

The Contractor shall be responsible for traffic control devices and maintenance during the course of the project. The Contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic and the public. All work performed shall be in accordance with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), latest edition. Prior to the start of construction, the Contractor shall submit a traffic control plan for approval by the Engineer in accordance with subsection 120.02.A.

Unless otherwise provided, during the course of the project, all affected roads shall be kept open by the Contractor to all traffic. When so provided on the plans or approved by the Engineer, the Contractor may bypass traffic over an approved detour route. The Contractor shall keep the portion of the project being used by public traffic, whether it is through or local traffic, in such condition that will permit the safe, continuous flow of two-way traffic at all times.

When approved by the Engineer, areas where the nature of the work restricts or prohibits two-way flow, one-way operation may be allowed while active work is taking place. Whenever one-way traffic is in effect, the distance allowed shall be set by the Engineer, and the Contractor shall provide sufficient flaggers whose sole duty is to direct traffic in accordance with subsection 120.02.C.

The Contractor shall not close any public trafficway (street, road, sidewalk, alley, etc.) until he has obtained the necessary permits, and/or approval by the Owner, and has coordinated the closure with the Engineer. The Contractor shall provide a safe, substitute route for any portion of a trafficway obstructed wholly or partially by his operations. He shall erect and maintain all necessary barricades, lights, detour signs, danger signal and signs, directions to travelers and shall take all necessary precautions for the protection of the work, the safety of his employees and the safety of the public.

The Contractor shall also provide and maintain in a safe condition access to all properties adjacent to public rights-of-way during construction. The Contractor shall construct temporary drives, or detour routes constructed of cold-mix asphalt concrete, as required, to maintain access, and the Contractor shall remove temporary drives, or detour routes upon completion of work. Contractor shall coordinate any temporary drives or closures of driveways for reconstruction with the property owner/tenant. Residential driveways shall not be closed during the evening hours or on weekends, unless otherwise approved by the Engineer.

When the Contractor's operations encroach upon a sidewalk, walkway, or crosswalk area, the Contractor shall take special precautions to protect the pedestrian's safety including provisions to separate pedestrian traffic from the work area, and/or to install temporary cold-mix asphalt concrete ramps and walkways as directed by the Engineer.

The Contractor shall provide those traffic control devices and operation required to delineate temporary hazards that are a result of Contractor operations as specified herein and in subsection 105.12 "Maintenance During Construction." The delineation of temporary hazards shall include the placement of any traffic control devices or fencing that are necessary for the protection from, and/or delineation of, such objects as open trenches or holes, stationary objects, drop-offs, parked

equipment, stockpiled materials, fresh oil, etc., until such time that the hazard is removed or permanent fencing or railing is installed. These traffic control devices or fencing shall be placed at locations where they will provide adequate warning to the traffic and general public, including side roads that enter the work limits. Fencing shall, as a minimum, be constructed of 4 foot high orange mesh fencing attached to barricades, or posts driven into the ground, so that the mesh fencing is taut, without appreciable sagging, and access to opening is not easily gained.

When the pay item of "Maintenance of Traffic and Traffic Control" is not included in the Contract, the Contractor shall perform operations according to subsection 105.12 "Maintenance During Construction" and this Section. Full compensation for this work will be considered included in the contract unit prices bid for the various items of the Contract.

The Contractor shall provide a competent traffic control supervisor for the project. Full compensation for costs associated for providing such person will be considered included in the contract lump sum price bid for "Maintenance of Traffic and Traffic Control," or if "Maintenance of Traffic and Traffic Control" is not included in the Contract as a pay item, included in the contract unit prices bid for the various items of the Contract.

The Contractor shall bear all expense of maintaining traffic over the section of road undergoing improvement, of providing required traffic control devices, and of constructing and maintaining such approaches, crossings, intersections, and other features, including providing and installing cold-mix asphalt concrete, as may be necessary, without direct compensation, unless a pay item for this work is included in the Contract.

120.02 CONSTRUCTION REQUIREMENTS

A. TRAFFIC CONTROL AND BARRICADE PLAN. A Traffic Control and Barricade Plan, along with any Contractor requested detours plan, must be submitted for acceptance prior to the start of construction. Submittal shall be a minimum size of 11"x17" and shall show detour locations, temporary road widenings; work areas; planned phases of construction; time frame of phases; and barricades, barriers, and traffic control signage. No monies for "Maintenance of Traffic and Traffic Control" shall be deemed earned until Contractor obtains approval of a Traffic Control and Barricade Plan.

B. TRAFFIC CONTROL DEVICES. Necessary traffic control devices consist of temporary traffic signs, barricades, lights, signals, cones, concrete barriers, temporary pavement markings, and other means of guidance of traffic through the work zone. The furnishing, installation, and maintenance of traffic control devices shall be done in accordance with Part VI of the MUTCD and the approved Traffic Control and Barricade Plan, and shall be subject to the approval of the Engineer. Traffic control within the state or federal highway rights-of-way shall be subject to approval by the Arkansas Highway and Transportation Department.

Necessary traffic control devices shall be properly placed and in operation before construction is allowed to start. Portable sign supports shall not be used. When work of a progressive nature is involved, such as resurfacing, the appropriate devices shall be kept current and placed in only the areas of actual work activities.

Signs, vertical panels, barricades and drums shall be maintained in first-class condition and shall be of materials that comply with the MUTCD for the construction of devices using AASHTO M 268 Type IX (VIP Grade) retroreflective sheeting. Care shall be exercised to keep the sign faces and reflective barricade surfaces free of dust and splashed mud. Any which may become scarred, damaged, destroyed, or unacceptable per the Engineer, shall be repaired immediately or replaced, at the Contractor's expense.

Temporary traffic lanes must be delineated using either paint, traffic tape, or raised

pavement markers as allowed by the MUTCD, or directed by the Engineer, excepting that paint may only be used on pavement to be replaced or overlaid as part of the Work. Existing lines that conflict with required temporary lines shall be effectively removed in such a manner so as to leave no residue or other trace of the former line that may be misconstrued by a driver to be a traffic line under any condition of daylight, darkness and wetness of pavement.

All temporary traffic control devices shall remain the property of the Contractor upon completion of the Contract and shall be removed from the project by him.

The Contractor shall maintain all existing highway, street, and county road regulatory, warning, guide, and informational signs in an effective location at all times for the duration of the Work and shall reinstall them at the correct location upon completion of the work.

The responsibility for the protection of the work, workmen, and public traffic will rest with the Contractor and he shall be liable for damages and injury suffered by reason of the Contractor's operations or any circumstances, conditions, actions, or negligence in connection thereof.

C. MAINTENANCE OF TRAFFIC AND/OR TRAFFIC CONTROL DEVICES. The Contractor shall designate an individual to furnish continuous surveillance over traffic control operations. This designee shall perform or supervise the performance of daily inspections to verify that all traffic control devices in use comply with the approved traffic control plans and MUTCD requirements. At least one inspection weekly shall be performed at night. This designee shall be available at nights and weekends to respond to calls involving damage to traffic control devices. The name, address, and 24 hour telephone number of the individual shall be furnished to the Engineer at the pre-construction conference.

If the Contractor, at any time, fails to maintain traffic and/or traffic control devices as specified in the MUTCD or elsewhere by these specifications, the Engineer will immediately notify the Contractor in writing of such noncompliance. If the Contractor fails to remedy the unsatisfactory maintenance within two (2) hours after receipt of such notice, the Owner may immediately proceed to perform such maintenance, and the entire direct cost of this maintenance will be deducted from money due or to become due to Contractor.

If a condition develops that is dangerous to public safety in the opinion of the Engineer, such condition may be immediately remedied with whatever means is available to the Owner and the cost of this maintenance will be deducted from money due or to become due to Contractor.

Further, each instance of failure to remedy unsatisfactory maintenance within two (2) hours of notification will result in a deduction of one day's value of the traffic control pay item from the lump sum. One day's value is determined by dividing the lump sum amount bid by the number of calendar days allowed for the project. This sum is in addition to any direct costs incurred by the Owner to remedy unsatisfactory maintenance.

When emergency maintenance is required during non-working hours, devices that are classified as "unacceptable" according to ATSSA Quality Standards for Work Zone Traffic Control Devices may be used in emergency maintenance provided the devices are effective in reducing the existing hazard and further provided that they are replaced not later than the next business day.

D. FLAGGER. The Contractor, as required by the Engineer, shall provide and station competent flaggers, per the recommendations of the MUTCD, whose sole duties shall

consist of directing the movement of public traffic either through or around the work. Flaggers must be used to assist trucks and equipment for safe ingress and egress whenever such movement may interfere with safe passage through the work zone. In addition, flaggers shall be used whenever Engineer deems it necessary for safety purposes. Flaggers on the project must have a valid ATSSA flagger certification or other certification approved by the Engineer.

E. DETOURS. Special detours shall be constructed as shown on the plans. Detour locations indicated on the plans may be approximate only; the exact location shall be as directed by the Engineer. If required on the Plans or in the Special Provisions, the special detour shall receive surfacing material of the kind and type specified, and they shall be placed and constructed in accordance with the requirements of the particular materials used.

For temporary detours requested by Contractor, the Contractor may utilize material available within the project, including existing surfacing, which is suitable for surfacing temporary portions of the grading for use as passageways for traffic. Traffic may be placed on detours constructed of gravel or crushed stone only during daylight hours, if other suitable materials are not available within the project limits.

Any temporary road widening, and subsequent cut/fill slope, shall be kept within the right-of-way and easements shown on the plans.

If it is determined that the Contractor's performance of the work was not completed in an efficient, workmanlike manner, making it necessary to use temporary asphalt concrete surfacing materials for maintaining traffic, the Contractor shall provide the necessary temporary asphalt concrete surfacing material at no cost to the Owner.

All detours or temporary roadways shall be maintained in a condition to allow the safe and convenient passage of vehicles. The passageway shall be maintained dust free by the application of water or other approved material to the roadway itself or to adjacent areas of construction activity that are the source of dust.

Eradication of all detours will be performed to the extent that the ground will be restored as nearly as feasible to the original condition, and material disposed of, to the approval of the Engineer.

F. PROJECTS ON EXISTING ROADWAYS. Where any operations result in a vertical differential greater than 3 inch at the centerline, lane lines, or edge of pavement, the Contractor shall immediately place traffic control devices or install a positive barrier according to the plans. Traffic control devices shall be maintained until the planned typical section is completed or until temporary shoulders are constructed.

Where traffic must traverse vertical differentials greater than 1 inch, ramps constructed of temporary asphalt concrete surfacing material must be provided by the Contractor at no cost to the Owner.

Portable concrete barrier rail shall be used to separate travel lanes from excavations when any excavation remains open at the end of the work shift, exceeds one foot in depth, exceeds one foot in width, is sloped steeper than 4:1, and is less than 18 feet from the nearest travel lane. When approved by the Engineer, portable concrete barriers may be omitted for excavations less than 5 feet deep, when the slopes are flatter than 2:1 and an area clear of obstacles is provided 14 feet past the bottom of the slope.

Access to residential side streets shall be maintained at all times. Where necessary, access shall be provided on temporary asphalt concrete.

The Contractor shall schedule all work in a manner that will allow the routing of traffic over the permanent pavement as quickly as practicable.

All curb and gutter, underdrains, inlets, junction boxes, storm drains, driveways, and sidewalks shall be completely installed on one side of a street before work may begin on the opposite side of the same street.

The Contractor shall maintain all existing highway, street, and county road regulatory, warning, guide, and informational signs in an effective location at all times for the duration of the work and shall reinstall them at the correct location upon completion of the work. Any signs damaged by the Contractor shall be replaced at no cost to the Owner.

No traffic signal shall be activated without the approval of the Engineer. Traffic signals may only be activated on Tuesdays, Wednesdays, or Thursdays.

Existing asphalt and concrete driveways disturbed during construction must be replaced with temporary asphalt concrete driveways, at a slope that all vehicles can negotiate safely, within 24 hours of removal and remain until such time that the permanent driveways can be installed. Temporary commercial driveways that exhibit excessive potholing and rutting, or are to remain in place more than 7 calendar days, shall be replaced with permanent asphalt concrete at the direction of the Engineer.

Utilities shown on the plans for relocation or adjusting will be moved once to their final location. If contractor requires additional relocation or adjusting of utilities for their operations or for detours, other than those shown on the plans, it will be done at contractor's expense.

120.03 MEASUREMENT AND PAYMENT

"Maintenance of Traffic and Traffic Control" will be measured and paid for by the lump sum. Distribution of payment for traffic control will be made in proportion to the amount of work accomplished as determined by each periodic estimate.

Payment for "Maintenance of Traffic and Traffic Control" shall be full compensation for performing all required traffic control including installation and removal of temporary detours other than those shown on the plans (including restoration of pre-existing conditions); for maintenance of special detours shown on the plans; temporary asphalt concrete surfacing material and Class 7 base material; installation and removal of temporary asphalt driveways and transition ramps; portable precast concrete barrier rail, barricading, warning lights, temporary impact attenuation, signing, project signs, and temporary lane delineation; removal of conflicting lane delineation; reinstallation of permanent striping on existing roadways; for furnishing traffic control supervisor and flag persons, as specified herein, and as required by the Engineer; for maintaining and re-erecting all existing highway, street, and county road signs; and for all materials, labor, equipment, tools, and incidentals necessary to safely maintain traffic during the construction period.

Measurement and payment for costs associated with the construction and removal of Special Detours shown on the plans will be in accordance with the individual items of associated work or as a lump sum item as shown on the Bid Proposal.

Payment will be made under:

Pay Item	Pay Unit
Maintenance of Traffic and Traffic Control	LS

SECTION 140
STORM WATER POLLUTION CONTROL

140.01 DESCRIPTION

This item consists of storm water pollution control permit requirements and pollution prevention measures relative to construction operations.

140.02 APPLICABLE REGULATIONS

The Contractor shall comply with the requirements of the Federal Water Pollution Control Act, 33 USC § 1251 et seq., the Arkansas Water and Air Pollution Control Act, Ark. Code Ann. § 8-4-101 et seq., and the regulations, orders, or decrees issued pursuant thereto. In the event of conflict between these regulations, orders, or decrees and the provisions shown on plans, the more restrictive requirements shall apply.

140.03 NPDES PERMIT FOR CONTRACTOR FACILITIES

The National Pollutant Discharge Elimination System (NPDES) requires a permit to discharge storm water associated with industrial activity or construction sites into the waters of the United States. The Arkansas Department of Environmental Quality issues the permits. A Notice of Intent must be filed to comply with the Permit. The Contractor shall furnish the Engineer a copy of the Notice of Intent.

Contractor's operations on lands located outside rights-of-way and easements, such as borrow pits, plant sites, waste sites or other facilities, may require submitting a Notice of Intent. If so, the Contractor shall be responsible for submitting the Notice of Intent, developing a Storm Water Pollution Prevention Plan, implementing the plan, final stabilization of the land, submitting the Notice of Termination, and complying with all requirements in the permit and any revisions or additions to it. In addition, the Contractor may be legally required to obtain other permits associated with specific activities outside rights-of-way. It is also the Contractor's responsibility to obtain these. The Contractor should contact the Arkansas Department of Environmental Quality or other appropriate State and/or Federal agencies to determine the necessity of any additional permit requirements.

All costs incurred in completing the above will not be paid for directly, but shall be considered incidental to other items of work.

140.04 NPDES PERMIT

The Owner will file a Notice of Intent and develop a Storm Water Pollution Prevention Plan (SWPPP) for all disturbed rights-of-way and easements within this project. When the right-of-way is stabilized, the Owner will submit the Notice of Termination with the Arkansas Department of Environmental Quality.

The SWPPP for work on right-of-way will contain temporary and permanent erosion and sedimentation control devices as necessary to comply with the NPDES Permit. These will be measured and paid for under the appropriate Sections of the Specifications.

140.05 STORM WATER POLLUTION PREVENTION PLAN

The Owner shall provide the Contractor with a copy of the SWPPP and the NPDES Permit Notice of Coverage (NOC). The Contractor shall post the SWPPP and NOC on-site near a construction entrance in a location that is easily visible from the roadway. The NOC shall be posted in a clear plastic container so that it is protected and readily visible. The SWPPP shall be posted in a mailbox that is marked “SWPPP” along

both long sides with standard adhesive three-inch letters. A rain gauge shall also be posted on-site when required by the SWPPP.

Prior to beginning work on the project, the Contractor shall complete the Contractor Identification section of the SWPPP as required by Part II.4.B of the NPDES Permit.

The Contractor shall be responsible for compliance with all applicable terms and conditions of the NPDES Permit as it relates to activities on the construction site, including installation and maintenance of Best Management Practices (BMPs) and other controls required by the SWPPP. Special provisions for the protection of endangered species will be a part of the Contract, if applicable.

The Contractor shall inform the Engineer sufficiently in advance of planned construction activities and conduct construction activities in a manner to allow the SWPPP to be modified to accommodate the activities.

The Contractor shall be required to inspect all erosion and sedimentation controls, complete all inspection reports, and maintain all required records in accordance with the requirements set forth in the SWPPP and the NPDES Permit. The Contractor shall provide copies of all inspection reports to the Engineer on a monthly basis. At the conclusion of the project, the Contractor shall provide the Engineer with the original inspection records, SWPPP, and NOC.

The Contractor shall install, construct, repair, and maintain erosion and sedimentation control items as shown on the plans or as directed by the Engineer.

The Contractor shall install, construct, repair, and maintain erosion and sedimentation control items within three business days of being instructed to do so by the Engineer. However, if heavy equipment is required and the Engineer agrees that conditions do not allow heavy equipment to be used, a longer time frame may be allowed. The Contractor shall submit adequate documentation to the Engineer that proves conditions are not suitable for the use of heavy equipment and that there is no alternative to its use. When conditions become suitable, as determined by the Engineer, the Contractor shall proceed with the required actions to be completed within three business days after receiving notification.

If required, additional temporary and permanent erosion and sedimentation control items that are not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls, shall be performed as ordered by the Engineer and will be paid for either at unit bid prices or as provided for in subsection 109.05 “Extra and Force Account Work.”

Minimizing time of exposure of disturbed ground is a primary objective. Therefore, disturbing an area and postponing subsequent work could result in the Contractor being required to stabilize the area at no cost to the Owner. Disturbed soil is defined as exposed bare soil denuded of vegetative cover or lacking stabilization. Stabilized soil is defined as soil that is covered by grass, seeded and mulched, mulched, covered by erosion control matting, or covered by permanent stabilization as shown on the plans or as directed by the Engineer. The Engineer will have the authority to limit the surface area of disturbed land based on the Contractor’s capability to effectively control erosion and sedimentation on these areas and contain the sediment within the right of way limits, including temporary construction easements. The Contractor shall be responsible for making the necessary arrangements with the proper owner(s) and for reclaiming sediment and stabilizing the area that is not contained within these limits.

Cut and fill slopes shall be completed and stabilized in increments not to exceed 15 feet, measured vertically, as the construction progresses.

Completed areas within buffer zones adjacent to water bodies as shown on the plans or otherwise

designated by the Engineer, shall receive permanent seeding, temporary seeding, or mulch cover as soon as possible, but in no case more than five business days after completion, or sooner as directed by the Engineer.

All other completed areas, including increments of cut and fill slopes described above, shall receive permanent seeding, temporary seeding, or mulch cover within 14 calendar days after completion, or sooner as directed by the Engineer.

Disturbed areas that are temporarily abandoned shall be stabilized within 14 calendar days after activity ceases. Payment for this work will be made if abandoned due to no fault or negligence of the Contractor. Payment will not be made for temporary stabilization required by Contractor negligence, by the lack of proper Contractor scheduling, or for the convenience of the Contractor.

Excavation, including silt removed from erosion and sedimentation control devices, shall not be deposited where it can be eroded into waters of the United States. At locations of drainage structures, care shall be taken to prevent mounds of excavation on the inlet end from washing through the structure or on the outlet end from washing downstream.

Water pumped during any dewatering activity shall be diverted into a sediment basin of the appropriate type as shown on the standard drawings or other device as approved by the Engineer. This sediment basin or device and its holding capacity shall be approved by the Engineer. No turbid discharge to waters of the State shall be allowed.

Off-site vehicle tracking of sediments and the generation of dust shall be minimized as also specified in subsection 105.12 "Maintenance During Construction." Contractor shall provide a crushed stone or gravel construction entrance as shown on the standard drawings and extending a minimum of fifty feet from the edge of the existing street pavement at all points of ingress and egress to construction areas.

After cut sections are constructed, the tops of backslopes will be rounded to blend the slopes into natural ground when practicable. At transitions from cut to fill, ditches shall be tailed out to prevent erosion of the toe of slope.

Temporary erosion and sedimentation control devices shall not be removed or destroyed by the Contractor without permission from the Engineer.

140.06 CONTRACTOR NEGLIGENCE

In the event that the Contractor fails to properly maintain, install and/or construct erosion and siltation control items as instructed by the Engineer, fails to inspect erosion and siltation controls, or fails to comply with all reporting and record keeping requirements, the Engineer may take, but is not limited to, one or more of the following actions:

A. Cessation of other Contractor operations
B. Withholding of Contractor payments
C. Suspension of the Project
D. Default of the Contractor

All erosion and sedimentation control work required due to Contractor negligence, carelessness, or failure to install permanent controls as scheduled, shall be performed by the Contractor at no cost to the Owner. In addition, the Contractor will be assessed damages resulting from his negligence in complying with the Storm Water Pollution Prevention Plan at the rate assessed against the Owner by the Arkansas Department of Environmental Quality.

140.07 POLLUTANTS

Pollutants such as chemicals, fuels, lubricants, asphalts, raw sewage, concrete drum wash water, and other harmful waste shall not be discharged into or alongside any waters of the United States, but shall be disposed of in accordance with governing State and Federal regulations and in accordance with the Storm Water Pollution Prevention Plan.

140.08 PROTECTION OF WETLANDS

Work in or near wetlands shall be performed in a manner that will minimize harm to the wetlands. Wetland areas outside the construction limits shall not be used for storage, parking, waste, access, borrow material, or any other construction support activity unless specifically approved in advance by the Engineer and in accordance with the applicable Corps of Engineers 404 Permit. Heavy equipment working in wetlands shall be placed on mats. All work in or near wetlands shall be in accordance with Section 110 "Protection Of Water Quality And Wetlands" of these specifications.

140.09 SPILL PREVENTION, REPORTING AND CLEANUP

Spill prevention, reporting, and cleanup shall be conducted in accordance with the requirements of subsection 110.07 "Pollutants."

140.10 MEASUREMENT AND PAYMENT

Work involved in complying with these requirements will not be measured or paid for separately, but will be considered included in the unit prices bid for other items of work.

SECTION 141
CONSTRUCTION EROSION CONTROL

141.01 DESCRIPTION

This work consists of temporary measures to control erosion and sediment during construction. Temporary measures shall be coordinated with the permanent erosion control features specified to the extent practical to assure continuous erosion control throughout the construction and post construction period.

141.02 MATERIALS

A. BALED STRAW. The vegetative materials shall consist of baled straw or baled hay. The bales of straw or hay shall be standard sized rectangular bales approximately 18x20x36 inches in size and shall be securely bound with wire or twine. Decomposed bales will not be acceptable.

The stakes used to anchor the bales shall be wood or metal approximately 36 inches long, of sufficient strength to be driven firmly in the ground.

B. SAND BAGS. Bags shall be tightly woven burlap or other material approved by the Engineer. Sand shall be a sandy soil or clean sand approved by the Engineer.

C. GEOTEXTILE FABRIC. Fabric shall conform to AASHTO M288 for Sediment Control, Self-Supported. It shall be a minimum of 36-inches wide.

D. POSTS. Posts shall be constructed of wood or steel. Posts shall be a minimum of 48" long and at least 18" longer than the height of the silt fence.

(1) WOOD POSTS. Wood posts shall be straight and have a minimum nominal cross-section of 2-inches by 2-inches.

(2) STEEL POSTS. Steel posts shall be standard "T" or "U" sections of 1.30 lb/ft minimum.

E. FASTENERS. Fasteners shall be either 5/8-inch long brass or copper staples, or 17 gage galvanized or aluminized steel tie wires long enough to securely attach the geotextile fabric and wire mesh to the posts.

F. WIRE MESH. Wire mesh shall be a minimum 14 gage galvanized welded wire reinforcement with 6-inch by 6-inch openings.

G. MATTING. Erosion control matting shall be Contech EFB2 or SFB2, or approved equal.

H. SEED AND MULCH. Seed shall be common rye grass, cereal grasses (wheat, barley, oats), Brown Top Millet or Sudan Grass, meeting the requirements of the J Arkansas State Plant Board. Seed mulch, fertilizer and water shall be in accordance with subsection 290.04 "Seeding and Fertilizing." Mulch shall be straw.

I. TEMPORARY CONSTRUCTION ENTRANCE. Temporary construction entrances shall consist of 4" – 6" stone over filter fabric.

(1) STONE. Stone shall be of hard, durable, natural rock and shall range in size from 4-inches to 6-inches with the stone gradation being equally distributed within the

required size range.

(2) FILTER FABRIC. The filter fabric shall be a woven or unwoven synthetic fiber geotextile conforming to the requirements of AASHTO M 288. Filter fabric shall be similar to Mirafi 140 N or Dupont Typar Style 3601, or approved equal.

J. GRAVEL FILTER BAGS. Bags shall be constructed of a pervious, non-biodegradable material. When filled with gravel, bags shall be approximately 24" long by 12" wide by 6" high. Gravel shall be ½" to 1" diameter coarse aggregate.

K. ABOVE GRADE CONCRETE WASHOUT AREA. Above grade concrete washout areas shall consist of baled straw and a plastic liner secured with posts.

(1) LINER. As a minimum, the liner shall be plastic, with a 10 mil thickness
.

(2) BALED STRAW. Baled straw shall comply with Section 142.02 A.

(3) POSTS. Posts shall comply with Section 142.02 D.

L. ROCK DITCH CHECK. Stone for Rock Ditch Checks shall be of hard, durable, natural rock and shall range in size from 3-inches to 6-inches with the stone gradation being equally distributed within the required size range.

141.03 CONSTRUCTION REQUIREMENTS

A. GENERAL. Prior to the start of construction, the Contractor will submit for acceptance the schedule for accomplishment of temporary and permanent erosion control work. Work shall not be started until the erosion control schedule and methods of operation for construction have been approved by the Engineer.

The Engineer will determine and limit the surface area of erodible earth material exposed by clearing and grubbing, the surface area of erodible earth material exposed by excavation, borrow, and fill operations. The Engineer will direct the Contractor to provide immediate permanent or temporary erosion control measures which may involve the construction of temporary, dikes, dams, mats, seeding, or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds.

The Contractor will incorporate all permanent erosion control features into the project as outlined in the accepted erosion control schedule. Temporary erosion control measures shall be used to correct conditions that develop during normal construction practices, but are not associated with permanent control features on the project.

Clearing and grubbing operations shall be scheduled and performed so grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures may be required between successive construction stages. Under no conditions shall the surface area of erodible earth exposed at one time by clearing and grubbing exceed 750,000 square feet per equipment spread without approval of the Engineer.

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 finish grading, mulching, seeding and other permanent erosion control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures will be taken immediately.

If temporary erosion control measures are required as a result of the Contractors negligence, carelessness or failure to install permanent control as a part of the work scheduled and are ordered by the Engineer, the work shall be performed at the Contractors expense. Temporary erosion control may include construction work outside the Right of Way where the work is related to the roadway construction such as borrow pit operations, haul roads and Contractors work sites.

The erosion control features installed shall be maintained by the Contractor.

B. BALED STRAW DITCH CHECKS AND INLET BARRIERS. Baled straw ditch checks shall be constructed across swales, draws or ditches to reduce the velocity of storm water runoff and intercept silt. Baled straw inlet barriers shall be constructed around inlets to impede silt from entering the inlets. Ditch checks and inlet barriers shall be constructed in accordance with the details and at the locations shown on the plans or as directed by the Engineer.

Bales shall be installed so that the bindings are oriented around the sides of the bales. The bales shall be keyed into the ground a minimum of 4 inches and securely held in place by staking or other methods that will prevent displacement. No gaps shall be left between bales. The number of bales required and the specific arrangement of them will vary with the conditions at each site. After permanent stabilization has been completed, or simultaneously with the permanent stabilization, the baled straw ditch checks and the silt trapped by them shall be removed and disposed of as directed by the Engineer.

C. SAND BAG DITCH CHECKS. Sand bags shall be placed in accordance with the details and at locations shown on the plans or as directed by the Engineer. They shall be laid in horizontal courses and successive courses shall break joints with preceding ones. The sacks shall be rammed and packed against each other and tamped on the surface to secure a uniform surface. The number of bags required and the arrangement at each installation will vary with on-site conditions.

D. SILT FENCE. Silt fences shall consist of a self-supporting geotextile fabric and wire mesh constructed in accordance with the details and at the locations shown on the plans and as directed by the Engineer. Geotextile fabric and wire mesh for silt fence shall be fastened to the upstream side of the posts in such manner that they will remain attached and fully supported for the entire time the barrier is needed for service. Wire mesh shall be attached between the fabric and the posts. The geotextile fabric and wire mesh roll ends shall be overlapped a minimum of 6-inches at post locations. The fabric toe and wire mesh shall be buried to a depth of 6-inches to secure the base.

The silt fence shall not be constructed across a ditch, swale, or area of concentrated flow. On slopes, the terminal ends of silt fence shall be turned upslope a sufficient distance to eliminate flow around the ends of the silt fence. When permanent stabilization of the area has been completed, or simultaneously with the permanent stabilization, the silt fence and the silt trapped by it shall be removed and disposed of by the Contractor.

E. EROSION CONTROL MATTING. Erosion control matting shall be installed at locations shown on the plans or as directed by the Engineer. Areas receiving matting shall be shaped and temporarily seeded when required, prior to placement of the matting.

F. DIVERSION DITCH AND SEDIMENT BASIN. Excavation and grading for diversion ditches and sediment basins shall be in accordance with the dimensions and at the locations shown on the plans or as directed by the Engineer.

G. TEMPORARY SEEDING AND MULCH COVER. The area designated or directed to be temporarily seeded shall be lightly tilled.

Rye or the cereal grasses shall be planted at the rate of 100 pounds per acre between August 15 and December 15. Brown Top Millet or Sudan Grass shall be planted at a rate of 50 pounds per acre between March 1 and August 15. The seeding mixture may be altered by the Engineer in selected areas with no adjustment in contract price. The alteration will be made on an equivalent cost basis. Fertilizer shall be applied at the rate of 500 pounds per acre of 10-20-10 or the equivalent amount of plant food.

The Engineer may adjust the seasonal limitations specified above when immediate erosion control measures are required and other methods are not considered practicable. The decision to waive seasonal limitation will be based on the practicality of planting seed at that particular time and the period of time remaining before permanent erosion items can be applied. Watering, when required, shall be in accordance with Section 290 "Site Restoration."

Mulch cover shall be applied in accordance with Section 290.

H. TEMPORARY CONSTRUCTION ENTRANCE. Prior to the start of construction, Contractor shall install temporary construction entrances at the locations shown on the plans and at all points of access to the project off of existing paved roads, construction yards, material storage areas, drives or parking lots where tracking of dirt and mud from the project may occur.

The Contractor is responsible for maintaining the temporary construction entrances so that tracking of dirt and mud off the project site is kept to a minimum. At completion of construction, Contractor shall remove the temporary construction entrances and restore the area back to the original condition.

I. INLET SEDIMENT FILTER. Inlet sediment filters shall be constructed around sump inlets and upstream of on-grade curb inlets using gravel filter bags to impede silt from entering the inlets. Inlet sediment filters shall be constructed in accordance with the details and at the locations shown on the plans or as directed by the Engineer.

J. ABOVE GRADE CONCRETE WASHOUT AREA. Above grade concrete washout areas shall be installed prior to any concrete placement on site. Signs shall be placed at the construction entrance, at the washout area, and elsewhere as necessary to clearly indicate the location of the concrete washout area to operators of concrete trucks. Concrete washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of four inches. Facilities must be cleaned, or new facilities must be constructed and ready for use once washout facilities have reached 75% capacity. At the end of construction, the concrete washout area and all remaining waste concrete shall be removed from the site and disposed of at an accepted waste site. When the washout area is removed, the disturbed area shall be topsoiled and sodded or otherwise stabilized in a manner accepted by the Engineer. Above grade concrete washout areas shall be constructed in accordance with the details and at the locations shown on the plans or as directed by the Engineer.

K. ROCK DITCH CHECK. Rock Ditch Checks shall be placed in accordance with the details and at locations shown on the plans or as directed by the Engineer. The upstream and downstream sideslopes of the ditch check shall be no steeper than 2:1. A rock overflow shall be constructed on the downstream side of the ditch check. The rock overflow shall be a minimum of 6 inches thick and a minimum of 2 feet in length. The amount of rock necessary to construct the Rock Ditch Check, including the rock overflow, at each

installation shall vary depending upon on-site conditions.

141.04 MEASUREMENT AND PAYMENT

Measurement and payment for temporary erosion control measures shall be on a lump sum basis except when the following items are included in the bid form.

A. Baled straw ditch checks and baled straw inlet barriers will be measured by the bale, in place, and will be paid for at the contract unit price bid for Straw Bales.

B. Sand bag ditch checks will be measured by the bag, in place, and will be paid for at the contract unit price bid for Sand Bags.

C. Silt fence will be measured by the linear foot complete in place and will be paid for at the contract unit price bid for Silt Fence.

D. Erosion control matting will be measured by the square yard, in place, and will be paid for at the contract unit price bid for Erosion Control Matting.

E. Diversion ditches will be measured by the linear foot and will be paid for at the contract unit price bid, for Diversion Ditches. Sediment basins will be measured by the number of units constructed and will be paid for at the contract unit price bid for Temporary Sediment Basin.

F. Temporary seeding and mulch cover will be measured by the square yard and will be paid for at the contract unit price bid for Temporary Seeding/Mulch Cover. Preparation of areas for seeding and furnishing and applying water shall be considered incidental to temporary seeding and mulching and no separate payment will be made.

G. Temporary construction entrances will be measured by the square yard as constructed. Temporary construction entrances required at contractor's construction yards, material storage areas, and other work areas will not be measured and paid for separately but shall be considered incidental to "Site Preparation." Work completed will be paid at the contract unit price bid for "Temporary Construction Entrance", which price shall be full compensation for excavation; furnishing, transporting and installing filter fabric and rock; maintenance and removal of entrance; restoration of area to original condition, including topsoil and sodding; and for all labor, tools, equipment, and incidentals necessary to complete the work.

H. Inlet sediment filters will be measured by the bag, in place, and will be paid for at the contract unit price bid for Gravel Filter Bags.

I. Above grade concrete washout areas will be measured by the number of units constructed. Work completed will be paid at the contract unit price bid per each for, "Above Grade Concrete Washout Areas," which price shall be full compensation for furnishing, transporting, and installing straw bales, plastic liner, and posts; maintenance and removal of washout area; restoration of washout area to original condition, including topsoil and sodding; and for all labor, tools, equipment, and incidentals necessary to complete the work.

J. Rock ditch checks will be measured by the number of installations constructed. Work completed will be paid at the contract unit price bid per each for, "Rock Ditch Checks," which price shall be full compensation for furnishing, transporting, and installing rock ditch checks and rock overflows; maintenance and removal of rock ditch checks and rock overflows; restoration of channel to original condition; and for all labor, tools, equipment, and incidentals necessary to complete the work.

The removal and disposal of silt accumulations, and the removal and disposal of temporary erosion control measures shall be considered incidental to the various items of work, and no separate payment will be made.

Payment will be made under:

Pay Item	Pay Unit
Construction Erosion Control	LS
Straw Bales	EA
Sand Bags	EA
Silt Fence	LF
Erosion Control Matting	SY
Diversion Ditch	LF
Temporary Sediment Basin	EA
Temporary Seeding/Mulch Cover	SY
Temporary Construction Entrance	SY
Gravel Filter Bags	EA
Above Grade Concrete Washout Areas	EA
Rock Ditch Check	EA

DIVISION 200 - SITEWORK AND EARTHWORK

SECTION 201
SITE PREPARATION & REMOVALS

201.01 SCOPE OF WORK

This work shall consist of all site preparation and removal and disposal of obstructions.

201.02 DEFINITIONS

A. SITE PREPARATION. This work shall consist of preparatory work and operations, including but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals; for the establishment of the Contractor's offices, buildings, inspector's office when required by Special Conditions, and other facilities necessary to undertake the work on the project.

This item shall also include other work and operations that must be performed, or other expenses incurred, before beginning work on the various Contract items on the project site. It shall also include pre-construction costs which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the Contract.

This item shall also include the provision of a full-time Project Superintendent/Coordinator who shall be on-site at all times that work is progressing on the Project. The Superintendent shall be responsible for receiving all instructions from the Engineer and shall have full authority to execute orders or directions of the Engineer; shall coordinate all phases of the work, and all crews and subcontractors involved in the Project; shall be responsible for all safety and traffic control requirements, including being the designated person for furnishing continuous surveillance over traffic control operations; and shall be responsible for the compilation of all pay estimate and review with the Engineer.

This item shall also include the removal of obstructions, as needed, for the construction of the project for those items not listed separately. This work shall include, but not be limited to, the removal and relocation of mailboxes and the removal and disposal of all structures, foundations, slabs, signs and sign foundations, culverts, headwalls, pavements, abandoned utilities, rubbish and other items constituting an obstruction which are encountered. All items so encountered will be removed as part of the site preparation unless otherwise provided in the plans or proposal by the listing of separate specific bid items.

This item shall also include the maintenance of the project site, including mowing, spraying, trimming and/or removal of grass and weeds within the project limits, including easements.

B. REMOVAL AND DISPOSAL OF OBSTRUCTIONS. This work shall consist of the removal and satisfactory disposal of curb and gutter; portland cement or asphalt concrete driveways and pavements; parking areas; sidewalks and steps; retaining walls; headwalls, inlets and junction boxes; storm drain pipe, ditch paving, culverts and channels; and other items listed in the proposal, all of which are not designated or permitted to remain.

The work may also include demolishing and/or removing from the site remaining buildings, or portions thereof, which are more particularly described on the plans and/or in the Special Conditions, together with all appurtenances, either attached or detached, including but not limited to canopies, porches, awnings, piping, poles, attached signs and foundations, auxiliary buildings, or sheds.

201.03 LIMITS OF WORK

The limits of the work shall extend to the right-of-way or easement lines, unless indicated otherwise on the plans or in the Special Conditions. Areas within temporary construction easements shall not be cleared and existing vegetation and objects shall not be disturbed except as needed for the construction and unless otherwise noted on the plans. Any vegetation or objects not noted for removal, or that are outside the limits of work, that are damaged or disturbed shall be returned to original condition at no cost to the Owner.

201.04 CONSTRUCTION REQUIREMENTS

A. GENERAL. The attention of the bidder is directed to the necessity for careful examination of the entire site to determine, at the time of bid preparation, the full extent of the work to be accomplished. The work area shall be cleared of all obstructions, of whatever nature, that will affect or will be affected by the construction of the project. All items so encountered will be removed, per the requirements of these specifications, unless otherwise shown on the plans or directed by the Engineer.

All structures, foundations, culverts, drainage structures, concrete slabs, pavements, and other such items which must be removed to complete the project as shown on the plans shall be so removed in a workmanlike manner under 'Site Preparation', unless individual bid items for removal are included in the bid proposal.

Abandoned water lines and sewer lines that are encountered during excavation or trenching shall have the interfering portions removed and the remaining ends filled with a concrete plug, unless the lines are to be incorporated into the new work. This work shall be considered incidental to the amount bid for 'Site Preparation.'

The Contractor shall take every precaution in protecting and removing all structures that are to designated to be relocated or salvaged. These items shall include, but not be limited to, private signs and walls, the brick and rock from sidewalks and driveways and all other items which are or should be considered as the property of those adjoining the street right-of-way. Items so removed shall be provided to the adjacent property owner if requested; otherwise, items shall be disposed of as specified.

Contractor is required to maintain all roadways, pedestrian ways, waterways, water, sewer, and storm drainage systems during removal operations as specified in Section 105.12 "Maintenance During Construction". The Contractor shall not unnecessarily interfere with the use of any adjacent sidewalks, streets, or roads.

Grass and weeds in yard areas, open lots, and adjacent to driveways, sidewalks and roadways shall be maintained by mowing, trimming, spraying, or removal, such that their height is less than twelve inches at all times. Grass and weeds within ditch areas shall be maintained at a height that does not restrict the flow of the channel and so that visibility is not obstructed at intersections and driveways.

All material removed under this section shall be disposed of by the Contractor as specified in Section 104.08 "Final Cleaning Up."

Removal and relocation of mailboxes will be provided as required in subsection 107.06 Public Safety and Convenience.

Removal and relocation of traffic and street signs shall be coordinated with the City of Fort Smith Operations Department.

B. REMOVAL AND DISPOSAL OF OBSTRUCTIONS. All surface items such as curb and gutter, driveways, parking areas, walks, steps, pavement, signs and walls shall be separated or broken away from the adjacent part of the structure designated to remain in place by a vertical saw cut along the line designated by the Engineer, or where shown on the plans. The area of each of these items so removed shall be restricted to the minimum possible area that will conform to the lines and grades of the completed construction.

Sawing shall be reasonable true to line and the depth of sawing shall be full depth or a depth such that when removing the material, undue breakage or shattering of the adjacent area will not occur. The equipment for sawing shall be approved mechanical concrete saws in satisfactory working condition and adequately powered to cut to the depth required. The edge of the structure left in place shall be approximately vertical with no abrupt changes in alignment. Any damage to or removal of the structure designated to remain in place shall be repaired or replaced at no cost to the Owner.

Abandoned drainage culverts, or parts thereof, that interfere with the new construction shall be removed and the remaining ends filled with a concrete plug. Concrete and masonry abutments, headwalls, and retaining walls shall be removed entirely. All sign foundations shall be removed entirely; except when billboard signs are outside the road section, and when approved by the Engineer, their foundations may be removed only down to an elevation at least three feet below the subgrade elevation.

Where old box culverts, pipe culverts, or walls are to be extended or otherwise incorporated into the new work, only such part of the old structure shall be removed as to provide a proper connection to the new work. The connecting edges shall be cut, chipped, and trimmed to the required lines and grade without weakening or damaging the part of the structure to be retained. For a pipe culvert extension, the headwall and the attached end joint shall be removed to accommodate the extension. This work will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the items involved in the culvert extension.

Trenches resulting for the removal or demolition of old culverts shall be filled with approved material placed in layers according to Section 205 “Trench & Structure Excavation and Backfill”.

Removal of parking areas shall include the removal and disposal of all materials encountered to existing subgrade elevation, including asphalt concrete, concrete, brick, base course, and other materials.

C. REMOVAL AND DISPOSAL OF BUILDINGS. The Contractor shall be responsible for the removal and disposal of all buildings, foundation systems, outbuildings, septic tanks, distribution boxes, storm cellars, fences, dead trees, landscaping, etc. within the right-of-way. Within the temporary construction easements, only those items shown on the plans or directed by the Engineer shall be removed. All other items are to remain in place and be protected from damage. The work shall be subject to the following conditions:

(1) The Contractor shall obtain the necessary demolition permits from the City Code Enforcement Department and comply with all requirements of the permits.

(2) All floor slabs and foundations shall be removed to a depth of two feet below the finish grade or subgrade, whichever is lower, except those that are within the right-of-way shall be completely removed. Fill material in basement, cesspool, or cistern can be rock, brick, concrete, dirt, or sand up to two feet below the finish grade or subgrade. Voids between all brick, rock, and etc. shall be filled with dirt or sand. All fill materials shall be compacted equal to the adjacent ground.

(3) All areas excavated by contractor operations shall be filled to original existing grade unless otherwise specified. Site grading shall be performed to provide positive drainage (no ponding of surface water shall be allowed), leaving the site in a mowable condition. Areas to be filled shall be approved by the City Building Inspector before filling is started. Fill materials shall be free from deleterious material and shall conform to Section 203 of the specifications.

(4) Water and sewer lines shall be capped at the property line, or removed to the main as indicated on the plans, and approved by the Engineer before covering. Other franchise utility lines will be terminated at the property line by the utility companies. Work shall be coordinated by the Contractor with his general work.

(5) All materials to be removed from the project site shall become the property of the Contractor and shall be removed from the project site premises and disposed of in accordance with any applicable laws.

(6) The removal of trees, shrubs and any miscellaneous landscaping necessary for the removal of the structure shall be accomplished as part of the structure removal operation.

(7) Finished project site must have final approval of the City Building Inspector and the Engineer before payment for work under this item is submitted.

Salvage materials in buildings to be demolished and materials in other man-made obstructions will become the property of the Contractor and shall be removed from the project site. The Contractor shall have no claim against the Owner because of the absence of any pre-existing buildings, materials, equipment, or fixtures from the items to be removed.

Moveable buildings remaining for the Contractor's disposition may be removed from the right-of-way intact if the Contractor so elects, or they may be demolished in place with the removal of resulting material and debris.

Buildings and structures containing lead-based paint and/or asbestos-containing building materials will be identified, and abatement requirements included, in the Special Conditions.

201.05 MEASUREMENT AND PAYMENT

A. SITE PREPARATION. Site Preparation will be measured on a lump sum basis and shall include all site preparation; removal and disposal of all structures, abandoned utilities, and other obstructions not listed separately in the proposal; removal and disposal of all asphalt and/or concrete pavement and parking areas and all materials encountered to existing subgrade elevation, including, but not limited to, asphalt, concrete, integral curb, brick, and base course; removal and disposal of all asphalt driveways and base course; plugging of abandoned lines; removal and relocation of signs, mailboxes and other obstructions; maintenance of site; and related work as delineated on the plans and as specified in these specifications.

No monies will be deemed earned for Site Preparation until such time that any Contractor's offices, buildings, and inspector's office required by Special Conditions are established and/or the full-time, on-site Project Superintendent/Coordinator is provided.

In computing the allowable partial payments from the schedule below, the percentage of the original Contract earned will be based on all items exclusive of the item of Site Preparation.

PARTIAL PAYMENT SCHEDULE

Percentage of Original Contract Amount Earned	Percentage of Bid Price For Site Preparation Allowed
First Progress Estimate	25
25	50
50	100

No adjustment in the amount bid for this item will be made for additional quantities or items of work required to satisfactorily complete the Contract.

B. REMOVAL AND DISPOSAL OF OBSTRUCTIONS. The measurement and payment for the removal and disposal of specific items, when included on the bid form, will be as specified below unless otherwise stated in the Special Conditions. Payment will be made at the contract unit price bid for the specific item and will be full compensation for the saw cutting, removing, clearing, salvaging, storing, disposing of all materials removed; plugging of culvert ends; backfilling and restoring surfaces; and for furnishing all labor, equipment, tools and incidentals necessary to complete the work.

(1) CONCRETE SIDEWALK AND DRIVEWAYS. Removal and disposal of concrete sidewalk and driveway will be measured by the square yard based on the lines and dimensions shown on the plans or as directed by the Engineer.

(2) CONCRETE CURB OR CURB & GUTTER. Removal and disposal of concrete curb or curb & gutter will be measured by the lineal foot based on the limits shown on the plans or as directed by the Engineer.

(3) HEADWALLS, WINGWALLS, INLETS, AND JUNCTION BOXES. Removal and disposal of headwalls, wingwalls, inlets and junction boxes will be measured by the individual unit removed and shall include all inlet extensions, footing, salvaging of any manhole frame and cover.

(4) STORM DRAIN PIPE AND BOX CULVERT. Removal and disposal of storm drain pipe and box culvert will be measured by the lineal foot along the centerline of the pipe or culvert for each individual run from end to end, including flared end sections, but excluding headwall depth. Various sizes of pipe and culvert will be classed into groups based upon the inside diameter, or height for culvert and non-circular pipe, measurement.

(5) CONCRETE DITCH PAVING AND CHANNEL. Removal and disposal of concrete ditch paving and channel will be measured by the square yard based upon the lines and dimension shown on the plans or as directed by the Engineer.

(6) RETAINING WALL. Removal and disposal of retaining walls will be measured by the linear foot, measured horizontally, based upon the limits shown on the plans or as directed by the Engineer. Classification of walls by height will be the height of wall as measured from existing ground.

(7) BUILDING STRUCTURES. The removal and disposal of building structures will be measured on a per each basis for each site and shall include asbestos and lead paint abatement, when identified in the Special Conditions; removal and disposal of all buildings, foundation systems, carports, garages, outbuildings, septic tanks, distribution boxes, miscellaneous non-boundary fences and storm cellars on the site; removal of all trees, shrubs and landscaping, etc. necessary for the removal of the structure; and disconnection and capping of all utilities. Payment includes all labor, materials and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Site Preparation	LS
R&D of Concrete Sidewalk/Driveways	SY
R&D of Concrete Curb and Curb & Gutter	LF
R&D of Headwalls, Wingwalls, Inlets or Junction Boxes	EA
R&D of Storm Drain Pipe (up to 24")	LF
R&D of Storm Drain Pipe (over 24")	LF
R&D of Concrete Ditch Paving	SY
R&D of Concrete Box Culvert (up to 4' high)	LF
R&D of Concrete Box Culvert (over 4' high)	LF
R&D of Reinforced Concrete Channel	SY
R&D of Concrete Retaining Wall (up to 4' Tall)	LF
R&D of Concrete Retaining Wall (over 4' Tall)	LF
R&D of Building Structure	EA

SECTION 202
CLEARING AND GRUBBING

202.01 DESCRIPTION

This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris which are within the designated limits except such objects as are designated to remain or are to be removed in accordance with other sections of these specifications.

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

202.02 LIMITS OF WORK

The limits of the clearing and grubbing shall extend to the right-of-way or easement lines, unless indicated otherwise on the plans or in the Special Conditions. Areas within temporary construction easements shall not be cleared and existing vegetation and objects shall not be disturbed except as needed for the construction and unless otherwise noted on the plans. Any vegetation or objects not noted for removal, or that are outside the limits of work, that are damaged or disturbed shall be returned to original condition at no cost to the Owner.

202.03 CONSTRUCTION REQUIREMENTS

A. CLEARING AND GRUBBING. Clearing and grubbing shall include the cutting and removal of all trees, brush and other objectionable growth, stripping and scalping, and the removal and disposal of logs, rubbish piles, refuse dumps, and other objectionable matter within the construction limits. All surface objects and all trees, brush, shrubs, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed.

B. CLEARING AND GRUBBING TREE OR STUMP. Clearing and Grubbing Tree (specified size) or Stump, when provided in the proposal, shall consist of the cutting, grubbing, and removal of individual, isolated trees and stumps greater than 8" diameter measured 40" above the ground, including roots, as shown on the plans or designated by the Engineer to be removed. Identification of individual, isolated trees and stumps for cutting, grubbing and removal will only be done for those projects that do not include a pay item for "Clearing and Grubbing."

C. GENERAL. Work required under Section 110 "Protection of Water Quality and Wetlands" and other applicable NPDES requirements shall be conducted in conjunction with clearing and grubbing. Clearing and grubbing of an area shall not commence until erosion control measures are in place.

The construction limits for the project shall be cleared and grubbed except for those objects designated to remain. Items designated to remain shall be carefully protected from abuse, marring, or damage during construction operations as specified in Section 107.10 "Protection and Restoration of Property and Landscape." Movement and operation of equipment shall be such that the roots, branches, and trunks of trees and shrubs selected for retention will not be scarred, broken, or otherwise damaged to the extent that the life of the plant is endangered. Trees shall be felled and removed in such a manner as to avoid injury to other trees or other objects designated to remain. In case of injury to bark, limbs, or roots of vegetation designated to remain, the Contractor shall repair such damage by corrective pruning or other appropriate methods.

Low hanging, unsound or unsightly branches shall be removed from trees or shrubs designated to remain. Branches of trees extending over the roadbed shall be trimmed to give

clear height of 20 feet above the roadbed surface. All trimming shall be done by a licensed tree surgeon or landscape contractor in accordance with good tree surgery practices. Trimming should be accomplished during dormancy period of trees when possible. Trimming will not be measured or paid for separately but shall be considered incidental to the amount bid for "Clearing and Grubbing" or under "Site Preparation," if there is no item included in the proposal for "Clearing and Grubbing."

Except in areas to be excavated, holes remaining after removal of trees, stumps, etc., shall be backfilled with suitable materials and compacted as specified in Section 203 "Excavation and Embankment," so that the project site shall be free of holes, ditches, or other abrupt changes in elevations.

All material removed under this section shall be disposed of by the Contractor as specified in Section 104.08 "Final Cleaning Up." Merchantable timber in the clearing area that has not been removed from the right-of-way before the date that the Contract is awarded shall become the property of the Contractor, unless noted otherwise.

The Contractor shall make all necessary arrangements for obtaining suitable disposal locations. Disposal operations and final cleanup of sites, including seeding and stabilization, shall comply with the requirements of Section 110 "Protection of Water Quality and Wetlands." The costs involved in obtaining disposal sites, hauling and cleanup will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for other items of the Contract. When requested by the Engineer, the Contractor shall furnish copies of all agreements with property owners.

202.04 MEASUREMENT AND PAYMENT

When included on the bid form as a pay item, measurement will be by one or more of the following methods:

A. LUMP SUM BASIS. When the bid schedule contains a clearing and grubbing lump sum item, no measurement of area will be made.

B. AREA BASIS. The work to be paid for will be the number of acres and fractions thereof acceptably cleared and/or grubbed within the limits shown on the plans or delineated by the Engineer.

C. LINEAR BASIS. The work to be paid for will be the area within the varying width of the project limits measured along the construction centerline in stations.

D. INDIVIDUAL UNIT BASIS. Individual trees or stumps greater than eight inches in diameter, measured at a height of forty inches above the ground, will be measured by the number of each removed only when there is not a general clearing and grubbing item listed in the proposal form and a "Clear and Grubb Tree or Stump" item is included in the proposal form.

Quantity shown on the plans and in the proposal for Clearing and Grubbing, plus or minus authorized changes, will be considered as final quantity and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between the quantity shown on the plan and the actual quantity due to changes in alignment, grade, typical sections, or apparent errors.

Clearing and Grubbing for borrow sites and material sources outside the right-of-way limits will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the items being excavated for use on the roadway.

When the proposal form does not contain an item for clearing and grubbing, the work herein will not be paid for directly, but will be considered incidental to Section 201 “Site Preparation” or other contract items.

Payment at the contract lump sum price or unit bid price, as may be the case, for clearing and grubbing or clearing and grubbing trees shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work, including the cost of obtaining disposal sites, hauling, and protecting and repairing damaged trees and items that are designated to remain or be relocated.

Payment will be made under:

Pay Item	Pay Unit
Clearing and Grubbing	LS
Clearing and Grubbing Trees (8" to 12" Dia.)	EA
Clearing and Grubbing Trees (13" to 34" Dia.)	EA
Clearing and Grubbing Trees (35" and larger)	EA
Clearing and Grubbing Trees (Stump)	EA

SECTION 203
EXCAVATION AND EMBANKMENT

203.01 DESCRIPTION

This work shall consist of excavation, construction of embankment, grading, compaction, hauling, disposal and topsoiling which is within the limits of the work necessary for the construction of the improvements in accordance with the specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the Engineer.

203.02 APPLICABLE SPECIFICATIONS

Subgrade preparation or modification shall be as specified in other sections of these specifications.

203.03 CLASSIFICATION

All material excavated above the subgrade shall be defined as “Unclassified Excavation” regardless of the material encountered. Any excavation below the subgrade is defined as “Undercut Excavation” or is included in the price bid for the item being installed in the excavation. Any suitable material excavated as “Unclassified Excavation” becomes “On-Site Borrow” as defined below.

"Undercut Excavation" shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter, or other soils, not suitable for foundation material and which is located at a lower elevation than the subgrade.

"Select Material" shall consist of excavation made from borrow areas outside the limits of the project. It shall be the Contractor's responsibility to locate and obtain the select material subject to the approval of the Engineer. Select material shall be granular, maximum particle size of 3 inches, graded from coarse to fine, conforming to AASHTO classification A-1, A-2-4 or A-2-5, or a sandy or gravely clay conforming to classification A-2-6 or A-6 with the exception that the plasticity index shall not exceed 15. The Contractor shall furnish, at his expense, test data to indicate compliance of select material with this specification. “Select Material” shall only be used if the contractor demonstrates to the Engineer that no suitable On-Site Borrow is available. Select Material will also be used if shown on the plans or as directed by the Engineer.

"Topsoil" shall be the surface layer of soil with no admixture or refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones more than 2" in diameter, clay lumps or similar objects. This surface layer of soil shall contain humus and organic matter and any grass roots and native seeds that may have accumulated in the surface layer.

“On-Site Borrow” shall consist of material excavated within the limits of the project. All suitable excavated material shall be used, as needed, as “On-Site Borrow.” Muck, peat, matted roots, or any other material unsatisfactory for a subgrade foundation shall not be used as On-Site Borrow. All material determined by the Engineer as unsuitable for “On-Site Borrow” shall be disposed of off-site by the Contractor.

203.04 CONSTRUCTION REQUIREMENTS

A. GENERAL. The grading work shall consist of all excavation, embankment, dressing, shaping and finishing necessary for the construction, compaction and completion of all subgrades and other earthwork indicated on the plans, strictly to the required alignment, grade and typical cross section as shown on the plans or as directed by the Engineer.

Excavation shall not be made below grade except where rock is encountered or removal of unstable material is directed by the Engineer. Should be Contractor, through negligence or other fault, excavate below the designated lines, he shall replace the excavation with approved materials, in an approved manner and condition at his own expense. The Engineer shall have complete control over the excavation, moving, placing and disposition of all material, and shall determine the suitability of material to be placed in embankments.

The Contractor shall inform and satisfy himself as to the character, quantity and distribution of all material to be excavated.

Excavation work shall be performed to provide drainage at all times. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the work. Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions.

Material determined by the Engineer to be unsatisfactory for subgrade construction shall be classified as undercut excavation and shall be removed as directed by the Engineer. Undercut areas shall be backfilled with select material from off-site borrow areas unless otherwise directed by the Engineer. All unsuitable material removed from undercut areas shall be disposed of off-site by the Contractor.

Where the natural ground conditions or excavation results in a subgrade or slopes of unsuitable soils, the Engineer may require the Contractor to undercut the unsuitable materials and backfill with approved material to the elevation designated by the Engineer. The Engineer may designate as unsuitable those soils that cannot be stabilized in place through normal drying and compactive efforts when satisfactory weather and ground conditions exist. Normal drying and compactive efforts shall be considered to be the work required in processing and compacting, with appropriately sized equipment, the natural ground to a maximum depth of 12 inches after the soil is brought to near optimum moisture content.

Where the Engineer determines that undercut excavation is required, excavation shall be made to the maximum depth shown on the plans or as directed by the Engineer. All unsuitable material removed from undercut areas shall be disposed of off-site by the Contractor. Excavation methods used shall be such that the resulting subgrade is minimally disturbed. Excavation of soils that will not support tracked dozer equipment without indentation of the subgrade of more than 6 inches shall be accomplished by excavator equipment from outside the limits of the excavated area. Proof rolling of the sub grade is not required in undercut areas.

Placement of any soil stabilization fabric within the undercut area shall be accomplished by hand in accordance with Section 230 "Geotextile Fabric for Soils."

The Engineer shall direct the type of backfill material to be used. The placement of either select material or oversized rock as part of the backfill may be directed. Oversized rock shall be crushed sandstone 1 ½ inches to 5 ½ inches in diameter from a currently qualified aggregate material source as listed on the ArDOT Qualified Product List. The Contractor shall furnish certification from the material supplier of material manufacture, analysis or other information when specified or requested by the Engineer. Copies of material tickets shall be furnished to the Engineer at the point of delivery to the project site. Material tickets, and weight scales used to generate tickets, shall meet the requirements of subsection 109.02 MEASUREMENT OF QUANTITIES, Item E. When oversized rock is used it shall be capped with two to three inches of Aggregate Base Course, which will be considered incidental to the Undercut and Backfill (Oversize Rock) bid item. Placement of

backfill materials shall be accomplished from the leading edge of the fill. Haul vehicles will only be allowed on compacted fill material and shall not be allowed within the excavation.

The Contractor has the option of utilizing the existing pavement and base material for backfill in the undercut and fill areas. The recycled pavement and base shall be processed such that it conforms to the Select Borrow or Oversize Rock requirements.

"On-Site Borrow" shall be used in the formation of embankments and backfills unless otherwise specified. "On-Site Borrow" shall be placed in areas of the embankment as directed by the Engineer. Muck, peat, matted roots, or other unsatisfactory material for a subgrade foundation shall be removed to the depth directed by the Engineer. All material determined to be unsuitable by the Engineer shall be disposed of off-site by the Contractor.

Construction of embankments or backfilling shall not be started until the area has been inspected and approved by the Engineer. Fill areas shall be cleared and grubbed so as to remove all vegetation and objectionable material. Also, all topsoil shall be removed prior to the commencement of filling. All depressions or holes beneath the ground surface, whether caused by grubbing or other reasons, shall be backfilled with suitable material and compacted before the construction of the subgrade is commenced. Areas to be filled shall be scarified to a depth of 6 inches prior to the placement of fill. Fill shall be constructed to the specified grade in uniform layers parallel to the finished surface and not more than 8 inches in thickness, loose measurement. The material in the layers shall be of the proper moisture content before compacting. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Select Material should only be utilized after all suitable "On-Site Borrow" has been utilized in the fill, or when directed by the Engineer. If the Contractor places more Select Material than is required and thereby causes a waste of "On-Site Borrow," the amount of waste shall be deducted from the Select Material volume.

Backfilling of trenches for storm drainage facilities, water line improvements and utility relocations shall be accomplished as specified in other sections of these specifications. Backfill shall be compacted to the specified density.

B. SOIL COMPACTION. In the preparation of subgrades and compaction of earthwork, the material shall be compacted to provide a stable, uniform surface. The subgrade shall be compacted to the required density and stability and shall show no evidence of displacement or rutting. Proof rolling shall be provided to evaluate the stability of the subgrade and shall be as directed by the Engineer.

Where modification of the subgrade is specified, stabilization and compaction requirements shall be as specified in other sections of these specifications.

Soils shall be compacted to the following standards. The maximum dry density shall be based on the Standard Test, AASHTO T-99.

(1) All soils in the upper 6" of the subgrade beneath pavements or driveways shall be compacted to 100% density.

(2) All other soils shall be compacted to 95% density.

(3) Trench densities shall be as specified for that type trench excavation. When no density is specified, the densities specified in 1 and 2 above shall apply.

The moisture content of the material being compacted shall be within a range of two

percent below optimum to a maximum of two percent above. The Contractor shall adjust the moisture content of the material to maintain the range specified by the addition of water or by aeration.

All testing shall be done by a testing laboratory approved by the Engineer. The cost of the testing will be paid for by the Owner with the following exception. The Contractor shall pay the cost of testing any materials proposed by him for substitution of previously approved materials, unless in the opinion of the Engineer, the substitution will be of particular benefit to the Owner.

Not less than one field density determination shall be made for each 750 square yards of area in each lift of embankment and on the finished subgrade. Trench backfill density determinations shall include a minimum of one determination for each 250 feet of completed trench.

The field density determination shall be made in accordance with AASHTO T-238-76 Density of Soil and Soil Aggregate in Place by Nuclear Methods.

C. SUBGRADES. The completed subgrade surface shall be true to the lines, grades and cross sections shown on the plans or as directed by the Engineer. Any irregularities or depressions that develop shall be corrected by loosening the material until the surface is smooth, uniform and compact. Should the subgrade be rutted prior to the next phase of construction over the subgrade, it shall be reshaped and compacted without additional compensation to the Contractor.

Shaping and compacting of subgrades prior to construction of pavements shall be as specified in other sections of these specifications.

D. TOPSOIL. Topsoil stripped from within the project limits shall be stockpiled at an off-site location provided by the Contract unless on-site stockpile areas are designated on the plans. The topsoil shall be stockpiled in such a manner that other materials will not become intermixed and interfere with reuse of the topsoil. Topsoil shall be stripped form the designated areas and shall be stripped to a minimum depth of 6 inches unless otherwise indicated on the plans.

When suitable topsoil is not available on the site, the Contractor shall locate and obtain a supply subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made.

Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or by other means approved by the Engineer, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches in diameter and all litter.

The topsoil shall be evenly spread on the prepared areas to a uniform depth of 4 inches after compaction. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that seeding operations can proceed with a minimum of soil preparation or tilling. After spreading is completed, the topsoil shall be smooth-graded and the surface left at the prescribed grades in an even properly compacted condition. The finished grades shall prevent the formation of low places or pockets where water will stand. Light rolling with placing or spreading equipment, and wetting if needed, will be required to consolidate the topsoil to the finished grades.

E. BACKFILLING CURBS AND WALKS. After the completion of the walks, curbs and driveways, the Contractor shall backfill adjacent areas to the grade shown on the plans. This backfill shall be placed so as not to damage the walks, curbs and driveways and shall be compacted.

F. TOLERANCES. Grading shall be accomplished to the tolerances listed below for the various areas and classes of work as shown. The tolerances listed are maximum variations which will be acceptable for each class of work without exception.

(1) The subgrade beneath structures shall be formed and compacted to within 0.05 feet of the finished subgrade as established by grade hubs or stakes.

(2) The subgrade for streets, drives and sidewalks shall be formed and compacted within 0.05 feet of the finished subgrade as established by grade hubs or stakes.

(3) All areas outside of those mentioned in the previous paragraphs and which are not to receive any type of a finished structure or pavement shall be rough graded to with 0.10 feet of the finished grade after the necessary allowances have been made for the thickness of topsoil. This tolerance shall be reduced as necessary to provide drainage at all points and to prevent the formation of water pockets in the finished grading.

Any deviation in excess of the amounts shown above shall be corrected by loosening, adding or removing materials, reshaping and recompacting by sprinkling and rolling.

203.05 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the unit prices listed in the proposal for the various classes of work. Payment at the unit prices listed in the proposal for each of these items shall be considered full compensation for all the equipment, tools, material, labor, supplies and incidentals necessary for completion of the specified work item.

Classes of earthwork listed in the proposal will be measured by the cubic yard and, unless otherwise specified, will be measured in its original position based on cross sections and calculated by the average end area method.

For Unclassified Excavation, the estimated quantities shown on the plans, plus or minus any authorized changes, will be considered as final quantities for payment purposes and no further measurement will be made except for undercutting of unsuitable material and backfilling with appropriate material. These final quantities will be revised if, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between the quantities shown on the plans and the actual quantities due to changes in alignment, grade, typical section, or apparent errors. If revision of the plan quantities is deemed necessary, the Contractor shall allow the Engineer sufficient time to take original cross-sections, if required, before any earthwork is begun.

Undercut excavation, when authorized by the Engineer, will be measured by the cubic yard in its original position calculated by the method of average end areas. Undercut excavation including removal, drying, mixing or conditioning and replacement will be paid for at the contract unit price for "Undercut Excavation." Undercut excavation and backfill will be paid for at the contract unit price for "Undercut Excavation and Backfill (Select Material)" or “Undercut Excavation and Backfill (Oversized Rock).” The cost for furnishing and installing the Aggregate Base Course material for choking purposes will be considered incidental to the Undercut Excavation & Backfill (Oversized Rock) bid item. Undercut Excavation & Backfill (Oversized Rock) will be measured to the top of the choke material. Payment of the contract unit price shall be considered full compensation for excavation, removal and disposal of material, furnishing and placement of backfill and choke material, grading and compaction. No separate payment will be made for materials or

placement of materials used to backfill undercut areas. Undercut excavation payment will not be made for removal, excavation and backfill of areas in which trees and stumps are cleared and grubbed.

No separate payment will be made for placement of On-Site Borrow. No separate payment will be made for the handling of On-Site Borrow, even if it is necessary to handle the material more than once during the execution of the construction.

No separate payment will be made for removal, stockpiling and replacement of existing pavement materials unless otherwise specified in other sections of these specifications.

For Select Material, the estimated quantity is for use only if directed by the Engineer for a specific location. Any Select Material used will be paid for based on average end area method. Contractor shall allow time for the Engineer to take cross sections in these areas before and after placement of Select Material.

Payment will be made under:

Pay Item	Pay Unit
Unclassified Excavation	CY
Undercut Excavation & Backfill (Select Material)	CY
Undercut Excavation & Backfill (Oversized Rock)	CY
Select Material	CY

SECTION 205
TRENCH & STRUCTURE EXCAVATION AND BACKFILL

205.01 DESCRIPTION

Trench work shall consist of the excavation and backfill of trenches for the accommodation of substructures including, but not limited to storm drain pipe and precast concrete box culverts, water lines, sewer lines, traffic signal conduits, and all appurtenances.

Structure work shall consist of the excavation and backfill necessary for the construction of bridges, retaining walls, cast-in-place box culverts, concrete channels and ditch paving, manholes and other structures according to the plans or as directed by the Engineer.

This work shall also include use of Occupational Safety and Health Administration (OSHA) compliant trench or excavation safety systems for all excavations which equal or exceed 5 feet in depth.

205.02 MATERIALS

The Contractor shall furnish, at his expense, test data to indicate compliance of materials with the following specifications:

A. SELECT BACKFILL. Select backfill shall be a granular material, maximum particle size of 3 inches, graded from coarse to fine, conforming to AASHTO classification A-1, A-2-4, or A-2-5, or a sandy or granular clay conforming to classification A-2-6 or A-6 with the exception that the plasticity index not exceed 15. The material shall not be frozen, not have excess water, and be free of organic matter or other deleterious or objectionable material that would prevent proper consolidation or that might cause subsequent settlement.

Select material shall be obtained from the material excavated from the trench if it complies with the above requirements. If suitable select material cannot be obtained from the material excavated, then suitable material shall be obtained from another location and hauled to the jobsite. It shall be the Contractor's responsibility to locate and obtain the suitable select material and to pay all costs associated therewith.

B. GRANULAR BACKFILL OR BEDDING: Granular backfill or bedding shall be a well-graded crushed stone or granular material containing aggregate sizes ranging from a 3/4 inch maximum to No. 4. Unless otherwise approved by the Engineer, the material shall meet the gradation requirements of ASTM C33, Gradation No. 67. Aggregate sizes ranging from 1-1/4 inch to 3/4 inch crushed stone may be used for larger trenches and precast box culverts when approved by the Engineer.

Granular backfill or bedding shall be from a currently qualified aggregate material source as listed on the ArDOT Qualified Product List. The Contractor shall furnish certification from the material supplier of material manufacture, analysis or other information when specified or requested by the Engineer. Copies of material tickets shall be furnished to the Engineer at the point of delivery to the project site. Material tickets, and weight scales used to generate tickets, shall meet the requirements of subsection 109.02 MEASUREMENT OF QUANTITIES, Item E.

C. FLOWABLE FILL. Flowable fill material shall be in accordance with Section 206 "Flowable Fill Material."

D. CLASS "B"BEDDING. Class "B" bedding shall consist of Granular Bedding material, meeting the requirements of Granular Backfill as stated above, placed within the pipe zone

to a depth below and above the pipe, or under and around the structure, as shown on the Plans.

E. CONCRETE ENCASEMENT BEDDING. Concrete encasement bedding shall consist of Class "B" (2500 psi) concrete placed in accordance with Section 401 "Concrete" within the pipe zone to a depth below and above the pipe as shown on the plans. Concrete encasement shall be used in locations shown on the plans or when directed by the Engineer.

205.03 TRENCH OR EXCAVATION SAFETY SYSTEMS

All excavation, including the manner of supporting excavation and provisions for access into excavations, shall comply with the current edition of the OSHA Standard for Excavation and Trench Safety Systems, 29 CFR 1926, Subpart P, hereby incorporated into these Specifications by reference and deemed to be included in the Contract the same as though herein written out in full. A copy of the OSHA documents is available at the City of Fort Smith Engineering Department office. The Contractor shall comply with the provisions of said document for all excavations which equal or exceed 5 feet in depth.

In addition to the above, when necessary to protect the Work or adjacent property, the Contractor shall provide and install shoring. The material used shall be of suitable dimensions and strength to prevent the settlement or movement of the ground adjacent to the excavation and to prevent damage to all surface or subsurface structures. The adequacy and need for the shoring shall be the complete responsibility of the Contractor. The shoring shall remain in place until the backfill has proceeded to the point where it can be removed safely, except that, if in the opinion of the Engineer, damage is likely to result from withdrawing shoring, it shall remain in place.

205.04 TRENCHING & STRUCTURE EXCAVATION

A. GENERAL. Prior to start of excavation, the Contractor shall physically locate vertically and horizontally by excavation all existing, potentially conflicting utilities shown crossing proposed structures, storm drain, water, and sanitary sewer facilities, and all tie-in points of the new facilities, allowing adequate time for the Engineer to resolve any potential conflicts or problems. The Contractor shall provide the Engineer with all measurements, dimensions, elevations, types, and sizes of utilities, and all information necessary to determine utility conflicts with the new facilities.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the Engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation or reconstruction of the obstructions. The Contractor shall cooperate with the owners of the utility structures in removing, reconstructing, or permanently supporting the existing structures. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, conduits, sewers and other structures encountered in the progress of the work shall be furnished by the Contractor without additional compensation. The Contractor shall be held responsible for the repair of structures broken or otherwise damaged because of carelessness on his part.

The Contractor shall do all excavation for structures and structure footings to the lines and grades shown on the plans. Excavation for structures to be constructed on existing pipe lines shall be accomplished in a manner which will prevent damage or displacement of existing pipe. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure footings shown. The elevation of the bottoms of footings as shown on the plans shall be considered as approximate only and the Engineer may order changes in dimensions or elevations of footings necessary to secure a satisfactory foundation. After

the excavation work is completed, the cleaned and leveled subgrade shall be approved by the Engineer prior to the placing of reinforcing steel or concrete.

The Contractor shall accurately excavate trenches so that the pipe can be laid to the required alignment and grade shown on the plans or established by the Engineer. No deviation shall be made from the required line or grade except with the written consent of the Engineer.

The excavation of the trenches shall not advance more than 150 feet ahead of the completed backfill without permission of the Engineer. If due to delays in delivery of materials, or for other reasons, the Contractor is not expected to fully complete the work within an excavated area in a reasonable length of time as determined by the Engineer, the Engineer may require the Contractor to backfill the excavation and re-excavate when the work can be completed expeditiously, with no additional payment for the backfill and re-excavation. In areas determined by the Engineer to be hazardous, trenches shall be backfilled at the end of the work shift.

Material suitable for backfill shall be piled in an orderly manner sufficient distance from the banks of the trench or excavation to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or unsuitable for backfill shall be removed and disposed of as indicated or as directed by the Engineer.

B. DE-WATERING. All excavation shall be de-watered before any construction is undertaken therein. All pipes shall be laid in dry trenches and all concrete shall be placed only upon dry and firm foundation material. Contractor shall furnish and maintain all pumping, ditching, or other approved measures for the removal or exclusion of water reaching the site of the work from any source so as to prevent damage to the work or adjoining property. The Contractor shall be responsible for any damage to persons or property due to interruption or diversion of storm or waste water on account of his operations.

Should de-watering of the trench or excavation prove unsuccessful, the trench or structure foundation shall be excavated to a depth of approximately 6 inch below grade. It shall then be backfilled to grade with Granular Bedding material. A sump, approximately 6 inches below the granular material, shall be formed to provide a place for a pump to take suction and thus lower the water level to a point below the bottoms of the pipe joints or structure foundation. The pumping shall be continued until the pipe or concrete has been placed and the presence of water will not injure them. Backfill shall not be commenced until the excavation has been de-watered.

C. OVER-EXCAVATION. If rock is present at the grade line of the foundation excavation, the Engineer shall determine the adequacy of the rock as a foundation material and will direct Contractor to place concrete directly on the rock or to remove the rock to an acceptable depth. If rock is present at the grade line of the pipeline trench, it shall be excavated to an elevation at least 6 inches below the bottom of the pipe, valve or fitting and to a clear width of 6 inch on each side of all pipe and appurtenances. Adequate clearance for properly jointing pipe laid in rock trenches shall be provided at all bell holes.

Rock shall consist of sedimentary or other types of rock which cannot be excavated without the use of rippers or impact hammers. Rock excavation shall include boulders and deposits of concrete with a volume of ½ cubic yard or more. Explosives shall only be used when determined necessary by the Engineer and authorized in accordance with subsection 107.09 "Use of Explosives." Contractor shall notify Engineer when rock is encountered and shall allow sufficient time for the Engineer to measure limits of rock excavation.

If the soil at the bottom of the trench or excavation is unstable and in such condition that it cannot be properly shaped and graded, the trench or excavation shall be excavated to firm

soil or a depth determined by the Engineer.

When any trench or excavation is excavated below the required grade, all loosened earth and rock must be removed and the excavation bottom brought to design grade with Granular Bedding material. This material shall be placed to an elevation sufficient to provide a cradle for the lower quarter of the pipe circumference. When directed by the Engineer, for structure excavations the over-excavated area may be filled with concrete at the time of placing the foundation.

Payment will be made for the over-excavation or rock excavation and granular bedding or concrete, to the point of design grade, only when the excavation below grade is directed by the Engineer and not due to neglect by the Contractor.

D. TRENCH & EXCAVATION WIDTHS. Excavations for manholes and other structures shall have a minimum of 12 inches and maximum of 30 inches clearance on all sides. Trenches shall have vertical sides from a point 12 inches above the outside top of the pipe to the bottom of the trench, with a width within the limits shown on the Standard Detail Plans. Additional excavation and backfill materials required for compliance with OSHA regulations, or due to adjacent underground lines, is considered incidental to the price bid for Trench or Excavation Safety Systems and no additional payment will be made therefor.

At any point where the width of the lower portion of the pipe trench exceeds the limits shown on the Plans, corrective measures shall be taken by the Contractor. As directed by the Engineer, the Contractor shall provide either pipe of adequate strength, special pipe embedment, or a concrete cradle as required by the loading conditions. These corrective items, along with the additional bedding and backfill quantities, shall be furnished and installed by, and at the expense of, the Contractor and no additional payment will be made.

E. WATER LINE. Trenches shall be graded to the approximate depth shown on the plans and shall maintain a depth that will provide not less than 30 inches of cover from the top of the pipe to the finished surface of the ground. Water service lines shall have a minimum depth of cover of 18 inches from the top of the service line to the finished ground, except within streets where the minimum depth of cover shall be 24 inches. The pipe shall be laid to a grade such that the entire line will have a minimum number of high and low points. At utility or street crossings requiring greater line depth, the approach to the crossing shall be on a gradual and uniform grade.

205.05 BEDDING

All pipe, boxes, and conduits shall be installed on a firm and stable bedding material that conforms to the grade of the pipe and provides contact with the pipe at every point throughout the entire length of the pipe. Pipe shall be bedded in accordance with Class "B" Bedding from the trench subgrade to a minimum of 6 inches above the pipe. This area shall be referred to herein as the "pipe zone." Box culverts and conduits shall have the same "pipe zone" as pipe.

Bell holes shall be excavated in the bedding material immediately prior to placing the pipe in the trench and shall be such depth that the pipe bell will not come into contact with the pipe bed. After the joint has been made, the bell hole shall be carefully filled with bedding material to provide support for the pipe throughout its length. Blocking shall not be used to bring the pipe to grade.

Bedding material shall be placed within the pipe zone, with maximum lift thickness of 8 inches, by any approved method which will not injure or disturb the pipe and will result in the compaction specified in subsection 205.08.
Water service lines outside of the roadway section may be bedded on 3 inches of sand or topsoil which has been lightly hand-tamped or walked upon.

Placing of concrete encasement around the pipe shall be accomplished in such a manner that will prevent flotation of, or damage to, the pipe. The pipe shall be supported on concrete blocks at approximately 6 foot spacing. During pouring, the concrete shall be thoroughly vibrated to ensure the filling of all voids with concrete under the bottom and under the haunches of the pipe.

When called for on the plans or in the Special Conditions, or as directed by the Engineer, bedding for structures shall be provided as specified. Sand shall not be used for fine grading or bedding beneath structures.

205.06 PIPE CASING

A. CASINGS. Casing of pipe and conduits under roadway, and/or used for separation of utilities, shall be furnished and installed as shown on the plans or directed by the Engineer. Unless otherwise shown on the plans, casings shall be installed with a minimum of 36 inches of cover from the top of the casing to the bottom of the ditch line/native ground, or 42 inches below the top of the roadway subgrade, whichever gives the greater cover. Casings should, as a minimum, extend 6 feet beyond the flowline of the parallel ditches, toe of slope, or back of curb as applicable for the roadway section.

Casing pipe shall be the type and strength indicated on the plans or in the Special Conditions. Water service line casing shall be schedule 40 PVC, other material approved by the Engineer. Water main casing shall either be new or used steel pipe of the diameter and gage shown on the plans. All joints in steel casing pipe shall be welded for the full circumference.

All water mains, but not water services, installed in casings shall have restrained joints and shall be installed with fabricated molded polyethylene casing spacers within the encasement pipe. The skids of the spacers shall be a minimum of one inch greater in diameter that the pipe bell or retaining gland set screw. The spacers shall be installed at approximately 6 foot intervals with a minimum of three spacers for each section of pipe within the casing. Stainless steel band casing insulators (Model no. 59 by J-Four Pipeline Products) or approved equal shall be installed in accordance with manufacturer's recommendations.

Fabricated molded rubber end seals shall be installed at the end of each casing for water main, sewer main, and sewer lateral pipe. The end seals shall be attached to the casing pipe and to the water or sewer pipe with stainless steel bands. The thickness of the end seal shall be 3/8 inch over the casing pipe and 3/16 inch thick at other locations.

B. BORING. Casings for roadway crossings shall be installed by boring or other subsurface method, unless otherwise shown on the plans or approved by the Engineer. Borings shall be excavated with a mechanical boring assembly designed to produce a uniform straight shaft at the specified line and grade. Casing or liner pipe shall be installed using equipment that encases the hole as the earth is removed. Boring without the concurrent installation of a casing pipe will not be permitted on lines greater than 4 inches in diameter unless approved by the Engineer. Directional boring may be used on lines 4 inches or less in diameter or when called for in the Special Conditions or approved by the Engineer.

Extra precaution shall be taken when boring under concrete or asphalt streets, driveways, curbs, gutter, aprons, etc. so as not to lift or crack the concrete or asphalt. Where the concrete or asphalt cracks, is displaced, or otherwise damaged, the concrete or asphalt shall be removed and replaced with similar material at the Contractor's expense.

Boring pits or trenches shall be excavated as required to accommodate the boring operations. Excavation, trenching, backfilling and surface restoration shall be as specified in other

subsections herein. The introduction of water into the excavation is prohibited.

205.07 BACKFILLING

A. TRENCHES. All trenches shall be backfilled immediately after the pipe is laid and approved. Such backfilling, before testing, shall not relieve the Contractor of his responsibility for correction of leaks and defects in the pipe line. Backfill above the pipe zone, with maximum lift thickness of 8 inches, may be placed by any approved method which will not injure or disturb the pipe and will result in the compaction specified in subsection 205.08. Before backfilling, all forms, trash, and debris shall be removed from the trench.

B. STRUCTURES. Unless otherwise directed by the Engineer, bracing, sheeting or shoring shall be removed by the Contractor prior to backfilling. Removal shall be accomplished in a manner which will not disturb or mar the finished surface.

Structure backfill shall not be placed until the structure or facilities has been inspected by the Engineer and approved for backfilling. No backfill shall be placed against abutments, retaining walls, or box culverts until the concrete has cured for at least 7 days or until the concrete has developed 100 percent of the minimum design strength as determined under Section 501 "Storm Drainage Improvements."

Backfill around structures shall be placed in approximately 8 inches thick layers, loose measurement, at or near optimum moisture content, and compacted with mechanical tamping units to the requirements of subsection 205.08. Backfill in front of walls shall be placed first to prevent the possibility of forward or overturning movement. If embankment material can be deposited on one side only of abutments, wingwall, 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 or excessive pressure against the structure. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be conducted so that the embankment is always at approximately the same elevation on both sides of the structure. Existing slopes which are so shaped as to cause wedge action in the backfill, shall be step-cut or benched before backfilling.

C. GENERAL. Backfill material shall be approved by the Engineer prior to placement in the trench or excavation. Moisture content of the backfill material shall be controlled as required to obtain the compaction specified. Density and lift thickness requirements are waived if Granular Backfill or Flowable Fill material is used.

All excavations shall be backfilled, compacted and the ground restored to its original condition as soon as possible after the above requirements are met. Any unnecessary delay in restoring the excavation area to its original condition shall constitute just cause for stopping all other work until the area is so restored.

Backfill material for trenches and excavations under un-paved areas, gravel roads and gravel driveways shall consist of Select Backfill or on-site material excavated from trenches or pavement subgrades and shall be free of rocks, chunks of highly plastic clay, clods or frozen masses over three inches in diameter, or organic matter.

Backfill materials for trenches and excavations under existing or proposed sidewalks shall be Granular Backfill or Flowable Fill.

Unless otherwise shown on the plans or directed by the Engineer, backfill material for trenches and structures under paved areas shall consist of Flowable Fill with a 6-inch thick Deep Patch cap. The Flowable Fill material shall extend to 12 inches beyond the edge of

pavement or back of curb. The Deep Patch cap shall extend to the edge of pavement or toe of gutter. Flowable Fill shall be placed in a manner to avoid air pockets in the trench or underneath the Deep Patch cap or curb and gutter. Flowable Fill shall be allowed to cure for a period of not less than 24 hours prior to placement of Deep Patch cap. Flowable Fill shall be protected with bridge plates until Deep Patch cap is installed. The Deep Patch cap shall be placed in accordance with Section 370. The Deep Patch cap shall be protected with bridge plates until it is of adequate strength to allow traffic on it. The finished surface of any temporary or permanent surface patch placed above the Deep Patch cap shall be level with the existing pavement.

If at any time within the warranty period, as specified in subsection 108.12 "Warranty and Guarantee", there shall be any settlement of the trenches requiring repairs to be made, the Owner may notify the Contractor to make such repairs as may be necessary. Should the Contractor fail to do so within 15 days after the date of such notice, or should the nature of such defect be such as to require immediate attention, the Owner may make such repairs as may be necessary and bill the actual cost of such repairs to the Contractor.

205.08 COMPACTION

A. COMPACTION REQUIREMENTS. Trench and structure backfill shall be placed to the density requirements as listed below which vary with the location and depth of the excavation. The percentage of compactive requirements for the various locations are the minimum densities which will be accepted.

Location or Depth	Percent Compaction
Under streets, driveways, sidewalk, and paved areas:	
Top 6" of fill	100%
Remainder of fill, except pipe zone	95%
Pipe Zone under all areas	90%
All other areas:	Density equal to adjacent undisturbed soil, but not less than 85%

When conflicts exist between these densities due to location or depth of excavation, the higher density specified shall be obtained.

The maximum laboratory density and optimum moisture content shall be determined, per the test methods below, for each material type used as backfill.

Percent coarse particles retained on the #4 (4.75 mm) sieve shall be determined according to AASHTO T-27 (ASTM C136) and the maximum laboratory density determined as follows:

% Retained - #4 (4.75 mm) Sieve	Test Method
10 Max	AASHTO T-99, Method A
11-30	AASHTO T-99, Method C
31 Min.	AASHTO T-180, Method D (Modified)

Note: In lieu of AASHTO T-224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

The in-place density shall be determined by using AASHTO T-310, Direct Transmission.

The moisture content shall be determined by AASHTO T-310.

B. COMPACTION TESTS. The Contractor is responsible for Quality Control testing during material production and placement operations and for necessary adjustments to material production and placement operations to produce Work which conforms to the specifications.

The Owner will provide Quality Assurance tests for the purposes of determining acceptance of the backfill and materials. The frequency of the tests will be one test per 12 inch lift per 300 lineal feet of trench backfill, or per 12 inch lift per 750 square yard of structure backfill, or as may be directed by the Engineer. The Owner will obtain and pay for all Quality Assurance testing, with the exception that the Contractor shall pay for all tests that fail as specified.

Material or workmanship which fail to meet specification requirements, as determined by the Quality Assurance tests, shall be either replaced or reworked to meet requirements.

205.09 STREET, HIGHWAY AND DRIVEWAY CROSSINGS

Installation of pipe and conduits under streets, driveways, and alleys shall be in open cut unless boring is specified on the plans, or is authorized by the Engineer. Installation of crossings within ArDOT right-of-way shall be by boring unless open cut is specified on the plans or is authorized by the Engineer. Borings shall be as specified in subsection 205.06 or as shown on the plans or Special Conditions.

A. REMOVAL OF PAVED SURFACES. Asphalt pavement in the area of the excavation may be initially wheel cut or spade cut, with the final sawcut prior to installation of the permanent patch being done in accordance with Section 330 "ACHM Courses." Concrete pavement in the area of the trench excavation shall be saw cut in accordance with Section 401 "Concrete."

B. VEHICULAR ACCESS. The Contractor shall install traffic-rated steel plates over all backfilled excavations subject to traffic until such time that the Flowable Fill has reached sufficient strength as to accept traffic loads without deformation. Temporary asphalt concrete patches shall then be installed on top of the Flowable Fill and the steel plates removed.

C. TEMPORARY SURFACE. Temporary surfaces are those patches that will either be overlaid or removed and replaced prior to completion of the project, regardless of what type of material is used as the temporary surface. Patches in streets that will be removed prior to the end of the project shall be considered temporary.

Temporary surfaces shall consist of cold mix asphalt or hot mix asphalt concrete except in alleys and driveways where gravel or aggregate base material may be allowed at the discretion of the Engineer. The following surface tolerance for temporary patches shall be observed. When a ten foot straight edge is laid across the temporary patch parallel to the centerline of the street and in a direction transverse to the centerline, a rut, hump, or depression of more than 3/4 inch shall not be evident. Deteriorated temporary patches exhibiting ruts, humps, or depressions shall be repaired or replaced immediately upon notification by the Engineer. If the existing street exceeds the above tolerances, then the temporary patch shall be equal to better than the condition of the surrounding pavement.

All temporary asphalt concrete patches shall be replaced with permanent asphalt concrete patches within 30 calendar days of subjecting the temporary asphalt patch to traffic, unless otherwise approved by the Engineer.

On roads to be cold milled, in lieu of placing temporary asphalt concrete patches above the Deep Patch cap, the Contractor may elect to thicken the Deep Patch cap, place it level with the existing pavement surface, and mill the excess concrete Deep Patch. The final thickness of the Deep Patch cap, after milling, must be a minimum of 6 inches thick. No additional payment will be made for the extra thickness of the Deep Patch cap. Milling of the Deep Patch Cap will be paid for at the same unit price as Cold Milling Asphalt Pavement.

Should areas of temporary patches or caps fail and become hazardous, the Contractor shall repair at the Engineer's direction.

D. PERMANENT SURFACE. Permanent patches are those surface repairs that are constructed to the final grade of the roadway without subsequent overlay or reconstruction, including trench patches, asphalt driveway repairs, and other such asphalt surface course repair work not normally placed with a full-width paving machine, but does not exclude the use of paving machine for placement.

Prior to placing the permanent patch, the existing pavement shall be sawcut to a neat line parallel with the excavation and to a minimum of 18 inches outside the excavated area on each edge. For concrete pavement and aprons, sawcuts within 5 feet of an existing joint shall be removed and replaced to the existing joint. For all asphalt streets, if the sawcut is within 3 feet of the edge of the existing asphalt concrete surface or other patch, the existing asphalt shall be removed to that edge and the entire section replaced. Longitudinal sawcuts shall not fall within 12 inches of the tire path.

Existing base course material, if disturbed, shall be recompacted to meet the requirements of Section 305 "Aggregate Base Course." Compaction by rolling with vehicle tires will not be permitted.

For permanent patches, existing pavement shall be replaced with like material, in accordance with the requirements of the applicable specification (Section 330 "ACHM Courses," Section 370 "Pavement Repairs," Section 350 "Portland Cement Concrete Pavement," and Section 305 "Aggregate Base Course"). The depth of the repair patch shall match the existing pavement depth, except that the minimum depth shall be 3 inches for asphalt streets and 6 inches for concrete pavement, unless otherwise shown on the plans.

Upon completion, the surface of the permanent patch shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge ten feet long is laid across the permanent patch parallel to the centerline of the street and in a direction transverse to the centerline, the surface shall not vary more than 1/4 inch from the lower edge of the straightedge. If the existing street exceeds the above tolerances, then the patch shall be equal to or better than the condition of the surrounding pavement.

205.10 MEASUREMENT AND PAYMENT

Unless otherwise provided in the Special Conditions or Proposal, no payment will be made for clearing, excavation, removal and disposal of pavement, shoring, de-watering, granular bedding/backfill within the pipe zone, disposal of excess material, or temporary street surface repair as such, excepting for those items as indicated below; the cost thereof under normal circumstances being considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant.

Permanent street surface patches will be measured and paid for separately as specified in Section 330 for asphalt concrete pavement, Section 370 for surface patch, Section 350 for concrete pavement, and Section 305 for granular surfaces.

Deep Patch cap will be measured and paid for separately as Deep Patch as specified in Section 370.

Flowable Fill material will be measured and paid for separately as specified in Section 206. Backfill of structures with native materials will not be measured or paid for separately and is considered incidental to the structure item.

Trenching and backfill for all pipe, conduit, or boxes, excepting sanitary sewer main pipe, will not be measured and paid for separately but will be considered incidental. Granular and select backfill placed above the pipe zone will be measured and paid for separately as set forth below.

No payment will be made for trench and backfill of any type required where the specified excavation limits are exceeded.

A. TRENCH OR EXCAVATION SAFETY SYSTEM. The lump sum amount included in the bid item for "Excavation and Trench Safety Systems" shall include all labor, equipment and materials needed for providing the safety systems required to comply with the OSHA Safety Standard set forth above.

B. SANITARY SEWER TRENCH & BACKFILL. Trenching and backfill for sanitary sewer main pipe will be measured by the number of lineal foot of trench, of the various depths acceptably excavated and backfilled, measured along the centerline of the trench. Measurements will be made from the original ground surface to the flowline grade of the sewer line and will be made at 50 foot intervals and at all abrupt changes of ground. Payment will be made at the contract unit price bid per lineal foot for applicable depths listed in the proposal which will constitute full compensation for all clearing, excavation, trenching, bypass pumping, bracing, bedding, backfilling, compaction, disposal of excess material and for all incidental labor and materials necessary to complete the work.

C. ROCK EXCAVATION AND OVER-EXCAVATION. Measurement and payment for Rock Excavation and Over-Excavation will be measured and paid for only when provided for in the Proposal. Volume will be computed as follows: length will be measured along the centerline of the pipe; width will be the actual width used except in no case shall it exceed the maximum trench width specified; and depth will be calculated at 25 foot intervals from six inches below the bottom of the pipe to the top of the rock. For structures, volume will be computed by average end area method for the limits directed by the Engineer. Payment for "Rock Excavation" and Over-Excavation" will be at the contract unit price listed in the proposal and shall be full compensation for excavation, hauling and disposing of excess material, and for all labor, equipment, tools, and incidental necessary to complete the work. No payment will be made for over-excavation beyond the limits directed by the Engineer.

D. SELECT BACKFILL. Select Backfill will be measured by the cubic yard of material authorized by the Engineer and acceptably placed in the work. Volume will be computed as follows: length will be measured along the centerline of the pipe; width will be the actual width used except in no case shall it exceed the maximum trench width specified; and depth will be calculated at 25 foot intervals from top of pipe zone to top of fill. For structures, volume will be computed by average end area method for the limits shown on the plans or directed by the Engineer. Payment for Select Backfill will be made at the contract unit price listed in the proposal and shall be full compensation for furnishing all materials, hauling, placing, compacting, disposing of excess material, and for all labor, equipment, tools, and incidental necessary to complete the work.

E. GRANULAR BACKFILL. Granular bedding material around the pipe zones for water, sewer, and storm drain pipe, and on box culverts, inlet or junction boxes for the limits shown

on the Plans will not be measured and paid for separately but will be considered incidental. Additional granular material placed above or below the pipe zone or Granular Backfill placed in lieu of Flowable Fill, both only when directed by the Engineer, shall be measured and paid for by the cubic yard of Granular Backfill. Volume will be computed by method stated above for Select Backfill. Payment for Granular Backfill will be made at the contract unit price listed in the proposal and shall be full compensation for furnishing all materials, hauling, placing, compacting, disposing of excess material, and for all labor, equipment, materials, and other related items necessary to complete the work.

F. CONCRETE ENCASEMENT. Concrete encasement will be measured to the line and dimensions shown on the plans or as directed in the field by the Engineer. Payment for the concrete encasement at the contract unit price listed in the proposal shall be considered full compensation for furnishing and placing concrete, and for all labor, equipment, materials and other related items necessary to complete the work.

H. PIPE CASING. Pipe casing will be measured by the linear foot along the centerline of the casing from end-to-end. Payment for casing at the contract unit price for size, type of casing, and method of installation (boring or open-cut) listed in the proposal shall be considered full compensation for furnishing and installing casing, spacers and end caps, including excavation and backfilling, boring when called for, and for all labor, equipment, materials and other related items necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Trench or Excavation Safety System	LS
Sanitary Sewer Trenching & Backfilling 0'-4'	LF
Sanitary Sewer Trenching & Backfilling 4'-8'	LF
Sanitary Sewer Trenching & Backfilling 8'-12'	LF
Sanitary Sewer Trenching & Backfilling 12' & deeper'	LF
Rock Excavation	CY
Over-Excavation	CY
Select Backfill	CY
Granular Backfill	CY
Pipe Casing (Size, Type & Installation Method)	LF
Concrete Encasement	CY

SECTION 206
FLOWABLE FILL MATERIAL

206.01 DESCRIPTION

This item shall consist of the furnishing, mixing, and placing a flowable mixture of portland cement, fly ash, sand, and water for backfilling bridge abutments, pipe culverts, box culverts and other structures as called for on the Plans or in the Specifications. The material shall be placed in close conformity with the lines, grades, dimension, and details shown on the plans or established by the Engineer.

206.02 MATERIALS

The materials used in the flowable fill shall conform to the applicable requirements of Section 401 "Concrete."

A. MIX DESIGN. The mix design will be prepared by the Contractor and will be proportioned to produce a flowable mixture without segregation. Material for one cubic yard, absolute volume, shall be as follows:

Cement	150 lbs.
Fly Ash	100 lbs.
Sand	3185 lbs.

Compressive strength shall be a maximum of 300 psi at 28 days

The mix design shall be accompanied by the following documentation:

- A list of the weights of all components of the proposed mix (water and admixtures may be measured by volume;
- Certified test results for flow, unit weight, and compressive strength.

When unsatisfactory results or other conditions make it necessary, a new mix design will be established.

B. SAMPLING AND TESTING. The Contractor is responsible for product quality control and the Owner will provide Quality Assurance testing according to subsection 401.07.

Compressive strength shall be determined according to ASTM D4832 "Preparation and Testing of Soil-Cement Slurry Test Cylinders."

206.03 CONSTRUCTION REQUIREMENTS.

Mixing of flowable fill material shall be according to Section 401 "Concrete."

When deemed necessary by the Engineer, the flowable fill material shall be contained within the designated area by metal or wood forms that are sufficiently tight as to keep the loss of material to a minimum, or by sandbags, earth dams, or other means approved by the Engineer. Where lateral fluid pressure may be a concern, the flowable fill material may be placed in layers with each layer allowed to harden prior to placing the next layer.

The flowable fill material shall be discharged from the mixer and conveyed into the space to be filled according to Section 401. The fill material shall be brought up uniformly to the fill line shown on the plans or as directed by the Engineer. Placing of other material over flowable fill material may

begin after the flowable fill material has taken its initial set, is stable, and does not displace under equipment.

206.04 MEASUREMENT AND PAYMENT

Flowable Fill will be measured by the cubic yard to the limits shown on the plans or as directed by the Engineer. Materials placed outside the limits shown on the plans due to over-excavation by the Contractor will not be compensated.

Work completed, accepted, and measured as above will be paid for at the contract unit price bid per cubic yard for Flowable Fill, which price shall be full compensation for designing the mix; for furnishing, mixing, and placing the material; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Flowable Fill	CY

SECTION 210
SUBGRADE PREPARATION

210.01 DESCRIPTION

This work shall consist of shaping and compacting the subgrade prior to placing a base, surface course, or other improvements thereon.

210.02 CONSTRUCTION REQUIREMENTS

This work shall be done after any unstable sections of the subgrade have been repaired and after any existing base or surface courses required to be removed have been removed.

The Contractor shall compact and shape the subgrade as may be necessary to produce, at the time the base or surface course is placed, the required density and stability in the top 6 inches of the subgrade and the required grade and cross section. The Contractor will be required to scarify, dry the material, or apply water as may be necessary to obtain the required density and stability. Required density shall be as specified in other sections of these specifications.

The subgrade stability shall be such that when any material for base or surface courses is deposited, no rutting or displacement of the subgrade will occur.

210.03 MEASUREMENT AND PAYMENT

Subgrade preparation will be measured by the square yard or by the station based on the areas shown on the plans.

Payment for subgrade preparation, when listed in the bid form, shall be full compensation for scarification, drying or wetting soil, compaction and shaping subgrade and related work. When subgrade preparation is not listed as a separate pay item, it shall be considered incidental to work specified in Section 203 “Excavation and Embankment”.

Payment for correction of unstable conditions below the top 6 inches will be as specified in other sections of these specifications.

Payment will be made under:

Pay Item	Pay Unit
Subgrade Preparation	SY

SECTION 211
SUBGRADE MODIFICATION

211.01 SCOPE OF WORK

This work shall consist of combining existing pavement materials with subgrade soils to provide a modified subgrade or subbase. This work shall also include the combining of new materials, where so designated, with subgrade soils.

211.02 MATERIALS

A. AGGREGATE BASE COURSE. Aggregate Base Course shall conform to the gradation requirements of Section 305 "Aggregate Base Course." Other requirements of Section 305 are waived with the exception that the material shall not contain more than 10 percent, by weight, of shale and other deleterious matter.

B. PRIME COAT. Prime coat shall be a medium curing cutback asphalt as specified in Section 320 "Prime and Tack Coat."

211.03 CONSTRUCTION METHODS

Existing pavement materials consisting of asphalt concrete surfacing and aggregate base course shall be used to modify and stabilize the subgrade soils and provide a subbase for subsequent pavement courses.

A. PREPARATION OF EXISTING MATERIALS. The existing asphalt surface shall be pulverized and reduced to a maximum size of three inches. Method of pulverizing shall be at the Contractor's option. Following pulverizing, the asphalt surfacing and aggregate base course shall be removed by windrowing in an adjacent lane or by stockpiling outside of the pavement area.

B. GRADING AND SUBGRADE PREPARATION. After removal of the existing pavement materials the street grade shall be excavated as required for construction of the proposed pavement section shown on the plans.

Grading and subgrade preparation shall conform to other sections of these specifications except that a finished subgrade is not required prior to combining the pavement materials. Density tests will not be performed, however, proof rolling will be utilized as required and as directed by the Engineer to evaluate the stability of the subgrade. Areas which show evidence of rutting, deflecting or yielding shall be corrected as directed by the Engineer. Undercut excavation and backfill shall conform to Section 203 "Excavation and Embankment."

C. PROCESSING. The existing pavement materials removed shall be placed on the subgrade in the proportions and to the depth shown on the plans. All existing pavement materials shall be utilized to the maximum extent possible. Any excess pavement materials shall be stockpiled in designated areas and will be salvaged by the City. Areas found to be deficient in the amount of existing pavement materials shall be supplemented from other areas within the project, or shall be supplemented by the addition of aggregate base course, as directed by the Engineer.

The materials placed shall be thoroughly mixed into the subgrade by rototilling or other approved method. Water shall be added as required to obtain the proper moisture content for compaction. The modified subgrade shall be constructed to the cross section shown on the plans and shall be compacted to the density and stability specified in Section 203 unless

otherwise noted on the plans.

D. FINISHING AND PROTECTION. At the time the base course is placed, the modified subgrade surface shall be uniform and the subgrade shall have the required stability.

When directed by the Engineer, a prime coat shall be applied to the surface of the modified subgrade as protection against rain and as a dust palliative. Application of prime coat shall be as specified in other sections of these specifications.

211.05 MEASUREMENT AND PAYMENT

Subgrade modification will be measured by the square yard or by the station of finished subgrade surface. Payment at the contract unit price shall be full compensation for pulverizing, removing, stockpiling and replacing existing pavement material, processing, mixing and compacting and related work required for a completed subgrade.

Aggregate base course will be measured by the ton. The Contractor shall furnish a legible copy of a weigh certificate at the point of delivery of the material.

No separate payment will be made for existing pavement materials which are stockpiled and are not used in the modified subgrade.

Prime coat will be measured and paid for as specified in Section 320.

Payment will be made under:

Pay Item	Pay Unit
Subgrade Modification	SY
Aggregate Base Course (for Subgrade Modification)	TN

SECTION 230
GEOTEXTILE FABRIC FOR SOILS

230.01 DESCRIPTION

This work shall consist of furnishing and installing a geotextile fabric in pavement construction as shown on the plans.

230.02 MATERIALS

Geotextile fabric shall be a woven synthetic fiber fabric meeting the fabric properties listed herein. Fabric shall be Mirafi 500X (Ten Cate Nicolon) or approved equal.

Fabric Properties	ASTM Test Method	Unit	Minimum Value
Grab Tensile Strength	D4632	lbs	200
Grab Tensile Elongation	D4632	%	15
Trapezoid Tear Strength	D4533	lbs	75
CBR Puncture Strength	D6241	lbs	700
Apparent Opening Size (AOS)*	D4751	U.S. Sieve	40
Permittivity	D4491	Sec^{-1}	0.05
UV Resistance (at 500 hours)	D4355	% strength retained	70
Weight	D5261	oz/yd^2	4.0
Thickness	D5199	Mils	20

*ASTM D4751, AOS is a Maximum Opening Diameter Value

230.03 CONSTRUCTION REQUIREMENTS

The filter fabric shall be installed in strict accordance with the manufacturer's recommendation. All splice joints shall be provided with a minimum lap as specified by the manufacturer or as approved by the Engineer.

Care shall be taken during the placement and installation of the material to prevent damage to the fabric. Damaged material shall be repaired by placing a piece of fabric large enough to cover the damaged area and lapping beyond the damaged area by a minimum of two (2) feet.

230.04 MEASUREMENT AND PAYMENT

Measurement and payment for the work included in this section of the specifications shall be at the unit price per square yard listed in the proposal for "Geotextile Fabric For Soils" and in place. Payment shall be considered full compensation for all equipment, tools, material, labor, supplies and incidentals necessary to furnish and install stabilization fabric.

Payment will be made under:

Pay Item	Pay Unit
Geotextile Fabric for Soils	SY

SECTION 290
SITE RESTORATION

290.01 SCOPE OF WORK

The work shall consist of the restoration of the site within the limits of the right-of-way including clean-up, topsoil, seeding, sodding, irrigation system relocation and related work.

The work under this item shall be accomplished as soon as practicable after the grading in an area has been completed in order to deter erosion of the roadway and siltation of streams and storm drainage system.

290.02 TOPSOIL

Topsoil shall be the surface layer of soil with no admixture or refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones more than 2" in diameter, clay lumps or similar objects. This surface layer of soil shall contain humus and organic matter and any grass roots and native seeds that may have accumulated in the surface layer.

Topsoil stripped from within the project limits shall be stockpiled at an off-site location provided by the Contract unless on-site stockpile areas are designated on the plans. The topsoil shall be stockpiled in such a manner that other materials will not become intermixed and interfere with reuse of the topsoil. Topsoil shall be stripped from the designated areas and shall be stripped to a minimum depth of 6 inches unless otherwise indicated on the plans.

When suitable topsoil is not available on the site, the Contractor shall locate and obtain a supply subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made.

Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by disks or by other means approved by the Engineer, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches in diameter and all litter.

The topsoil shall be evenly spread on the prepared areas to a uniform depth of 4 inches and with a surface elevation that is 2 inches below finished grade after compaction. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that seeding or sodding operations can proceed with a minimum of soil preparation or tilling. After spreading is completed, the topsoil shall be smooth-graded and the surface left at the prescribed grades in an even, properly compacted condition. The finished grades shall prevent the formation of low places or pockets where water will stand. Light rolling with placing or spreading equipment, and wetting if needed, will be required to consolidate the topsoil to the finished grades.

Topsoil shall be compacted and graded to the requirements listed in Section 203 Excavation and Embankment of these specifications.

290.03 SEEDING AND FERTILIZING

A. MATERIALS.

(1) Lime - Lime shall be agricultural grade ground limestone or approved equivalent.

(2) Fertilizer - Fertilizer shall be a commercial grade, 10-20-10, uniform in composition, free flowing and suitable for application with mechanical equipment. It shall be

delivered to the site in labeled containers conforming to current Arkansas fertilizer laws and bearing the name, trademark and warranty of the producer.

(3) Seed - Except as herein modified, the seed shall comply with current rules and regulations of the Arkansas State Plant Board and the germination test shall be valid on the date the seed is used. It shall have a minimum of 98% pure seed and 85% germination by weight and shall contain no more than 1% weed seeds. A combined total of 50 noxious weed seeds shall be the maximum amount allowed per pound of seed with the following exceptions: Johnson grass seed, wild onion seed, wild garlic seed, field bindweed seed, nut grass seed, sickle pod seed, sesbania seed, indigo seed, morning-glory seed, cocklebur seed, ballonvine, crotalaria spp., serrated tussock, and tropical soda apple will not be allowed in any amount whatsoever. Seed shall be furnished in sealed, standard containers.

Seed which have become wet, moldy or otherwise damaged in transit or in storage will not be acceptable.

Seed shall be composed of the following varieties and weight per acre:

Bermuda - Common - Hulled (Spring & Summer & Fall)	10 lb./acre
Bermuda - Common - Unhulled (Fall)	10 lb./acre
Red Fescue (Spring, Summer & Fall)	20 lb./acre
Annual Rye (Spring & Fall)	30 lb./acre

(4) Mulch - Mulch cover shall consist of straw from threshed rice, oats, wheat, barley or rye; of wood excelsior; or from hay obtained from various legumes or grasses, such as lespedeza, clover, vetch, soybeans, bermuda, carpet sedge, bahia, fescue or other legumes or grasses, or a combination thereof. Mulch shall be dry and reasonably free from Johnson grass or other noxious weeds and shall not be excessively brittle or in an advanced state of decomposition. All material will be inspected and approved prior to use.

(5) Tackifiers - Tackifiers used in mulch anchoring shall be of such quality that the mulch cover will be bound together to form a cover mat that will stay intact under normal climatic conditions.

(6) Water - Water shall be of irrigation quality and free of impurities that would be detrimental to plant growth.

B. SEED BED PREPARATION. Areas to be seeded shall be dressed to the shape and section shown on the plans. All excess dirt, construction materials, trees, rubbish, debris, roots and stumps shall be removed and disposed of off-site. The Contractor shall obtain soil samples, to a depth of five inches, from each major soil area, and have a lime requirement analysis conducted.

Lime at the rate determined by the lime requirement test shall be uniformly spread on areas to be seeded prior to their being roughened or scarified.. The seed bed shall then be thoroughly pulverized by means of disk harrows or other approved methods, thoroughly mixing lime and soil to a depth of four inches. Objectionable foreign matter turned up shall be removed. Water shall be applied in order to maintain the desired moisture content in the soil. Disk harrowing shall be followed by use of a spiked-tooth harrow to provide a finer surface texture.

C. FERTILIZING. Fertilizer shall be applied at a rate of 800 pounds per acre. Fertilizer shall be uniformly incorporated into the soil to a depth of at least two inches. It may be worked

into the soil alone or in conjunction with the required lime. The fertilizer may be drilled into the soil or combined with the seed in the hydroseeding operation.

D SEEDING. Seed shall be placed either by broadcasting, drilling or by hydroseeding. Broadcast sowing may be accomplished by hand seeders or by approved power equipment. Either method shall result in uniform distribution and no work shall be performed during high winds. The area seeded shall be lightly firmed with a cultipacker immediately after broadcasting.

When the seed is drilled, it shall be in rows parallel to the toe of the slope. Drills shall not be more than six inches apart. Fertilizer and seed shall not be drilled together and shall not be mixed.

If a hydroseeder is used, fertilizer and seed may be incorporated into one operation, but a maximum of 800 pounds of fertilizer shall be permitted per each 1500 gallons of water. The area shall be lightly firmed with a cultipacker immediately prior to hydroseeding.

E. MULCHING. Mulch cover shall be applied at the rate of 4000 pounds per acre immediately after seeding and shall be spread uniformly over the entire area by approved power mulching equipment. When approved by the Engineer, the Contractor may use hand methods to apply mulch cover to small or inaccessible areas. If the Contractor so elects, an approved mulching machine may be used whereby the application of mulch cover and tackifier may be combined into one operation. If this method is used, no change in application rates will be allowed. In its final position, the anchored mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and reduce the impact of rainfall on the surface of the soil. Care shall be taken to prevent tackifier material from discoloring or marking structures, pavements, utilities, or other plant growth. Removal of any objectionable discoloration shall be at no cost to the Owner.

F. MULCH ANCHORING. Immediately following or during the application of the mulch cover on seeded areas, the mulch shall be anchored by one of the following methods:

- Tracking or Roller Method. The mulch shall be effectively pressed into the soil using steel cleated track or cleated roller equipment. The anchoring shall be performed so that the grooves formed are perpendicular to the flow of water down slopes. The equipment and method used shall produce acceptable results.
- Asphalt Tackifier. Asphalt shall be applied at the rate of approximately 0.05 gallon per square yard. Application shall be made using a pressure distributor to ensure constant and uniform distribution. The use of asphalt may be reduced or eliminated by the Engineer at selected locations. Other tackifiers may be used as approved by the Engineer.

The method used shall be at the Contractor's option unless otherwise specified or directed. In lieu of separate application of tackifiers, the Contractor may use equipment that combines the application of mulch and tackifier into one operation. Application shall be at the specified rates.

G. WATER. After application of the mulch cover, water shall be applied in sufficient quantity to thoroughly moisten the soil to a depth of pulverization and then, as necessary, to germinate the seed and maintain growth at the direction of the Engineer for a period of at least 3 weeks. The time required for application of water will not be included in the computations of contract time for completion of the project provided all other work under the contract has been completed.

H. RESEEDING. After germination has occurred, any area which does not have a stand of grass shall be refertilized and reseeded and watered in accordance with the above paragraphs

at no cost to the Owner. Any portion of the seeded area which becomes gullied or otherwise damaged shall be repaired at no cost to the Owner and a stand of grass obtained.

290.04 SOLID SODDING

Sod shall consist of live, growing grass and shall be Bermuda unless other types of grass are specified. If zoysia grass is existing in area to be resodded, then zoysia grass sod shall be provided at no additional cost.

The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh, and uninjured at the time of placing. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be placed as shown as possible after being cut and shall be kept moist from the time it is cut until it is placed in its final position.. The sod shall be free from obnoxious weeds or other grasses and shall not contain any matter injurious to its growth or which might affect its subsistence or hardiness when transplanted.

The areas to be sodded shall be brought to a reasonable smooth and uniform surface to conform to the finished grade and cross section shown on the plans. A layer of topsoil shall be placed not less than 2" in depth and shall be in a firm but uncompacted condition with a relatively fine texture at the time of sodding. Sod strips shall be laid along contour lines, by hand, commencing at the base of the area to be sodded and working upward. The transverse joints of sod strips shall be broken, and the sod carefully laid to produce tight joints. At the top of slopes the sod shall be turned into the embankment slightly and a layer of earth placed over it and compacted to conduct surface water over and onto the sod. The sod shall be firmed, watered, and refirmed immediately after it is placed. The firming shall be accomplished by use of a lawn roller or approved tamper, with care being taken to avoid tearing end strips of sod.

When sodding is complete, the sodded areas shall be cleared of loose sod, excess soil, or other foreign material; a thin application of topsoil shall be scattered over the sod as a top dressing; and the areas thoroughly moistened.

Sod placed on slopes steeper than 3 horizontal to one vertical shall be pegged with wooden pegs or other approved devices driven through the sod into firm earth.

Sodded areas shall be thoroughly watered immediately after they are planted and shall be subsequently watered and mowed as required until completion and final acceptance of the project.

No sod shall be placed prior to inspection and approval of prepared topsoil.

When directed by the Engineer, solid sodding shall be overseeded with annual rye. Seed shall be applied at a rate of 6 to 10 lb/1000ft^2.

290.05 CLEANUP

Prior to final acceptance and payment, the Contractor shall remove all machinery, equipment, surplus materials, rubbish, etc., from the project. Contractor shall restore to original condition those portions of the site not designated for alteration by the Contractor. Pavement, driveways and sidewalks, gutters and storm drainage facilities shall be cleaned and all soils and other debris removed.

290.06 MEASUREMENT AND PAYMENT

No separate payment will be made for site restoration and clean-up except for the items listed below when shown on the bid form. Compensation for site restoration and clean-up shall be considered

incidental to other work specified in these specifications.

No separate payment will be made for topsoil. Compensation for excavation, hauling, preparation and placement of topsoil shall be considered incidental to other work included in this section.

Seeding, Fertilizing and Mulching, when listed on the bid form, will be measured and paid for on a unit price basis. Seeding, fertilizing and mulching will be measured by the square yard or acre as listed on the bid form. Payment at the contract unit price shall be full compensation for furnishing and applying topsoil, seed, fertilizer, lime, mulch and water; for seed bed preparation and for maintaining seeded areas.

Solid Sodding will be measured by the square yard of sodded area. Payment at the contract unit price shall be full compensation for furnishing and placing of topsoil and sodding, compaction of topsoil, preparation of areas to receive sod, rolling of sod, overseeding with annual rye, water and for maintenance of sodded areas.

Unless shown on the bid form as a pay item, Irrigation System Relocation shall be incidental to the project, and no separate payment shall be made. If listed as a separate pay item, Irrigation System Relocation will be shown in the bid form as a lump sum reimbursable contingency amount determined by the Engineer. Payment will be made only for work where construction of new improvements requires the relocation of an existing irrigation system. Repairs required due to Contractor negligence will not be paid for. All work shall be approved by the Engineer and accomplished on a Force Account basis as specified in section 109.05 Extra and Force Account Work.

Payment will be made under:

Pay Item	Pay Unit
Seeding, Fertilizing, & Mulching	SY
Seeding, Fertilizing & Mulching	AC
Solid Sodding	SY
Irrigation System Location	LS

DIVISION 300 - PAVEMENTS

SECTION 305
AGGREGATE BASE COURSE

305.01 SCOPE OF WORK

This item shall consist of a foundation course for surface course, for other base courses, or for pavements. It shall be constructed on the prepared subgrade, subbase, or other completed base course according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

305.02 MATERIALS

Aggregate Base Course shall consist of any mechanically crushed natural rock or stone of igneous, sedimentary, and/or metamorphic origin produced from a solid geological formation by quarrying methods. Aggregate Base Course shall be proportioned as meet the requirements listed below and shall be from a currently qualified aggregate material source listed on the ArDOT Qualified Product List.

SIEVE	PERCENT PASSING
1-1/2"	100
1"	60-100
3/4"	50-90
3/8"	
#4	25-55
#10	
#40	10-30
#200	3-12

Max. Plasticity Index (Minus #40 Material) - 6
Min. Percent Crusher-Run Material - 90
Percent Wear by the LA Test (AASHTO T96) - not greater than 45

The fraction passing the #200 sieve shall not be greater than three-fourths of the fraction passing the #40 sieve. The fraction passing the #40 sieve shall have a liquid limit not greater than 25.

Material furnished shall not contain more than 5% weight of shale, slate, and other objectionable, deleterious, or injurious matter.

When the material contains aggregate larger than that specified, the oversize aggregate shall be removed by screening or by screening and crushing. The removal of large size aggregate by hand methods will not be permitted.

When it is necessary to blend two or more materials, each material shall be proportioned separately through mechanical feeders to ensure uniform production. Premixing or blending to avoid separate feeding will not be permitted. Production of material by blending materials on the roadway to obtain a mixture that will comply the requirements specified herein will not be permitted.

The Contractor shall furnish certification from the material supplier of material manufacture, analysis or other information when specified or requested by the Engineer.

Copies of material tickets shall be furnished to the Engineer at the point of delivery to the project site. Material tickets, and weight scales used to generate tickets, shall meet the requirements of

subsection 109.02.E. “Measurement of Quantities.”

305.03 CONSTRUCTION METHODS

The subgrade shall be prepared as specified in Section 210 “Subgrade Preparation” and shall be free from an excess or deficiency of moisture at the time of placing the base course material. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the Contract that provide for the construction, reconstruction, or shaping of the subgrade or the reconstruction of the existing base course.

The base course material shall be placed on a completed and approved subgrade or existing base that has been bladed to substantially conform to the grade and cross section shown on the plans.

Base course material shall not be placed on a frozen subgrade or subbase.

The aggregate shall be placed on the subgrade or other base course material and spread uniformly to such depth and lines that when compacted it will have the thickness, width, and cross section shown on the plans. If 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 maximum compacted thickness of any one layer shall not exceed 6 inches except when vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of base course may be increased to 8 inches upon approval of the Engineer. Each layer shall be stable before advancing to the next layer sequence.

Placement of the base course shall be terminated if rutting or yielding of the subgrade occurs due to hauling, spreading or any other reason. Correction of rutted or yielded areas shall be as specified in other sections or as directed by the Engineer.

The material shall be spread the same day that it is hauled. Spreading shall be performed in such manner that no segregation of coarse and fine particles nor nests or hard areas caused by dumping the aggregate on the subgrade will exist. Care shall be taken to prevent mixing of subgrade or unspecified material with the base course material during the blading and spreading operation.

Aggregate shall not be dumped or mixed on an existing or newly constructed ACHM course or PCC Pavement that will not be overlaid under the same Contract nor on any open graded base course. Mechanical spreading equipment shall be used, if necessary, to place the base course on the subgrade.

If sufficient working space is not available to allow proper aeration or addition of water to the base, the base material shall be mixed by any satisfactory method before placement.

Each course shall be thoroughly mixed for the full depth of the course and shall be compacted by any satisfactory method that will produce the density specified in subsection 305.04. The aggregate shall be maintained substantially at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as necessary. The specified grade and cross section shall be maintained by blading throughout the compaction operation. Shoulders are considered to be within the normal traveled way. The aggregate shall be compacted across the full width of application.

The compacted thickness of the base course shall be within ½ inch, plus or minus, of the specified thickness. The compacted subbase course will be tested for depth. The Contractor shall correct all deficiencies by scarifying, removing or placing additional material, mixing, reshaping and recompacting to the specified density.

305.04 QUALITY CONTROL AND QUALITY ASSURANCE ACCEPTANCE TESTING

A. QUALITY CONTROL BY THE CONTRACTOR. The Contractor shall perform all applicable quality control sampling and testing aggregate base course mixtures used on the project. The Contractor is responsible for product quality control during handling, blending, storing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to maintain the tolerances specified for the mix.

Sampling shall be performed according to AASHTO T 2. Test methods shall be as shown below:

Property	Test Method(s)
Sieve Analysis	AASHTO T 27
Moisture-Density Relationship	AASHTO T 180 Method D, (Modified)
Percentage of Wear	AASHTO T 96
Soundness	AASHTO T 104
Moisture & Density (In-Place)	AASHTO T 239 & T 238

B. QUALITY ASSURANCE AND ACCEPTANCE. The Owner will provide for Quality Assurance tests for the purposes of determining acceptance of the base course and materials. The material in each course shall be compacted to a density, as determined by AASHTO T310 (ASTM D2922), Direct Transmission, of not less than 95 percent of the maximum laboratory density. Density and thickness of the material shall be tested at a frequency of one test per 750 square yards. All other tests shall be conducted at a minimum of one test for each type of aggregate used per project. All tests shall be in accordance with the test methods shown above under Quality Control.

305.05 MEASUREMENT AND PAYMENT

Aggregate Base Course will be measured by the cubic yard based on the in-place compacted volume. The volume will be computed from the actual area of the base course and the specified plan thickness. Only on projects required to follow Arkansas Highway and Transportation Department specifications might Aggregate Base Course be measured by the ton.

Aggregate Base Course for Driveways will be measured by the square yard for the plan specified thickness.

Payment at the contract unit price for the above items shall constitute full compensation for furnishing and placing aggregate base course including spreading, finishing, compaction, water and related items, and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Aggregate Base Course	CY
Aggregate Base Course (ArDOT project)	TN
Aggregate Base Course for Driveways	SY

SECTION 310
ASPHALT CONCRETE HOT MIX (ACHM) BASE COURSE

310.01 DESCRIPTION

This item shall consist of a base course constructed on an accepted course according to these specifications and in substantial conformity with the lines, grades, and typical cross section shown on the plans.

310.02 SUBMITTALS

The design and quality control of ACHM Base Course shall be according to Section 330 "ACHM Courses" as applicable. The Contractor shall submit one mix design for each of the particular mixtures listed on the plans or in the Contract.

310.03 MATERIALS

The base course shall consist of a mixture of gravel and/or crushed stone, asphalt binder, and any required additives as shown in the table below. The materials shall comply with the following requirements:

A. MINERAL AGGREGATE. Mineral Aggregate shall conform to the requirements of Section 305 "Aggregate Base Course." The aggregate shall be free of adherent films of material that prevent coating by the asphalt material.

B. ASPHALT BINDER. Asphalt binder, and anti-strip when required, shall conform to the requirements of Section 409 "Materials and Equipment for Asphalt Concrete Plant Mix Course" of ArDOT Standard Specifications.

When required by the mix design, the asphalt binder shall contain a heat-stable anti-strip additive. It shall be added at the rate determined by the laboratory mix design. The anti-strip additive shall be added by an in-line blending process just before introduction of the asphalt binder to the mixer. Addition of the anti-strip additive at the refinery will not be permitted.

DESIGN REQUIREMENTS FOR ACHM BASE COURSE

Asphalt Binder Content %:	3.0-5.0
No. of Blows:	50
Minimum Marshall Stability:	1000 lbs.
% AV:	3.0-8.0
Minimum Water Sensitivity Ratio:	75%
% Anti-strip:	As Required

The Engineer will have the option to inspect and test materials at the source or upon delivery to the site. The Engineer shall have full access for plant inspection during preparation, manufacture, or delivery of materials. The Contractor shall furnish certifications of material manufacture, analysis or other information when specified or requested by the Engineer.

The contractor shall notify the Engineer at least 10 calendar days in advance of its intention to use materials for which tests are specified to allow time to perform the tests. When requested, the Contractor shall assist the Engineer in obtaining samples and in performing inspection of materials.

310.04 EQUIPMENT

Equipment used in this construction shall comply with Section 330 "Asphalt Concrete Hot Mix Courses."

310.05 CONSTRUCTION REQUIREMENTS AND ACCEPTANCE

Construction requirements and acceptance shall conform to the requirements of Section 330 "Asphalt Concrete Hot Mix Courses" as applicable except that the minimum density required shall be 90% of the maximum theoretical density. The field density of the compacted base course shall be determined by testing of core samples. A minimum of one density test will be made for each 750 square yards of finished surface unless otherwise directed by the Engineer.

All ACHM Base Course shall be placed utilizing an asphalt paver.

The compacted base course will be checked for depth and all deficiencies shall be corrected by placing additional material, removing and replacing material, and recompacting as directed.

310.06 MEASUREMENT AND PAYMENT

ACHM Base Course acceptably completed shall be measured by the ton. The Contractor shall furnish a legible copy of the weigh certificate showing the gross, tare, and net weight of each truck load of asphalt concrete hot mix stabilized base course. When an automatic batching system is used, the certificate may only show the net weight of material furnished. Certificates shall be provided to the Engineer at the point of discharge to the paver.

ACHM Base Course will be paid for at the contract unit price bid per ton. Payment at the Price listed in the Proposal shall be considered full compensation for all equipment, tools, material, labor, supplies, and incidentals necessary for the completed base course.

Payment will be made under:

Pay Item	Pay Unit
ACHM Base Course	TN

SECTION 311
PORTLAND CEMENT CONCRETE
BASE

311.01 SCOPE OF WORK

This item shall consist of constructing a course of Portland cement concrete base on a prepared surface according to these specifications, in reasonably close conformity with the established lines, grades, and typical cross sections shown on the plans or established by the Engineer.

311.02 MATERIALS

All concrete shall be Class "AA" (3500 psi) air entrained, fiber reinforced, as specified in Section 401 "Concrete." The maximum size of aggregate used shall be 1-1/2" with a gradation conforming to ASTM C33, Gradation No. 467.

When High Early Strength Concrete is specified for the P.C. Concrete Base, or is requested by the Contractor and approved, it shall conform to the requirements specified in Section 401 of the specifications.

311.03 CONSTRUCTION METHODS

All work in this section shall meet the applicable requirements of Section 401 "Concrete" unless noted otherwise.

A. OPENING PAVEMENT TO TRAFFIC. The Engineer shall decide when the base course shall be opened to traffic and/or when placement of pavement surfacing can proceed. The base course shall not be subjected to any traffic until it has reached 75% of the design strength. If High Early Strength Concrete is used, the base course may be opened to traffic in 24 hours, or earlier if previous test data indicates adequate strengths.

B. SUBGRADE PREPARATION. Where required, the existing pavement and subgrade shall be removed to the depth specified, and replacement of unsuitable subgrade soils by means of undercut excavation and backfill shall be accomplished as directed and specified by the Engineer. Undercut excavation and backfill and compaction of the subgrade shall be in accordance with Section 203 "Excavation and Embankment."

C. JOINTING. Contraction joints shall be installed at a twenty foot maximum spacing unless otherwise directed by the Engineer.

D. SMOOTHNESS TOLERANCE. The completed base course shall be checked with a 10-foot straight edge for smoothness. Areas showing high spots of more than 1/4 inch, but not exceeding 1/2 inch, in 10 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation within the 1/4 inch tolerance. Where the departure from the correct cross section exceeds 1/2 inch, the base course shall be removed and replaced by and at the expense of the Contractor. Any area so removed shall be not less than 10 feet in length nor less than the full width of the lane unless otherwise directed by the Engineer.

E. FINISH. The surface shall be given a Class 1, Ordinary Surface finish. Prior to placement of any asphalt surface course, a tack coat shall be applied to the surface of the concrete base course at a rate of 0.10 to 0.15 gallons per square yard.

F. TOLERANCE IN BASE THICKNESS. The base course thickness shall be evaluated in accordance with and shall conform to the requirements of subsection 350.09.

311.04 QUALITY CONTROL AND QUALITY ASSURANCE ACCEPTANCE TESTING

The Contractor is responsible for product quality control and the Owner will provide Quality Assurance testing according to subsection 401.07 "Quality Control and Quality Assurance Acceptance Testing."

311.04 MEASUREMENT AND PAYMENT.

Portland cement concrete base will be measured by the square yard of completed base course.

Portland cement concrete base will be paid for at the contract unit price for "P.C. Concrete Base." Payment shall be full compensation for removing existing pavement and base within the limits of the base course, preparing the subgrade, furnishing, transporting, and placing concrete, jointing, curing, tack coat, and for all labor, equipment, tools, and incidental necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
P.C. Concrete Base ((_)" Thickness)	SY
P.C. Concrete Base (High Early) ((_)" Thickness)	SY

SECTION 320
PRIME AND TACK COATS

320.01 DESCRIPTION

This item shall consist of a single application of asphalt material and, if required, blotter material applied to the completed and approved subgrade, to the base course, or on the existing asphalt or concrete surface according to these specifications and in reasonably close conformity with the lines shown on the plans or as directed.

320.02 MATERIALS

Materials shall conform with the requirements below. In general for prime coats, a medium curing cut-back asphalt, an anionic emulsified asphalt (SS-1 or -1h), a cationic emulsified asphalt (CSS-1 or -1h) or an asphalt penetrating prime will be used. For tack coats, a rapid curing cut-back, a cationic emulsified asphalt (CSS-1 or -1h) or an anionic emulsified asphalt (SS-1 or -1h) will be used. Dependent upon the texture of the base and the season of the year that the work is being performed, the Engineer will select the particular grade of the type of asphalt material that will be used. Samples of asphalt material will be tested according to applicable AASHTO or ASTM methods.

A. **Rapid Curing Cut-back Asphalt (RC-70, -250, -800 or -3000)**. Rapid Curing Cut-back Asphalt shall conform to the requirements of AASHTO M 81.

B. **Medium Curing Cut-back Asphalts (MC-30, -70, -250, -800, or -3000).** Medium Curing Cut-back Asphalt of the grade designated shall conform to the requirements of AASHTO M 82.

C. **Anionic Emulsified Asphalt (SS-1, or SS-1h)**. Anionic Emulsified Asphalt shall conform to the requirements of AASHTO M 140 (ASTM D 977).

D. **Cationic Emulsified Asphalt (CSS-1 or CSS-1h)**. Cationic Emulsified Asphalt shall conform to the requirements of AASHTO M 208 (ASTM D 2397).

E. **Asphalt Penetrating Prime**. This material shall be produced by fluxing asphalt base with suitable solvents. Penetrating prime shall conform to the following requirements:

ASPHALT PENETRATING PRIME		
Item	Min.	Max.
Flash Point, Pensky Martens	100° F	--
Viscosity, Saybolt Furol at 122° F, seconds	40	120
Distillation AASHTO T 78:		
Over at 437° F vol. percent total solvent	15	45
Over at 500° F vol. percent total solvent	55	80
Over at 600° F vol. percent total solvent	85	--
Residue from distillation at 680° F, volume	50	--

Test of residue from distillation:		
Softening point (R & B)	115° F	165° F
Penetration at 77° F, mm /10	10	90

Base shall be asphalt refined from petroleum crude oil.

320.03 APPLICATION TEMPERATURES

Asphalt material shall be applied at a temperature that provides proper and uniform distribution and within practical limits avoiding higher temperatures than necessary. Satisfactory application usually should be obtained within the recommended ranges shown below.

No material shall be heated above the maximum allowable temperatures shown:

Type and Grade	Recommended Range (°F)	Maximum Allowable (°F)
RC-70	80-150	175
RC-250	100-175	200
RC-800	160-225	250
RC-3000	200-275	290
MC-30, MC-70	80-150	175
MC-250	100-200	230
MC-800	185-260	275
MC-3000	225-275	290
SS-1, SS-1h, CSS-1, CSS-	70-160	160
Asphalt Penetrating Prime	130-200	230

Note: Heating of asphalt materials (except emulsions) constitutes a fire hazard to various degrees. Proper precautions should be used in all cases and especially with rapid curing cut-backs, as the maximum allowable temperature may exceed the flash point.

320.04 EQUIPMENT

A. HEATING EQUIPMENT. Equipment for heating asphalt material in tank cars or storage tanks shall have adequate capacity to heat the material by steam coils, electricity, or other means such that no flame shall come in contact with the heating tank.

The heating equipment shall be provided with an accurate thermometer to indicate the temperature of the asphalt material in the unit to which heat is being applied. Heating equipment that agitates the material will be prohibited if, in the opinion of the Engineer, it injures or in any way changes the characteristics of the material. The introduction of free steam directly into asphalt material will not be permitted.

B. PRESSURE DISTRIBUTORS. Each pressure distributor used for applying asphalt material shall be equipped with the following listed appliances or devices:

(1) Tachometer devices registering traveling speed in feet per minute or feet per second.
(2) A gauge, indicating pump pressure or output in gallons per minute or gallons per second passing through the nozzles.
(3) Thermometer well and accurate thermometer to indicate the temperature in degrees Fahrenheit of the asphalt material in the distributor.
(4) Spray bars shall be of adjustable length and height and the distributor shall produce a 50% lap of the sprays from adjacent nozzles.
(5) A power unit and pump system that will supply a uniform pressure through the entire length of the spray bar to provide equal output from all nozzles.
(6) Calibrated metal measuring stick, marked in increments of not more than 10 gallons.
(7) Easily removable dome cover.
(8) Wind guard on ends of spray bars.

Calibration of the distributor will be checked by the Engineer before being used on the work. Distributors previously calibrated by the City or by a state Department of Transportation or the manufacturer, and certified in writing, will be accepted. Distributors will be kept free from sludge or other residue and at any time there is evidence of inaccuracy they will be subject to re-calibration. The Contractor shall provide, at no cost to the City, all necessary equipment, materials, and assistance for any required calibration.

320.05 CONSTRUCTION REQUIREMENTS

The methods employed in performing the work, and all equipment, tools, and machinery used in handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory, shall be changed and improved as required. All equipment, tools, and machinery used shall be maintained in a satisfactory working condition and shall meet the requirements above.

The surfaces of all structures shall be protected by some satisfactory method to prevent their being disfigured by the application of asphalt material. Objectionable asphalt discoloration, caused by the Contractor's operations, shall be removed from all roadway, bridge structures, culverts, handrails, guard fence, curbing and similar items at no cost to the City.

A. CLEANING. Immediately preceding the application of prime or tack coat, the surface to be treated shall be cleaned of dust, dirt, and loose or foreign material by sweeping with mechanical brooms. Care shall be taken to clean but not loosen or dislodge the embedded aggregate in base courses. Patches of asphalt, dirt, or other material that do not form an integral part of the surface to be treated shall be removed. If deemed necessary by the Engineer, the surface shall be sprinkled with water and given an additional sweeping.

The cleaning operations shall be carried only far enough in advance of the application of the asphalt material to ensure the surface being properly prepared at the time of application. When the existing surface is an old concrete pavement, excess joint and crack filler shall be removed from the surface.

Surfaces shall be approved by the Engineer before tack or prime coat application is started.

B. APPLICATION OF PRIME COAT. After the surface to be treated has been prepared in accordance with the specifications as outlined above, the asphalt material for the prime coat shall be sprayed uniformly over the surface by means of an approved mechanical pressure distributor at the rate of application indicated on the plans, or as directed by the Engineer.

Following the application of the prime coat, the road will be closed to traffic, if practicable, for a period of time sufficient to allow the proper curing of asphalt coating. Prime coat shall be allowed to cure a minimum of 3 days before any successive application of asphalt material. However, the minimum three day curing time may be waived when, in the opinion of the Engineer, the prime has sufficiently cured to allow placement of successive courses. No material for a succeeding course shall be placed on a primed base course until the prime coat has cured sufficiently to prevent damage by hauling operations. When shown on the plans or directed by the Engineer, the prime coat shall be applied in half widths in order to allow free passage of public traffic at all times.

Prime coat shall not be applied when the air temperature is below 45 degrees F, nor shall it be applied to a surface having excess moisture, nor when general weather conditions, in the opinion of the Engineer, are not suitable. Special precautions shall be observed to ensure a uniform distribution of the asphalt material. The distributor shall be so adjusted and operated at all times as to distribute evenly the material being applied. Deposits of asphalt material upon the road surface in excess of the quantity specified, caused by stopping or starting the distributor, by overflow, leakage, or otherwise, will not be permitted and shall be removed.

The asphalt material shall be applied at the temperature specified in subsection 320.03. The rate of application shall be from 0.10 gallons per square yard to 0.25 gallons per square yard as designated by the Engineer. The distributor shall be operated at a pressure of not less than 30 psi nor more than 70 psi. The Contractor shall provide the necessary facilities for determining the temperature of the asphalt material in the heating equipment and in the distributor, for determining the rate of application, and for securing uniformity of distribution at longitudinal and transverse joints.

If the primed surface becomes damaged from any cause whatsoever, such areas shall be cleaned thoroughly or patched and re-treated at no cost to the Owner.

C. APPLICATION OF TACK COAT. When an asphalt course is to be laid on an asphalt or concrete surface, a tack coat shall be applied prior to placing the course. The tack coat shall be applied by means of a pressure distributor in the same manner as outlined above for the application of prime coat. When emulsified asphalt is used it shall be diluted with water in order to ensure complete coverage and adhesion to the pavement surface. The asphalt material shall be applied at the temperature specified. The rate of application shall be from 0.03 gallons per square yard to 0.10 gallons per square yard as designated by the Engineer. The tack coat shall be applied sufficiently in advance of the asphalt course to allow the proper curing of the asphalt material but shall not be applied so far in advance as to lose its adhesiveness as a result of being covered with dust or foreign material. If the tack coat becomes damaged or covered with foreign material, such areas shall be cleaned as necessary and re-treated at no cost to the City.

320.06 BLOTTER COURSE

A. GENERAL. When directed, the fresh prime coat shall be covered by a blotter course in order to permit immediate use of the road by traffic without undue damage to the work or inconvenience to the traveling public.

B. MATERIAL. The material for the blotter course may be an approved, clean, sandy material from a local source or may be a commercially processed sand. Material used shall be free from lumps, roots, sticks, or other foreign matter.

C. CONSTRUCTION REQUIREMENTS. Before the primed surface is opened to traffic, the blotter course shall be distributed evenly over the primed surface in such quantity as may be

necessary to blot the surplus asphalt and prevent it from picking up under traffic. The surface shall then be dragged with an approved type of drag broom, supplemented as necessary by hand brooming, so as to distribute the material evenly.

320.07 MEASUREMENT AND PAYMENT

Asphalt material will be measured by the gallon. The number of gallons will be determined by outage measurements of the distributor as delivered on the road, based on a volume constant of 60 degrees F for cut back asphalt and 70 degrees F for emulsified asphalt. Deduction shall be made for the number of gallons not actually used in the performance of the work. Any quantity of water added to dilute emulsified asphalt will not be included in the pay quantity.

Blotter course material, applied at the direction of the Engineer, will not be measured or paid for separately but will be considered incidental to the price bid for prime coat.

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per gallon for Prime Coat or Tack Coat and per cubic yard, which price shall be full compensation for furnishing, preparing, hauling, diluting, and applying asphalt material and blotter course material, when required; for cleaning or scarifying and compacting the surface; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Prime Coat	GAL
Tack Coat	GAL

SECTION 330
ASPHALT CONCRETE HOT MIX (ACHM) COURSES

330.01 DESCRIPTION

This work shall consist of the construction of asphalt concrete hot mix pavement constructed on an accepted course according to these specifications and conforming reasonably close with the lines, grades, and typical cross sections shown on the plans. This work shall include binder, leveling, and surface courses, surface preparation and incidental work required for the completed pavement.

330.02 SUBMITTALS

The Contractor shall submit one mix design for each of the particular mixtures listed on the plans or in the Contract. The mix design shall be performed by a laboratory that is on the Arkansas Highway and Transportation Department Quality Products List of approved asphalt mix design laboratories or shall be AASHTO accredited. The mix design shall include the following:

- type of mix;
- design values for stability, asphalt binder content, air voids, voids in mineral aggregate, and gradation;
- source of each material to be used for production of the mix;
- designation of the asphalt plant to be used for production of the mix;
- optimum mixing and compacting temperatures;
- temperature viscosity curves for the asphalt binder to be used in the mix;
- performance grade of asphalt binder to be used in the mix;
- copies of all test results;
- and a certification by the Contractor that the mix design was prepared in accordance with the specifications and that the materials to be used are from sources approved by the Engineer.

Each mix design shall be prepared by laboratory analysis according to the requirements of the specifications. Each mix design shall establish a mix gradation for the aggregates (based on the weight of material passing specified screen sizes), an optimum asphalt binder content (expressed as a percentage of the total mix weight), an optimum mixing temperature, and an optimum compaction temperature. Optimum mixing and compaction temperatures shall be established based on temperature-viscosity curves of the asphalt binder to be used in the mix. The optimum asphalt content shall be established by performing Marshall Method tests according to AASHTO T 245 at a minimum of four different asphalt binder contents. Tests should be run on the basis of 1/2 percent (0.5%) increments in asphalt binder content. At least one asphalt binder content shall be above the optimum content and at least one content shall be below the optimum. Graphical plots of the test results shall be made. The following properties shall be plotted versus the asphalt binder content:

- Stability;
- Flow;
- Percent Air Voids (AV);
- Percent Voids in Mineral Aggregate (VMA); and
- Unit Weight (Density).

If an anti-strip additive is needed, a heat stable liquid anti-strip additive from the ArDOT Qualified Products List shall be added at the rate of 0.5% or 0.75% by weight of the asphalt binder as determined by laboratory analysis.

The asphalt binder mix design value shall be the optimum asphalt binder content based on the results of the Marshall Method tests. The maximum theoretical density computed from the specific gravity as determined by the Rice method (AASHTO T 209) shall be included in the mix designs. The mix

design for each type of asphalt mix shall meet the design criteria for asphalt binder content, stability, flow, AV, VMA, aggregate gradation, fines to asphalt ratio, and water sensitivity.

The Contractor certified mix design shall provide for the maximum compliance limits for asphalt binder content without exceeding the design requirements for asphalt binder content, stability, flow, AV, VMA, aggregate gradation, fines to asphalt ratio, and water sensitivity specified for the particular mix.

The mix design gradation must fall within the master gradation limits for the specified type of mix. If an acceptable pavement is not produced and it is determined that the accepted mix design is at fault, paving operations shall be stopped and the Contractor shall prepare a new mix design. The processing of proposed changes or new designs shall follow the same procedures as the initial mix designs.

Asphalt mixtures shall be designed according to the following methods, as applicable:

Property	Test Method *
Gradation	AASHTO T 11 & T 27
Marshall Stability/Flow	AASHTO T 245
Air Voids (AV)	AASHTO T 269
Voids in Mineral Aggregate (VMA)	ArDOT 464
Density	AASHTO T 166 & T 209
Water Sensitivity	ArDOT 455

*NOTE: Samples for design testing shall be mixed in the laboratory.

330.03 MATERIALS

The mineral aggregates for ACHM Binder Course, ACHM Surface Course, and Asphalt Concrete Cold Plant Mix shall consist of combinations of coarse aggregate, fine aggregate, and mineral filler proportioned as provided for the respective mixes. Asphalt binder shall be according to AASHTO M320, Table 1, except the Direct Tension requirement is deleted. All materials used shall comply with this subsection and with ArDOT Standard Specification Section 409, with the following exception: coarse aggregate shall contain no limestone. No binder or surface course shall contain Recycled Asphalt Pavement (RAP).

The materials shall be proportioned to meet the design requirements for the mixtures as shown in the Tables below. Asphalt concrete hot mix binder course shall conform to the Binder requirements of the table below. Asphalt concrete hot mix surface course shall be Surface Type 3. Surface Type 2 hot mix shall be used only when specifically authorized and directed by the Engineer. Both Surface Type 2 and Type 3 shall conform to the requirements of the table below.

DESIGN REQUIREMENTS FOR
ACHM BINDER & SURFACE COURSES

		SURFACE	
	BINDER	TYPE 2	TYPE 3
SIEVE, mm	**PERCENT PASSING**		
31.5 (1¼")	100	–	–
25.0 (1")	92-100	–	–
19.0 (3/4")	75-97	100	–
12.5 (1/2")	55-86	85-100	100
4.75 (#4)	31-60	47-80	54-80
2.36 (#8)	19-48	28-63	32-64
1.18 (#16)	13-38	19-50	22-51
0.600 (#30)	9-32	13-40	14-43
0.300 (#50)	5-26	8-29	8-32
0.150 (#100)	3-19	5-20	5-21
Fines to Asphalt Ratio*	0.6-1.4	0.6-1.4	0.6-1.4
Asphalt Binder Content	3.7-7.0	4.5-7.5	4.5-7.5
No. of Blows:	50	50	50
Min. Marshall Stability (lbs.)	1500	1500	1500
Marshall Flow (1/100")	7-16	7-16	7-16
% AV	4.0	4.0	4.0
Minimum % VMA	13	14	15
Min. Water Sensitivity Ratio:	75%	75%	75%
% Anti-strip:	As Required for all types		

*NOTE: Fines to asphalt ratio is defined as the weight of the Aggregate passing the #200 sieve, expressed as a percentage of the total mix weight, divided by the percent asphalt binder content.

The aggregates, mineral filler, and asphalt binder shall be measured separately and accurately mixed in the proper proportions according to the mix design. The aggregates shall be thoroughly coated and the mixture shall not show an excess or deficiency of asphalt binder, injury or damage due to burning or overheating, or an improper combination of aggregates.

The mineral aggregate in both Binder and Surface Course shall contain, if required by laboratory mix design, mineral filler complying with the physical requirements of AASHTO M 17. When required by the mix design, the asphalt binder shall contain a heat-stable anti-strip additive. It shall be added at the rate determined by the laboratory mix design. The anti-strip additive shall be added by an in-line blending process just before introduction of the asphalt binder to the mixer.

The Engineer will have the option to inspect and test materials at the source or upon delivery to the site. The Engineer shall have full access for plant inspection during preparation, manufacture, or delivery of materials. The Contractor shall furnish certifications of material manufacture, analysis or other information when specified or requested by the Engineer.

The Contractor shall notify the Engineer at least 10 calendar days in advance of its intention to use materials for which tests are specified to allow time to perform the tests. When requested, the Contractor shall assist the Engineer in obtaining samples and in performing inspection of materials.

330.04 EQUIPMENT

Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture true to line, grade, and cross section. The paver shall be capable of laying a uniform mixture to the full width being laid.

The paver shall be equipped with mechanical devices such as equalizing runners, straightedge runners, evener arms, or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. The paver shall be equipped with hoppers and distributing screws adequate to place the mixture evenly ahead of the screed for the full width being laid.

The term "screed" shall include any strike-off device, operated by cutting, crowding, or other practical action that effectively places and spreads the mixture without tearing, shoving, gouging, or segregating. Screeds shall be adjustable to crown and grade and shall have an indicating level attached.

The paver shall be equipped with an automatic screed control system for the control of grade and slope. The sensor for grade control may be operated from a reference stringline, from a ski-type grade reference system, or by any other appropriate method that will produce the desired results.

Final approval of spreading and finishing equipment will be based upon satisfactory performance during actual construction. If equipment becomes unsatisfactory, it shall be replaced before proceeding with the work.

Rollers shall be steel wheel, pneumatic tire, or a combination thereof. Rollers shall be of the size and type to produce the density required and a surface that is smooth and free from check cracking. Rollers shall have a system for moistening the full width of each tire or drum and devices for cleaning the tires or drums. Petroleum products shall not be used on the surfaces of the roller that will be in contact with the pavement.

330.05 CONSTRUCTION REQUIREMENTS

A. PREPARATION OF BASE OR EXISTING SURFACE. All surfaces which are to receive asphalt pavement shall be prepared and approved as specified in other sections of these specifications. Newly constructed base or surface courses shall be prepared as set forth in the specification item covering such courses.

Before placing asphalt base, binder, or surface courses, all required corrections of the existing pavement or old base, such as joint sealing, patching, filling pot holes, sags, and depressions, or alterations of the existing pavement crown, shall be made.

Before arrival of the mixture on site, the prepared surface, primed or tack coated as specified, shall be cleaned of all loose and foreign materials. The mixture shall not be placed on a surface that shows evidence of free moisture. Curbs and gutters shall also be cleaned of all loose and foreign materials prior to the arrival of the mixture on site. No direct payment will be made for cleaning the surface of existing pavement or curbs and gutters.

Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin coating of rapid curing cutback asphalt or emulsified asphalt. No direct compensation will be made for this work.

For foreign material, or when the time lapse between courses is more than 72 hours, the earlier course shall be cleaned and given a tack coat before placing the succeeding course. When directed, the tack coat shall be applied and paid for under Section 320. If directed by the Engineer, a tack coat shall be used even though the elapsed time has been less than 72 hours.

B. LEVELING COURSE. Leveling course shall consist of ACHM Surface Course, Type 2 or 3 or other mixture as directed by the Engineer. Leveling courses shall be placed to the thickness and in the manner shown on the plans. Limits of leveling courses will be as shown on the plans or as established in the field by the Engineer. Areas to receive leveling course shall be

cleaned and a tack coat shall be applied. The mixture shall be featheredged to a smooth and even surface around the edges of these areas. Before placing asphalt material, the base or existing surface shall be primed or tacked as applicable. The Contractor shall have the option of placing and finishing leveling courses with asphalt pavers or other approved methods. In areas where machine placement and finishing cannot be accomplished, hand methods may be utilized. Isolated depressions in the existing pavement shall be filled and compacted prior to placement of leveling courses.

C. TRANSPORTING. The mixture shall be transported from the mixing plant to the work in vehicles with clean tight beds. The maximum allowable haul distance shall be 25 miles from the construction site.

No loads shall be sent so late in the day as to interfere with spreading and compacting the mixture during daylight hours unless adequate artificial lighting is provided.

Sufficient haul vehicles and plant production rate shall be maintained for the project to provide a continuous operation on the roadway.

Only non-petroleum release agents approved by the Engineer shall be used in haul trucks.

D. SPREADING AND FINISHING. The mixture from all types of plants should be delivered to the paver within the recommended compaction temperature range as shown on the approved mix design. In no case shall binder or surface course be placed at a temperature less than 250 degrees F. Hot mix asphalt materials shall not be mixed or placed when the surface temperature is below 40 degrees F, or when there is frost in the base or subgrade, or at any other time when weather conditions are unsuitable for the type of material being placed.

The mixture shall be placed on an approved surface, spread, and struck off to the line, grade, and elevation established. The mixture shall be placed only on a base that shows no evidence of free moisture, and only when weather conditions are suitable. The Engineer may, however, permit work of this character to continue when overtaken by sudden rains to utilize materials that may be in transit from the plant at the time, provided the mixture is within the temperature limits specified and provided the finished pavement otherwise meets specification requirements.

All asphalt mixes shall be placed with a paver equipped with an electronic screed control system except where specified otherwise. Placement of the initial pass shall be made by controlling the paver screed with the electronic slope control and a sensor guided by the curb and gutter or a string line. The edge of the Binder or Surface Course shall be established by a string or chalk line for a distance of not less than 500 feet ahead of the spreading operation.

The paver shall uniformly distribute and compact the mixture in front of the screed for the full width being paved. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. The finished surface shall be smooth and of uniform texture.

When laying mixtures, the paver shall be operated at forward speeds consistent with satisfactory laying of the mixture. The speed of the paver shall be matched with the plant production rate and number of hauling units. Stop and go operation of the paver shall be held to a minimum

General casting back of material or hand raking material onto the surface will not be permitted. Hand spreading will be permitted only in areas inaccessible to the paver.

On roads under traffic, the mixture shall be spread and finished in full lane widths where

practicable. The paver shall alternate between the lanes with such frequency that the adjacent lane shall be laid no later than the next working day after the first lane is laid.

Unless authorized by the Engineer, rollers shall not pass over the unprotected end of a freshly laid mixture.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches, however, in general, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two lanes in width, or at lane lines if the roadway is more than two lanes in width. The slight excess of asphalt at a longitudinal joint, generated by overlapping during placement of an adjacent mat to a previous mat, shall not be scattered across the mat. This material shall be stacked over the joint and pinched into the joint by the first pass of a steel wheel roller running with all but 6 inches to 8 inches of the drum on the older mat. Vibrating rollers shall operate in the static mode during this operation.

Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed to do so by the Engineer, tack coat shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material. Joint details at transitions from existing to new pavement or at the interface with different types of pavement shall be as shown on the plans.

E. ROLLING. Rollers shall be steel wheel, pneumatic tire, or a combination thereof. The type and weight of rollers shall be sufficient to compact the mixture to the required density. At the beginning of placement of each mix design, the Contractor shall establish an optimum rolling pattern for the mix being placed. A strip of approximately 500 feet of the mat being placed shall be used to establish the rolling pattern. A sufficient number of coverages of the entire mat by the rollers proposed to be used by the Contractor during production paving operations shall be made to achieve the maximum density possible.

The established rolling pattern shall be used for compacting all mix placed. If a change in the accepted mix design occurs, or if the compaction method or equipment is changed, or if unacceptable results are obtained, a new optimum rolling pattern shall be established.

If for any reason a rolling pattern cannot be established to produce the specified density, a new mix design will be required. The Contractor shall establish an optimum rolling pattern that will produce the maximum density using the new mix design. Continuous production of the mix shall not begin until an optimum rolling pattern that produces the specified density within the allowable range has been established.

Rolling shall start longitudinally at the low edge and proceed toward the higher portion of the mat. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Alternate passes of the roller shall be terminated at least 3feet from any preceding stop. Rolling on superelevated curves shall progress from the low side. Rollers shall not be stopped perpendicular to the centerline of the traveled way.

The speed of the roller shall be slow enough to avoid displacement of the hot mixture, and shall in no case be more than 3 mph.

The roller shall be operated in such a manner that no displacement of the mat will occur. Rolling shall proceed continuously until all roller marks are eliminated and the required density attained. To prevent adhesion of the asphalt mixture to the rollers, the rollers shall be kept moist for the full width of the rollers, but an excess of water will not be permitted.

Upon completion of the rolling operations, the surface shall be smooth and of uniform texture.

Unless, authorized by the Engineer, rollers shall not pass over the unprotected end of a freshly laid mixture.

F. PAVEMENT SMOOTHNESS. Asphalt concrete surface courses shall be placed and finished to the grades and slopes shown on the plans. Surface courses shall be true to grade and cross section.

(1) Overlays and Minor Reconstruction. The finished surface when checked with a 10 foot straight edge placed parallel to the centerline, shall show no variation more than 1/8 inch for surface courses and 3/16 inch for binder courses. When surface tests indicate surface tolerances do not meet these requirements, changes to the paving operations shall be made before beginning the next day's operations.

All transverse joints shall be straightedges immediately following rolling of the joint. Paving will not continue until the transverse joints meet the applicable surface tolerances shown above.

Any areas not within this tolerance shall be corrected as stated in Item (3) below.

(2) Major Reconstruction. When called for on the Plans or in the Special Conditions, the profile of the finished surface course, for each lane of traffic, shall be tested with a California-style profilograph complying with ASMT E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the California-style profilograph scale. The Contractor shall take all profiles required, under the observation of the Engineer.

The finished pavement surface shall have a maximum profile index of 10 inches per mile (+/- 2.0 in blanking band) for each 0.1 mile section, or portion thereof, for the entire project. In addition, no areas representing high or low points having a deviation greater than 0.3 inch in 25 feet as determined by the profilograph shall be present.

A profile will be taken near the center of each traffic lane. The profiles shall begin 10 feet from an existing structure, or 10 feet back onto the previous day's run, or at the end of the pavement. The finished surface of the 10 foot sections adjacent to an existing structure or the end of pavement shall not show surface deviations in excess of 1/8 inch in 10 feet when tested with a 10 foot straight edge.

As soon as the first day's run is available for proper testing, profiles will be taken utilizing the profilograph equipment. Smoothness profiles of the first day's run will be analyzed before the second day's run commences. Should the first day's run not meet the profile index requirements, the paving operations shall be discontinued until better methods and equipment are obtained or until the present equipment is properly adjusted. If adjustments are necessary from the first day's run, the second day's run will be profiled to determine the ability of the equipment to finish the pavement within the specified tolerance. New methods and/or equipment will be given trial runs as indicated above to determine ability to finish the pavement within the specified tolerances.

For the duration of the work every reasonable effort shall be made to test smoothness within 5 working days after each day's run. All data obtained from the profiling operations will be furnished to the Engineer at the end of each day's profiling operations. Scheduling and testing shall be coordinated with the Engineer. The Contractor shall be responsible for traffic control associated with the testing.

Furnishing the profilograph, taking all required profiles, and performing all necessary computations will not be measured and paid for separately, but will be considered

included in the bid items for ACHM items.

(3) Corrective Measures. Areas not meeting the above surface test requirements shall be corrected in such a manner as to maintain a quality pavement having the same uniform texture and appearance as the adjoining surface. Skin patching the final surface course will not be permitted. Featheredging will be permitted only at the beginning and the end of the job. When the corrective action involves removing and replacing a section of the final surface, the minimum area to be removed shall be 50 linear feet of length for the full width of the course placed. Replacement of the final surface shall be accomplished using a paver.

Grinding will be allowed, if necessary, to reduce the profile index as determined by the profilograph, as appropriate, in any 0.1 mile section on all profiles, including the trial run. The grinding equipment shall be power driven and specifically designed to smooth and uniformly texture the pavement by means of diamond blades.

All corrective work and material necessary to correct surface tolerance deficiencies for surface courses shall be at no cost to the Owner.

Areas showing low spots of more than 1/4 inch in 10 feet in the longitudinal direction shall be corrected by grinding or shall be removed and replaced to an elevation that will not show surface deviations in excess of 1/8 inch in 10 feet.

330.06 QUALITY CONTROL AND QUALITY ASSURANCE ACCEPTANCE TESTING

A. QUALITY CONTROL BY THE CONTRACTOR. The Contractor shall perform all applicable quality control sampling and testing of the asphalt mixtures used on the project.

The Contractor is responsible for product quality control during handling, blending, mixing, storing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce the accepted mix design within the tolerances specified for the mix. Adjustments to the accepted mix design to conform to actual production values without re-design of the mixture shall be based on production of the mixture at a target value of 4.0% AV in Marshall specimens and an asphalt binder content not less than that specified in the accepted mix design. The VMA shall be within the specified limits for the adjustment to be acceptable.

The accepted mix design shall be field verified by the Contractor at the start of mix production or after an interruption of more than 90 calendar days. Verification will begin with testing mix that has been produced through the plant using the aggregate proportions shown on the accepted mix design.

If necessary, adjustments may be made to the aggregate proportions to produce a mix with the gradations shown on the accepted design. The mix will be considered to be verified if test values for air voids and VMA are within compliance limits, when the accepted mix design has been produced within the gradation tolerances below and the asphalt binder compliance limits.

After verification of the initial design, the Contractor may elect to make adjustments in aggregate proportions to vary the accepted mix design gradations and bring the mix properties near the center of the compliance limits. If these adjustments are made and the plant produced mix has the desired properties, the Contractor may request that a field mix design be accepted by the Engineer. If this is acceptable to the Engineer, the Contractor will be notified in writing.

If other changes to the accepted mix design are desirable, the Contractor must first produce another laboratory mix design, submit it to the Engineer for review and acceptance, and follow the verification procedures that are described above.

The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed asphalt pavement complies with all requirements of the specifications. Quality control sampling and testing shall be accomplished in a timely manner. Sampling and testing shall be planned and conducted so that a representative sample is obtained and tested. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be used.

If the accepted mix design is not being produced as defined by the accepted mix design, and if the mix cannot be adjusted within the tolerances of the accepted mix design to achieve the specified mix properties, production shall be discontinued. A new mix design shall be developed and submitted for review and acceptance. Sieve tolerances shall be as tabulated below.

Mix Design Tolerances

Sieve Size, mm		Tolerance (%)
25.0	1"	±7.0
19	3/4"	±7.0
12.5	1/2"	±7.0
4.75	#4	±7.0
2.36	#8	±7.0
1.18	#16	±4.0
0.60	#30	±4.0
0.30	#50	±4.0
0.15	#100	±4.0

Sampling shall be performed according to AASHTO T 168 and ArDOT 465. Test methods shall be as shown below:

Property	**Test Method(s) (NOTE 1)**
Aggregate Gradation	AASHTO T 30, ArDOT 460 1 per 750 tons minimum
Asphalt Binder Content	ArDOT449/449A
Stability	AASHTO T 45
Air Voids (AV) (NOTE 2)	AASHTO T 269
Voids in Mineral Aggregate (VMA)	ArDOT 464
Density - Maximum Theoretical	AASHTO T 209
Density (Field)	AASHTO T 166 or ArDOT 461
Water Sensitivity (NOTE 3)	ArDOT 455

NOTE 1: Where alternate test methods are shown, the method used shall be at the Contractor's option. All testing for quality control shall be performed on samples of the

plant mixed product. Field densities and samples to investigate segregation shall be taken from the roadway after compaction; all other samples shall be taken from trucks at the plant.

NOTE 2: Test for AV on samples prepared under AASHTO T 245.

NOTE 3: The Water Sensitivity shall be determined at least once during the first three days of production of each type mix; during the first three days of production of any new mix design; and/or during the first three days of production after an interruption of 90 calendar days or more. If the water sensitivity falls more than 10 percentage points below that specified for the type mix, production shall cease and a new mix design will be required.

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The Contractor's quality control personnel may observe the Owner's testing agency during acceptance sampling and testing for the purpose of comparing sampling and testing procedures.

If the test results show that the material is outside the mix design limits, is widely varying, or is consistently marginal, corrective action shall be taken. Corrective actions taken shall be based on the Contractor's quality control test results. Each individual aggregate cold feed may be adjusted no more than an amount that is sufficient to produce the specified Marshall stability and flow, AV, and VMA and that is within the tolerances for the accepted mix design. If excessive changes are required, production will be suspended and a new mix design shall be developed according to the applicable specifications.

Use of nuclear asphalt content gauges is regulated by the Radiation Control and Emergency Management Programs of the Arkansas State Department of Health. If the Contractor elects to use a nuclear gauge in his quality control program, he shall be responsible for meeting and following all licensing and use requirements.

B. QUALITY ASSURANCE AND ACCEPTANCE. The Owner will provide for Quality Assurance tests for the purposes of determining acceptance of the asphalt concrete pavement and materials. For Quality Assurance purposes, the field density of the compacted asphalt mixtures shall be determined by testing of core samples. Unless directed otherwise by the Engineer, a minimum of one density test will be made for each 750 square yards of finished surface. Surface, binder and leveling courses shall be compacted to a minimum density of 92 percent of the theoretical density. Asphalt binder content and aggregate gradation of the mix shall be tested at a frequency of one test for each 500 tons of mix placed or not less than one test per day. All testing will be in accordance with the test methods listed above under Quality Control requirements.

The owner will obtain and pay for sampling and testing of the asphalt concrete hot mix, with the exception that the Contractor shall pay for all tests that fail as specified in the Special Conditions. The Contractor shall fill and compact holes produced by core sampling with asphalt concrete hot mix.

Pavement areas which fail to meet the density requirement shall be removed and replaced at the expense of the Contractor. The Engineer will determine the extent of removal and replacement of pavement and corrective work to be performed. The Engineer may order additional density tests to delineate failure areas. The cost of these additional tests shall be at the expense of the Contractor.

Regardless of testing results, the Contractor shall correct any deficiencies identified in the finished pavement surface at no cost to the City. The method utilized to correct said

deficiency shall be approved by the Engineer and may include re-laying the asphalt, dependent upon the severity of the deficiency. Deficiencies in the finished pavement surface include, but are not limited to, cracking, bleeding, brown appearance, poor surface texture, rough uneven surface, honeycomb or raveling, uneven joints, roller marks, pushing or waves, rocks broken by roller, tearing of surface during laying, and surface slipping on base. If a deficiency is detected during paving operations, paving shall cease until the problem has been corrected.

330.07 MEASUREMENT AND PAYMENT

Asphalt concrete hot mix surface course shall be measured by the ton unless otherwise shown on the bid form. The Contractor shall furnish a legible copy of a weigh certificate showing the gross, tare, and net weight of each truck load of asphalt material. The certificate may show only the net weight of material furnished when an automatic batching system is used. Certificates shall be provided to the Engineer at the point of discharge to the paver.

Asphalt concrete hot mix surface course will be paid for at the contract unit price bid per ton. Payment shall be full compensation for furnishing and placing of all materials, compaction, and related work. No separate payment will be made for surface preparation, repairs, joint sealing, other preparatory work, profilographing, and corrective measures unless specified in other sections of these specifications.

Payment will be made under:

Pay Item	Pay Unit
ACHM Binder Course	TN
ACHM Leveling Course	TN
ACHM Surface Course (Type)	TN

SECTION 335
ASPHALT CONCRETE COLD PLANT MIX

335.01 DESCRIPTION

This item shall consist of an asphalt concrete cold plant mix, composed of a mixture of mineral aggregate and asphalt, according to these specifications.

335.02 COMPOSITION

The mixture shall conform to the requirements shown in the table below.

DESIGN REQUIREMENTS FOR ASPHALT CONCRETE COLD PLANT MIX

SIEVE	MAXIMUM MIX PERCENT PASSING	TOLERANCE (%)
1/2"	100	
#4	60-80	±7
#8	43-63	±5
#50	15-28	±4
#200	4-10	±2
Asphalt Binder Content	3.5%-6.5%	±0.4
Mineral Filler	3.0%	minimum

335.03 MATERIALS

Materials used in the mix shall conform to the following:

A. ASPHALT. The Engineer will specify the type and grade of asphalt to be used. The asphalt shall be an MC-250, MC-800, MC-3000, or a summer or winter grade seasonal type asphalt.

Medium curing asphalt shall comply with the requirements of Section 320 "Prime and Tack Coat."

Seasonal type asphalt shall comply with the following requirements:

Characteristics	Seasonal Type Asphalt Summer Grade	Winter Grade
Specific Gravity (@ 60°F)	0.95+	0.90+
Flash Point, °F	425+	160+
Float Test (@ 122°F), Secs.	60-120	60-120*
Spot Test – Standard Naphtha	Negative	Negative*
Penetration (@ 32°F)		
100 gms, 5 secs.	50+	50+
Solubility in Trichloroethane, %	98.5+	98.5+

Characteristics	Seasonal Type Asphalt Summer Grade	 Winter Grade
Distillation:		
Distillate, % by Volume of total Distillate to:		
600° F min.	--	3.5
680° F min.	--	12.5

*Test on distillation residue.

B. MINERAL AGGREGATE. Mineral aggregate shall conform to the requirements of Section 330 "Asphalt Concrete Hot Mix Courses."

335.04 PRODUCTION METHODS

The methods used in producing the mix and the equipment and plant machinery used shall be subject to the approval of the Engineer and shall conform, insofar as practicable, to the requirements of Section 330.

A. Preparation of Asphalt. Medium curing cut-back shall be heated to a temperature not exceeding 250 degrees F. Seasonal type asphalt shall be heated to a temperature not exceeding 175 degrees F.

B. Preparation of Mineral Aggregate. The coarse and fine aggregate shall be dried and heated at the mixing plant so that when delivered to the mixer, it shall be at as low a temperature as is consistent with proper mixing and in no case shall exceed 250 degrees F when using a medium curing cut-back or 175 degrees F when using a seasonal type asphalt.

C. Preparation of Mixture. Mixture preparation shall conform to the applicable portions of Section 330.

335.05 CONSTRUCTION REQUIREMENTS

Construction methods in addition to the general requirements of these specifications shall conform, insofar as applicable, to Section 330.

335.06 MEASUREMENT AND PAYMENT

All Asphalt Concrete Cold Plant Mix shall be considered incidental to the project with costs included in the amount bid for Traffic Control or other appropriate bid item.

Only when called for in the Special Conditions and listed in the Bid Proposal, Asphalt Concrete Cold Plant Mix will be measured and paid for at the unit price bid by the ton of mix. When an automatic printer system is used in conjunction with an automatic batching and mixing control system, the printed batch weight will be used in lieu of truck scale weights. The unit price bid shall be full compensation for furnishing materials; for heating and mixing; for hauling, stockpiling, placing, rolling, and finishing, as applicable; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Concrete Cold Plant Mix	TN

SECTION 350
PORTLAND CEMENT CONCRETE PAVEMENT

350.01 DESCRIPTION

This item shall consist of constructing a pavement composed of portland cement concrete, with or without reinforcement as specified, constructed on a prepared subgrade or base course according to these specifications and conforming to the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

350.02 MATERIALS

The materials used shall comply with the requirements as set out herein.

A. CONCRETE. The concrete shall be Class "P" (4000 psi) as specified in Section 401 "Concrete General." Coarse aggregate shall have a gradation conforming to AASHTO M43 (ASTM C33) Size No. 467 or No. 57.

B. JOINT MATERIALS. The joint materials used shall be as specified below and shall conform with the requirements of Section 401:

(1) Type 1 (preformed) joint materials shall be used for filling and sealing expansion joints as shown on the plans.

(2) Type 2 single-component silicone joint materials shall be used for filling and sealing longitudinal, warping, contraction, and other specified joints as shown on the plans.

(3) Backer rod filler shall be of polyurethane or cross-linked polyethylene foam material approximately 1/8" larger in diameter then the width of the joint to be sealed.

All components of the joint sealant system, including the backer rod, shall be compatible. No bond shall occur between the backup material and the sealant system for Type 2 joint sealer.

C. DOWEL AND TIE BARS. The bar materials used shall be as shown on the plans and shall conform with the requirements of Section 401. Each bar shall be coated with a film of epoxy, plastic, epoxy paint, zinc chromate primer, zinc strontium phospho-silicate primer, or tar paint.

D. CURING METHOD. Curing compound shall be a white-pigmented liquid membrane-forming compound conform to AASHTO M 148 (ASTM C 309), Type 2.

350.03 SUBMITTALS

The following are required to be submitted to the Engineer for approval at the Preconstruction Conference:

A. CONCRETE MIX DESIGNS. Contractor shall submit test results and/or certifications for all materials and detailed mix design data in accordance with Section 401 "Concrete General." Test data submitted shall include 28 day compressive strength test results.

B. JOINT MATERIALS. Contractor shall submit a copy of the proposed sealant manufacturer data sheets and recommended application procedure.

C. CURING. Contractor shall submit a copy of the proposed curing method and compound

manufacturer's data sheet.

350.04 CONSTRUCTION REQUIREMENTS

A. SUBGRADE OR FOUNDATION COURSE. Earthwork, compaction, stabilization and subgrade preparation shall be as specified in other applicable sections of these specifications. After the subgrade or base has been placed and compacted to the required density, the area which will support the slip-form paving machine, or forms, and the area on which pavement is to be constructed shall be brought to the proper profile and cross section by means of an electronic or automatic screed control system. Means other than electronic or automated grade control systems may be used upon approval of Engineer if Contractor can demonstrate proper control for bringing grade to required profile and cross section. The subgrade and the top of each successive type of base course material shall be graded to a stringline tolerance of 0 inch high and ½ inch low when compared to the computed grade for the subgrade or individual type of base course. The area shall be recompacted to the prescribed density. The subgrade, subbase or base course grade shall be approved by the Engineer prior to concrete placement. The finished grade shall be maintained in a smooth and compacted condition until placement of the concrete pavement.

Unless otherwise provided for in the plans or special provisions, no hauling will be allowed on the finished subgrade or base course except for dumping the concrete. Suitable temporary construction crossovers may be constructed when approved by the Engineer. The subgrade shall be prepared for a distance of not less than 500 feet in advance of the paver or the entire remaining distance when within 500 feet of the end of the paving or bridge end.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be moistened immediately before placing concrete. Moistening shall not be excessive to the point of forming mud or pools. Concrete shall not be placed on a soft, muddy, or frozen subgrade, subbase or base course.

B. SLIP-FORM PAVER. Concrete pavement shall be placed with a slip-form paver unless otherwise directed in the Special Conditions. The self-propelled slip-form paver shall be capable of spreading, consolidating, screeding, and finishing the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement conforming to the plans and specifications. The paving machine shall be equipped with the following:

(1) Automatic controls to control line and grade from either or both sides of the machine, or from averaging-skis that reference grade.

(2) Vibrators to consolidate the concrete for the full width and depth of the strip of pavement being placed.

(3) A positive interlock system that monitors vibrator performance and operation and stops all vibration and tamping elements when forward motion of the machine stops.

(4) An auto-float to seal the concrete surface during the paving operation.

The use of GPS systems on slip-form pavers for line and grade control shall not be allowed.

C. HAND-FORMED METHODS. Certain small isolated sections may be hand-formed and concrete placed using a self-propelled or manual form-riding machine and mechanical finishing, or hand-finishing methods, for striking off and consolidating concrete where approved by Engineer, or as directed in the Special Conditions.

Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they support, without springing or settlement. The method of connection between sections of forms shall be such that the joints shall not move in any direction. The maximum deviation of the top surface of the forms shall not exceed 1/8 inch in 10 feet or the inside face not more than 1/4 inch in 10 feet from a straight line.

All side forms shall be of metal, unless otherwise approved by the Engineer and except on curves with a radius of less than 100 feet where wood forms or flexible steel forms may be used. All forms shall be of a depth at least equal to the edge thickness of the pavement.

All forms shall be cleaned and oiled each time they are used. The Contractor shall check and correct alignment and grade elevations of the forms immediately before placing the concrete. When any form has been disturbed or is found to be off proper alignment or grade it shall be reset and rechecked. In lieu of setting forms for the edge of the pavement, the edge of previously placed concrete gutter section may be used as a form.

Unless otherwise provided, forms shall remain in place a minimum of 24 hours after placing concrete, except as needed to facilitate joint sawing. If the air temperature is below 50 degrees F at any time during the 24 hours, the forms shall be left in place for such a longer period deemed necessary by the Engineer to assure the pavement edges will not be damaged. Forms shall be removed carefully to avoid damage to the pavement. Honeycombed areas will be considered as defective work and shall be repaired or replaced, as directed. Application of the curing compound on the exposed concrete pavement edges shall begin immediately upon removal of the forms.

D. PLACING. Concrete shall be placed in accordance with the requirements of Section 401.

For slip form paving, the paver shall be operated with a continuous forward movement and all operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide a uniform progress with stopping and starting of the paver held to a minimum. Except in an emergency, no tractive force shall be applied to the machine except that which is controlled from the machine.

For hand-formed areas, necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in freshly placed concrete with boots or shoes coated with earth or foreign substances.

The finishing machine, or strike-board, shall be operated with a roll of concrete in front of the cutting edge at all times to fill depressions and leave the top of the slab smooth and even with the desired crown and at the proper elevation. Strike boards used must be straight, free from warp, shod on the striking surface with a strip of steel, shaped to the required crown, and have sufficient weight and rigidity to accomplish the purpose desired.

E. JOINTS. Construct transverse and longitudinal joints, by forming or sawing, to the details, dimensions and spacing shown on the Plans, using approved equipment, in accordance with the requirements of Section 401. Use construction-style joints at any longitudinal joint necessary to facilitate construction staging.

(1) Expansion Joints. Standard transverse expansion joints shall be placed at or near the ends of bridges, unless otherwise specified, and at other points designated on the plans. Special expansion joints shall be placed at all structures projecting through, into, or against the pavement such as drop inlets, junction boxes, etc. Unless otherwise specified, joints at such projecting structures shall be ½ inch in width and shall be filled

with Type 1 joint materials.

(2) Contraction Joints. Transverse contraction joints shall be spaced as noted on the plans. Extend all transverse joints the entire width of paving. When constructing curbs or islands integral with the pavement, construct transverse joints continuous through the curb or median. When pavement abuts existing pavement or curb and gutter, construct transverse joints in the pavement at locations matching transverse joints or cracks in existing pavement, or use an isolation joint to separate the new pavement from the old.

Longitudinal contraction joints shall be used along the centerline of the pavement if both pavement lanes are placed simultaneously and between lanes of multiple lane pavements.

(3) Construction Joints. Transverse construction joints shall be constructed when there is an interruption in the concreting operations of more than 30 minutes. Time may be adjusted, due to weather conditions, as directed by the Engineer. No transverse construction joint shall be constructed within 10 feet of an expansion joint, contraction joint, or place of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding contraction joint shall be removed. No payment will be made for the portion of the pavement which is discarded.

The header may be made of wood or metal and shall have openings for the dowel bars. The header may be of one or two pieces and shall be rigid and accurately set to grade perpendicular to the centerline and the surface of the pavement. In lieu of using a header, the Contractor may make the construction joint by cutting back the hardened concrete by sawing and installing dowel bars according to the provisions of Section 401 "Concrete."

The joint shall be finished with an edger of 1/8 inch radius. When placing the second slab the concrete must not be left overhanging the lip formed in the first slab by the edging tool.

(4) Dowel and Tie Bars. Dowel and tie bars shall be placed as follows, unless otherwise directed by the Engineer:

(a) Dowel bars for transverse contraction joints. Place dowel bars at the location, depth and spacing shown in the plans. Fasten the dowels to rigid baskets or insert them while the concrete is plastic. Align dowels vertically and horizontally within 3 degrees of true alignment in all directions, and provide a minimum embedment length of 6 inches on either side of the joint. Fasten dowel baskets securely to the subbase or subgrade using metal stakes or nails. Use dowels with a factory-applied debonding agent or coat each bar with form-release oil before paving.

(b) Dowel bars for construction joints. Place dowel bars in transverse construction joints at the location, depth and spacing shown on the plans using either of the following methods. Drill holes and epoxy dowels into position in a sawed joint face; or insert dowels with the use of a two-part threaded tiebar and splice coupler system; or insert them through holes in a bulkhead form taking care to maintain proper alignment. Dowels must meet the tolerance specified above for contraction joints. Dowel bars to have form-release oil or factory approved debonding agent for the full length of the bar, unless dowels are inserted after construction of the joint then only the free end of the bar shall be coated.

(c) Dowel bars for expansion joints. When called for in the plans, place dowel bars in transverse expansion joints at the location, depth and spacing shown. Fasten the dowels to an expansion basket that remains in the pavement, provides joint closure space and holds each dowel parallel to the surface and centerline of the slab. Dowels must meet the tolerance specified above for contraction joints. Attach expansion caps to each dowel bar as shown on the plans.

(d) Tie bars for longitudinal joints. Place tie bars reasonably perpendicular to the longitudinal joints with mechanical insertion equipment or by drilling and epoxying without damaging or disrupting the concrete. Do not bend and straighten tie bars into correct position by more than 90 degree. Repair or replace broken or badly damaged tie bars.

F. FINAL FINISHING. Excess water, laitance, or foreign materials brought to the surface during floating operations shall not be reworked into the pavement but shall be removed immediately upon appearance by means of a squeegee or straightedge drawn from the center of the pavement toward either edge.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

After all excess moisture has disappeared, the surface of the concrete shall be given a final finish with a drag or broom. The drag shall consist of a seamless strip of damp burlap, cotton fabric, or artificial turf that will produce a uniform surface of gritty texture after dragging longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge and moved along the surface by mechanical means. The dimension of the drag shall be such that a strip at least 2 feet wide is in contact with the full width of pavement surface while the drag is used. A burlap or fabric drag shall consist of not less than 2 layers with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags furnished.

For broom finish on small sections of pavement, a stiff bristled broom shall be drawn from the center of the edge of the pavement with adjacent strokes slightly overlapping to produce surface corrugations of uniform appearance and approximately 1/16 inch in depth.

After the final finishing, but before the concrete has taken its initial set, the edges of the pavement along each side of the slab, and on each side of transverse expansion joints and formed joints, shall be worked with an approved tool and rounded to a 1/8 inch radius. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during use. At joints, concrete on top of the joint filler shall be completely removed.

G. CURING. Immediately after finishing operations have been completed, and before the set of the concrete has taken place, the entire surface of the newly placed concrete shall be coated and sealed with a uniform layer of membrane curing compound in accordance with Section 401. Curing compound shall not be applied to the inside faces of joints to be sealed.

H. PROTECTION AGAINST RAIN. Contractor shall protect the concrete against rain in accordance with Section 401. In addition, if the slipform method of paving is used, the Contractor shall be required to present an acceptable plan for the emergency protection of the surface and edges prior to the start of concrete placement.

I. SURFACE EVENNESS AND TESTING

(1) Hand Forming Methods. The completed pavement shall be checked with a 10 foot straight edge for smoothness. Areas showing high or low spots of more than 1/8 inch shall be marked and immediately ground down with an approved grinding tool or machine, to an elevation within the1/8 inch tolerance. Where the high or low spot exceeds ½ inch the pavement shall be removed and replaced at the expense of the Contractor.

Any area requiring removal shall be removed back to the surrounding joints.

(2) Slip Form Paver Method. The profile of the finished concrete surface, for each lane of traffic, shall be tested with a California-style profilograph complying with ASTM E 1274. Vehicle mounted laser profilers, similar to the Lightweight Inertial Surface Analyzer (LISA) by Ames Engineering Inc., complying with ASTM E950 and calibrated to the California-style profilograph scale are acceptable testing devices. Profilograph equipment shall be capable of producing reports that displays the filter setting, profile index, profile with out of tolerance bumps and dips shaded and location marked, and a "must-grind" table of bump and dip locations.

The following areas are excluded from the profile requirements:
- sections 25 feet from bridge approaches or an existing pavement.
- sections 25 feet from manholes, drainage structures, and other in-pavement utility castings.
- bridge decks.

Curb inlets are not considered in-pavement utility castings. Excluded areas shall be tested using a 10 foot straightedge to the straightedge requirements below.

The profilograph equipment and straightedge shall be provided by the Contractor. The Contractor will take all profiles required under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer at the end of the day's operation.

For the first day's run, profiles will be taken as soon as the hardness of the concrete is sufficient for proper testing. Should the day's run not meet the profile index required, the paving operations shall be discontinued until better methods and equipment are obtained or until the present equipment is properly adjusted. The second day's run will be profiled again to determine the ability of the equipment to finish the pavement within the specified tolerances. New methods and/or equipment will be given trial runs as indicated above to determine ability to finish the pavement within the specified tolerances.

For the duration of the work every reasonable effort shall be made to test smoothness within 5 working days after each day's run. Scheduling and testing shall be coordinated with the Engineer.

The profilograph equipment shall be operated in the wheel path, a minimum of 3 feet off the edge of the pavement, with one pass per driving or turning lane. The profiles shall begin 25 feet back onto the previous day's run or from the end of the pavement or 25 feet from an existing structure. The California-style profilograph shall be propelled at a speed not to exceed 3 miles per hour. The vehicle-mounted laser profiler shall be run at a constant speed, approximately 8-12 miles per hour, with no stopping during runs.

A profile index shall be calculated from the profilogram for each extent. An extent is defined as the amount of pavement placed by each 528 foot long pass of a paving machine or finisher. When the quantity represented is 0.05 miles (264 linear feet) or less in length, it will be combined with an adjacent extent. When it is over 0.05 miles in length, it will be treated as a separate extent. The index shall be calculated using a computerized profilogram reduction system. The profile index is calculated by summing the vertical deviations outside a 0.2 inch blanking band (0.10 inch above and below) as indicated on the profile trace. The low pass and high pass filters will be set at 2.0 feet and 0.0 feet respectively. The units of this measure (inches) will be converted into inches per 0.1 miles and ultimately into inches per mile.

Bumps or depressions will appear as high or low points on the profile trace and correspond to high or low points on the pavement. Unacceptable bumps or depressions are defined as those with vertical deviations in excess of 0.30 inches (without using a blanking band) in a 25 foot span. The finished pavement surface shall also have a maximum profile index of 10 inches per mile for each 528 foot extent, or portion thereof. All new pavement having profile indices in excess of 10 inches per mile of pavement and all surfaces having bumps with deviations in excess of 0.30 inches in a 25 foot span shall be corrected by grinding or shall be removed and replaced to an elevation that will not show surface deviations in excess of the above requirements.

Straight edge tests shall be performed on cross slopes and at any other location(s) designated by the Engineer. Areas showing high or low spots of more than 1/8 inch with a 10 foot straightedge shall be corrected by grinding or removal and replacement to an elevation where the area or spot will not show surface deviations in excess of the above requirements.

A final profilograph equipment pass shall be made for acceptability in each extent for which corrective action has been taken.

Any area requiring removal shall be removed back to the surrounding joints.

350.05 GRINDING

The grinding equipment used to eliminate vertical differentials in the pavement shall be a power driven, self-propelled machine that is specifically designed to smooth and texture portland cement concrete pavement. The equipment shall be capable of grinding the surface without causing spalls at cracks, joints, or other locations.

The grinding operation shall produce a uniform finished surface that shall transition as required to provide positive drainage and an acceptable riding surface.

The Contractor shall establish positive means for removal of grinding residue from the pavement surface.

350.06 REPAIR OF DEFECTIVE PAVEMENT SLABS

Broken slabs, random cracks, non-working contraction joints, major honey combed areas, and spalls shall be replaced or repaired as directed by, and in accordance with methods approved by, the Engineer, at no cost to the Owner. Slab removal shall be made to the nearest working joint. Patch repairs shall be made in accordance with subsection 401.21 “Defective Work.”

350.07 OPENING PAVEMENT TO TRAFFIC

The Contractor shall prevent local and construction traffic (other than sawing equipment) from using

newly constructed pavement until the concrete is found, by suitable tests of representative cylinders prepared at regular intervals and subjected to the same curing conditions as the pavement, to have reached 85% of the design strength. The pavement shall not be opened to all public traffic until the concrete is found to have reached 100% of the design strength and 7 days has passed, except that the minimum time for opening the pavement to traffic shall be reduced to 24 hours when High Early Strength Concrete is used and the requirements of subsection 350.08 are met.

Before opening the pavement to public traffic, all joints shall be sealed and cured, and the surface of the pavement cleaned of foreign substances.

If the pavement is opened to traffic prior to completion of any needed repairs or grinding, traffic control required to complete these operations will be provided by the Contractor at no cost to the Owner.

350.08 HIGH EARLY STRENGTH CONCRETE PAVEMENT

When High Early Strength Concrete Pavement is specified, or requested by the Contractor and approved, it shall conform with Section 401. If use of High Early Strength Concrete is requested by the Contractor to facilitate his operations, no additional compensation will be paid above the bid price for Portland Cement Concrete Pavement for the use of the high early strength cement.

350.09 TOLERANCE IN PAVEMENT THICKNESS

Before final acceptance of the pavement, its thickness shall be determined by coring at maximum intervals of 1000 feet in each lane and by determining the depth of each core by average measurement. The core locations and intervals will be selected by the Engineer. Two or four inch diameter cores may be drilled for thickness deficiency determination. The Contractor shall repair all core holes at no cost to the Owner.

When any core is more than 5% less than the specified thickness, additional cores will be taken to determine the extent of the thickness deficiency. Cores will be drilled on cross sections of the same slab of the pavement, measured parallel to the centerline, 10 feet back and 10 feet ahead of the station of the original core. If both these cores are within 5% of the specified thickness, no further special cores for this individual zone of deficiency need be made. If either of both of these cores are not within 5% of the specified thickness, additional cores will be taken on cross-sections of the slab in question at 25 feet, 50 feet, 100 feet, and 200 feet ahead and back of the original core, and thereafter at 200 feet intervals until a thickness within the 5% tolerance is found in each direction. No payment will be made for any section of pavement that is more than 5 % deficient in thickness. The length of such section will be the sum of the distances measured in both directions, parallel to the centerline, from the deficient core to the nearest core that shows a thickness not more than 5% deficient. In all cases deductions will be made for the full width of the slab of which the cores are represented (normally two traffic lanes placed simultaneously).

When a deficiency in thickness of any portion of pavement slab in excess of 5% may seriously impair traffic service of the pavement, or if the thickness is 10% or more deficient, the Contractor will be required to remove such deficient slab and replace it with a slab of satisfactory quality and thickness that, when accepted will be included in the measurement for payment. The Contractor shall receive no compensation for any cost incurred in the original placement and subsequent removal of the deficient slab.

In removing pavement that is deficient in thickness, the pavement shall be removed from between longitudinal joints and on each side of any deficient areas until no portion of the exposed section is more than 5% deficient. If there remains less than 10 feet of acceptable pavement between the section that has been removed and a transverse joint, then the Contractor shall remove the pavement to the joint at no cost to the Owner. The joints shall be replaced with a joint of the same design as

the one removed.

No additional payment over the contract unit price will be made for any pavement constructed in excess of the thickness specified.

350.10 ACCEPTANCE OF THE PAVEMENT

Testing will be performed per subsection 401.07 "Quality Control and Quality Assurance Acceptance Testing." If the concrete flexural and/or compressive strengths do not meet the minimum design requirements, the Contractor shall be required to remove and replace the representative pavement sections at Contractor's expense.

350.11 MEASUREMENT AND PAYMENT

Portland Cement Concrete Pavement and High Early Concrete Pavement will be measured by the square yard. The width for measurement will be the width as constructed according to the plans and typical cross sections or as directed by the Engineer.

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard for Portland Cement Concrete Pavement or High Early Strength Concrete Pavement, as the case may be, of the thickness and type specified, which price shall be full compensation for preparing the subgrade or base and shaping the shoulders unless otherwise specified; for furnishing, transporting, and placing materials, including steel bars for joints and all other joint materials; for preparation and processing materials; for mixing, spreading, vibrating, finishing, and curing; for sawing, cleaning, filling, and sealing joints; for furnishing profilograph; for taking all required profiles and performing all necessary computations; for performing any grinding or removals and replacements needed to correct deficiencies; and for all labor, equipment, tools, and incidentals necessary to complete the work; except for adjustments to price for deficient areas as provided for elsewhere in this Section.

Curb constructed integral with pavement will be measured and paid for as specified in Section 410 "Concrete Curb and Gutter" of these specifications unless otherwise specified in the Special Provisions and listed on the bid form.

Payment will be made under:

Pay Item	Pay Unit
P.C. Concrete Pavement (_)" Thickness	SY
Hi-Early Strength Concrete Pavement (_)" Thickness	SY

SECTION 360
COLD MILLING ASPHALT PAVEMENT

360.01 DESCRIPTION

This item shall consist of cold milling the asphalt pavement at the location(s) designated on the plans or by the Engineer and removing the resulting material to a designated location. Unless otherwise provided, the reclaimed pavement shall remain the property of the Owner. The pavement remaining after milling shall provide a surface suitable for maintaining traffic.

360.02 EQUIPMENT

The Contractor shall provide self-propelled equipment with sufficient power, traction, and stability to maintain an accurate depth of cut and slope. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe or from an independent grade control and shall have an automatic system for controlling cross slope at a given rate. The machine shall be equipped with an integral loading means to remove the material being cut from the surface of the roadway and discharge the cuttings into a truck, all in one operation. The milling machine shall have an effective means for preventing dust resulting from the operation from escaping into the air. The machine shall also have a milling width of 6 feet or greater.

360.03 CONSTRUCTION REQUIREMENTS

The existing pavement shall be cold milled to the depth shown on the plans. The number of passes and the depth of each pass required to obtain the total depth to be removed will be determined by the Contractor, unless specified in the plans. The transverse joint left at the end of each day's run shall be tapered to provide a smooth ride. At the end of a day’s run, vertical differentials will only be permitted at the centerline or lane lines. The equipment shall be operated at a rate of travel that will provide a surface meeting the applicable surface requirements.

Unless otherwise designated by the Engineer, the Contractor shall transport all asphalt pavement material removed to the City of Fort Smith Operations Department yard located at 3900 Kelley Highway.

The Contractor shall take precautions to avoid damage to curbs and gutters, utility structures and other appurtenances. Damage to curbs and gutters and exposed structures shall be repaired or replaced by the Contractor at it's expense. Manholes or valve boxes concealed from view which are damaged by the milling operation shall be repaired or replaced by the Contractor in accordance with the requirements of this specification. Damaged manhole frames and covers shall be replaced with new frames and covers installed by grouting to the manhole structure. Damaged valve boxes shall be removed in their entirety and replaced with new boxes and lids.

Cuttings shall be cleaned from all surfaces. Brooming or other methods shall be utilized as required to ensure complete removal of the cuttings.

Unless otherwise specified, the finished surface after milling, when checked with a 10' straight edge placed parallel to the centerline shall show no variation more than 1/4 inch.

Any cold milled asphalt surface shall be overlaid with ACHM binder course or ACHM surface course no more than 7 days after the start of cold milling operations.

360.04 MEASUREMENT AND PAYMENT

Cold Milling Asphalt Pavement will be measured by the square yard of pavement milled to the depth specified. Measurement for area computations will be made horizontally and will be as shown on the plans, unless altered by the Engineer to fit field conditions.

Payment at the contract unit price bid per square yard for Cold Milling Asphalt Pavement shall be full compensation for all work as prescribed herein, including milling, removing and transporting cuttings to the designated locations and for all labor, equipment, tools, and incidentals necessary to complete the work.

No separate payment will be made for cold milling of Portland cement concrete or brick found underneath or protruding through the asphalt pavement to the depth shown on the plans.

No separate payment will be made for repair or replacement of manholes, valve boxes, or other appurtenances which are located and identified in advance of the cold milling operation and which are damaged by the Contractor.

Concealed manholes or valve boxes damaged by the Contractor's operations will be measured by the unit. Payment at the contract unit price shall be full compensation for furnishing and installing manhole frames and covers, valve boxes and lids, and repair of structures and pavements.

Payment will be made under:

Pay Item	Pay Unit
Cold Milling Asphalt Pavement	SY

SECTION 370
PAVEM ENT REPAIRS

370.01 SCOPE OF WORK

This work shall include all pavement repairs specified to prepare existing pavements for subsequent asphalt overlay or other improvements.

370.02 MATERIALS

A. ASPHALT PAVEMENT MATERIALS. Asphalt pavement materials shall conform to Section 330 "Asphalt Concrete Hot-Mix Courses"of these specifications.

B. TACK COAT. Tack coat materials shall conform to Section 320 "Prime and Tack Coat"of these specifications.

C. CONCRETE. Concrete used in deep patch repairs shall conform to Section 311 "Portland Cement Concrete Base" of these specifications.

D. FLOWABLE FILL. Flowable fill materials shall conform to Section 206 "Flowable Fill Materials" of these specifications.

E. JOINT SEALANT. Emulsified asphalt, SS-1, shall be as specified in Section 320 "Prime and Tack Coat" of these specifications. Hot-poured joint sealants for both asphalt concrete and portland cement concrete pavements shall conform to AASHTO M 310 (ASTM D 3405).

F. CRACK REPAIR FABRIC. Fabric shall consist of a flexible high density asphaltic membrane laminated between a nonwoven polyester geotextile and a woven polyester geotextile equal to Pave Prep as manufactured by Contech Products of Memphis, TN.

370.03 CONSTRUCTION METHODS

The limits of the various types of pavement repairs shall be as shown on the plans or as directed by the Engineer.

A. SURFACE PATCH. Surface patch shall consist of removing and replacing the existing asphalt surface course. The existing asphalt surface course shall be removed in square or rectangular sections and shall be removed to the full depth of the surface course. Pavement cuts shall be straight and vertical and shall be cut with a saw or air spade. The area to be patched shall be cleaned, re-compacted to100% as specified in Section 203 "Excavation and Embankment", and a tack or prime coat applied. Asphalt concrete surface course (Type 3) shall be placed in the patch area and shall be compacted by rolling. The finish surface of the patch shall be uniform and shall match the surrounding pavement slope and grade. The density and surface smoothness of the patch shall meet the requirements specified in Section 330 "ACHM Courses."

B. DEEP PATCH. Deep patch shall consist of removing and replacing the entire pavement section, including surface course(s) and base course, to a minimum depth of six (6) inches below the bottom of the proposed pavement, and shall include compaction of the subgrade. Deep patch depths greater than 6 inches may be called for on the plans. The existing pavement within the limits of the patch shall be removed by cold milling as specified in Section 360 "Cold Milling Asphalt Pavement." Small isolated sections of pavement may be removed by other methods with prior approval by the Engineer. Forms shall be used for the placement of deep patch where directed by the Engineer. The patch area shall be cleaned and all existing materials removed unless otherwise directed by the Engineer. The

exposed subgrade shall be compacted by rolling or by other approved equipment and shall be compacted to 100% of Standard Proctor (Method D) as specified in Section 203 "Excavation and Embankment." Where unstable subgrade is encountered, the Contractor shall undercut the subgrade as authorized and directed by the Engineer. Undercut excavation shall be as specified in Section 203.

Replacement of the base shall include furnishing and installing Portland Cement Concrete Base (High Early) to a minimum depth of 6 inches. Replacement depths greater than 6 inches may be called for on the plans. A tack coat shall be applied to the surface of the concrete at a rate of 0.10 to 0.15 gallons per square yard, prior to placement of the asphalt surface. Paving fabric/grid and binder, where called for on the Plans, shall be installed directly on the concrete base surface per the provisions of Section 380 "Fabric Reinforcement for Asphalt Concrete Pavement."

The surface of the deep patch shall be given a "Tined" finish. The deep patch shall be floated, and then a metal tine finishing device shall be used to cut continuous grooves across the surface of the deep patch. The grooves produced shall be transverse to the centerline of the pavement and shall be substantially from 1/8 inch to 3/16 inch in depth and width. The grooves shall be spaced on 1/2 inch to 3/4 inch centers.

Traffic may placed on deep patch areas after the P.C. Concrete Base has reached adequate strength as required in Section 311 "Portland Cement Concrete Base" and prior to placement of the overlay, if ramps constructed of A.C. cold plant mix are installed to provide smooth transitions between patch areas and existing pavement surface.

C. CRACK AND JOINT REPAIR. Crack and joint repair shall consist of cleaning, sealing and filling cracks greater than 1/4 inch wide in the existing asphalt concrete pavement surfacing prior to application of the tack coat and asphalt concrete overlay. Cracks and joints shall be cleaned using compressed air or other approved methods. All soil, vegetation, loose aggregate and debris shall be removed to a minimum depth of two inches. Surface cracks/joints shall be sealed with an emulsified asphalt, sand asphalt hot mix, ACHM surface course (Type 3), or with an hot-poured type joint sealant. Cracks and joints shall be filled flush with the surface of the pavement or if hot-poured joint sealant is used shall be recessed sufficiently to allow for expansion of the sealant during overlay operations. The Contractor is responsible for adjusting their overlay operations and equipment so that bump formation in the final asphalt concrete surface is prevented.

D. FABRIC CRACK REPAIR. Fabric crack repair shall consist of installing a fabric material at designated cracks, joints and distressed areas in the existing pavement surface prior to application of the asphalt concrete overlay. Prior to installation of the fabric, surface cracks/joints 3/4-inch wide or less need not be filled. Surface cracks/joints and distressed areas greater than 3/4-inch but less than 2 inches wide shall be cleaned and filled with an approved crack filler or ACHM compacted to the existing elevation. Cracks/joints and other distressed areas greater than 2 inches wide shall be cleaned and filled with ACHM compacted to the existing elevation. Cracks and/or joints with vertical deformations greater than ½-inch shall be wedged with compacted ACHM to the level of the distressed area. Any loose asphalt particles shall be broomed or blown clean from areas where fabric will be applied.

The existing road surface must be clean and dry prior to installation of the fabric. An asphaltic tack (grade AC-5,-10,-20, or -30) shall be applied at a rate of approximately 0.15 gallons/square yard over existing surfaces and approximately 0.20 gallons/square yard over milled surfaces. The tack coat shall extend a maximum of 1-1/2 inches on both sides of the fabric. Application of tack coat in excess of the recommended rates and/or spray width may cause the fabric to slip or shove during the paving process. The use of emulsified asphalts and/or cutbacks are strictly prohibited for use as a tack coat.

Fabric shall be installed in accordance with the manufacturer's instructions and as directed by the Engineer. The fabric shall be installed only when the surface temperature is a minimum of 50 degrees F and rising. The fabric should be placed at least 24 hours in advance of the paving operations. If application must immediately precede the paving operation, a rubberized asphalt cement may be required as a tack coat to bond the fabric. The fabric shall be rolled after it is placed according to manufacturer's instructions. Traffic may be placed on the fabric as soon as the tack coat has cooled sufficiently to lose its stickiness. Fabric should not be exposed to traffic for more than seven days, unless otherwise authorized by the Engineer.

If the fabric has been exposed to rain prior to placement of the overlay, it must be dry at the time the overlay is placed. A paving tack coat of emulsified asphalt must be used over the fabric prior to paving. Cutback asphalts are prohibited. Hot mix asphalt or dry washed sand can be broadcast ahead of the paver if the fabric is sticking to the tires or trucks and paving equipment. Care must be taken to avoid the use of excessive amplitude during vibratory compaction of the overlay, which may cause humping of the overlay over the fabric. The Contractor is responsible for adjusting their overlay operations and equipment so that bump formation in the final asphalt concrete surface is prevented.

370.04 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section shall be as specified below. Separate payment will be made only for those items listed in the bid form. Payment at the contract unit price for each of these items shall be considered full compensation for all equipment, tools, materials, labor, supplies and incidentals necessary for the completed pavement repairs.

Surface Patch will be measured by the square yard of completed patch. Payment at the contract unit price shall be considered full compensation for cutting and removal of existing pavement; re-compacting base; prime and tack coat; and for furnishing and placing asphalt concrete surface course.

Deep Patch will be measured by the square yard of completed patch. Payment at the contract unit price shall be considered full compensation for cutting and removal of existing pavement and base course; re-compacting base; and for furnishing and placing portland cement concrete base, including all forming, jointing, and finishing work. Undercut excavation will be measured and payment made as specified in Section 203.

Crack and Joint Repair will be measured and paid for according to the number of lineal feet completed. Payment at the contract unit price shall be considered full compensation for cleaning of cracks/joints, and for furnishing and installing all sealant materials.

Fabric Crack Repair will be measured by the square feet of fabric installed. Payment at the contract unit price shall be considered full compensation for cleaning and sealing of cracks/joints; tack coat; and for furnishing and installing fabric.

Payment will be made under:

Pay Item	Pay Unit
Surface Patch	SY
Deep Patch*	SY
Deep Patch ((_)" Thickness)	SY

Crack and Joint Repair	LF
Fabric Crack Repair	SF

*Note: Pay item for 6" thick deep patch only. For all other thicknesses of deep patch, thickness shall be specified as part of "Deep Patch ((_)" Thickness)" pay item.

SECTION 380
FABRIC REINFORCEMENT FOR ASPHALT CONCRETE PAVEMENT

380.01 DESCRIPTION

This work shall consist of furnishing and installing a fabric between pavement layers as a waterproofing and stress relieving membrane for asphalt concrete pavement.

380.02 MATERIALS

A. PAVING FABRIC. Paving fabric shall be an approved paving grade nonwoven material consisting of at least 85 percent polyesters, polyolefins, or polyamides by weight. The paving fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which will adversely alter its physical properties. The fabric shall be specifically designed for pavement applications and be heat bonded only on one side to reduce bleed-through of tack coat during installation. The fabric shall meet the following test requirements.

Property	Requirements	Test Method
Tensile Strength (Grab Method)	80 lbs	ASTM D 4632
Elongation at Break	50% minimum	ASTM D 4632
Asphalt Retention*	0.2 gal/sq yd min.	Texas DOT Item 3099
Melting Point (Fº)	300 minimum	ASTM D 276
Minimum Weight	4 OZ/SY	ASTM D 5261

* Asphalt required to saturate the paving fabric only. Asphalt retention must be provided in manufacturer certification. Value does not indicate the asphalt application rate required for construction.

All numerical values represent minimum average roll value in weaker principal direction. Lot shall be sampled according to ASTM D 4354.

The Contractor shall furnish a manufacturer's certificate of compliance.

The fabric shall be supplied by the manufacturer in rolls of standard widths and lengths uniformly wound onto cylinder forms for dispensing from mechanical lay down equipment. Selected fabric sizes shall provide full coverage of the pavement with a minimal number of splices.

Rolls of fabric shall be furnished with wrapping for protection against sunlight and moisture. When stored outdoors, the rolls shall be elevated and covered with a tarpaulin.

B. TACK COAT. The tack coat used to impregnate the fabric and bond the fabric to the pavement shall be the same grade as the asphalt hot mix and shall conform to Section 320 "Prime and Tack Coat." A cationic or anionic emulsion may be used as approved by the Engineer. The Contractor shall follow the recommendations of the paving fabric manufacturer when an asphalt emulsion is used. The use of cutbacks or emulsions which contain solvents shall not be used.

380.03 CONSTRUCTION REQUIREMENTS

A. SURFACE PREPARATION - The pavement surface shall be thoroughly cleaned of all dirt, water, oil or other foreign matter to the satisfaction of the Engineer. Cracks 1/4 inch wide or

greater shall be cleaned and filled, and other pavement distress repaired, as directed by the Engineer and as specified in Section 370 "Pavement Repairs." Crack filling material shall be allowed to cure prior to paving fabric placement.

B. TACK COAT APPLICATION. The tack coat shall be applied in accordance with the requirements of Section 320 "Prime and Tack Coat" by means of a calibrated distributor spray bar. Hand spraying and brush application may be used in locations of fabric overlap. Every effort should be made to keep hand spraying to a minimum. The rate of application shall be from 0.25 gallons per square yard to 0.35 gallons per square yard or as established by the Engineer. The tack coat application must be sufficient to saturate the fabric and bond the fabric to the existing pavement surface. The distributor shall be started and stopped over paper or roofing felt to provide neat cut-off lines.

The minimum application temperature of the asphalt binder shall not be less than 290 degrees F. The maximum application temperature shall not exceed 325 degrees F to avoid damage to the fabric. For asphalt emulsions, the distributor tank temperatures shall be maintained between 130 degrees F and 160 degrees F.

The width of binder application shall be 2 to 6 inches wider than the fabric width. The tack coat shall be applied only as far in advance of paving fabric installation as is appropriate to ensure a tacky surface at the time of paving fabric placement. Traffic shall not be allowed on the tack coat. Care shall be exercised in the application of the binder to avoid spills or excessive application to cause flushing of the asphalt material.

C. PAVING FABRIC PLACEMENT. The paving fabric shall be placed using mechanical or manual lay-down equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. The fabric shall be placed prior to the tack coat cooling and losing its tackiness. When asphalt emulsions are used, the emulsion shall be allowed to cure properly such that essentially no water moisture remains prior to placing the paving fabric.

The fabric shall be broomed to remove air bubbles and maximize fabric contact with the pavement surface. Wrinkles severe enough to cause folds shall be cut, realigned and jointed as directed by the Engineer. Overlap of fabric at joints shall be sufficient to ensure full closure of the joint but not exceed six inches. Transverse joints shall be shingled in the direction of paving to prevent edge pick-up by the paver. Additional tack coat shall be applied to joints at the rate determined by the Engineer by hand spraying or brushing. The paving fabric shall be imbedded into the tack coat and bonded to the pavement. Self-propelled pneumatic tired rollers shall be used if determined necessary by the Engineer. No paving fabric shall be placed on concrete deep patch.

D. WEATHER LIMITATIONS - Minimum air and pavement temperature shall be at least 50 degrees F and rising for placement of tack coat and at least 60 degrees F and rising for placement of asphalt emulsions. Neither tack coat nor paving fabric shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. In the event of rainfall on the paving fabric prior to the placement of the asphalt overlay, the paving fabric must be allowed to dry completely before asphalt is placed.

E. OVERLAY PLACEMENT. Placement of the asphalt concrete pavement overlay shall immediately follow fabric lay-down unless otherwise permitted by the Engineer. If approved by the Engineer, the paving fabric may be opened to traffic for 24 to 48 hours prior to installing the overlay. Warning signs shall be placed which advise the motorist that the surface may be slippery when wet. The signs shall also post the appropriate safe speed. Excess sand shall be broomed from the surface prior to placing the overlay. If, in the opinion of the Engineer, the fabric surface appears to be dry, and lacks tackiness following exposure to traffic, a light tack coat shall be applied prior to the overlay.

Any damage or debonding of the paving fabric caused by traffic or wet weather conditions due to unnecessary delay or negligence shall be repaired at the Contractor's expense. In the event excess tack coat bleeds through the fabric before the overlay is placed, the excess material shall be blotted by spreading blotter sand on the affected area as directed by the Engineer. The temperature of the paving mix at time of placement shall not exceed 325 degrees F. The turning of pavers or other vehicles should be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires pick up the fabric or the paver cause movement of the fabric during paving operations, asphalt paving mix may be broadcast ahead of trucks and the paver to prevent damage. Any damage to the paving fabric due to equipment shall be repaired and at the Contractor's expense.

380.04 MEASUREMENT AND PAYMENT

Paving Fabric will be measured by the square yard in place according to the dimensions in place with no allowance made for overlapping at the joints.

Tack coat will not be measured or paid for separately but will be considered incidental to the price bid for "Paving Fabric."

The accepted quantity of paving fabric measured will be paid for at the contract unit price per square yard for Paving Fabric. The contract unit price will be full compensation for furnishing and installing all fabric, tack coat, blotter sand, and all other materials, equipment, labor and incidentals to complete the work as specified.

Payment will be made under:

Pay Item	Pay Unit
Paving Fabric	SY

DIVISION 400 - CONCRETE CONSTRUCTION

SECTION 401
CONCRETE GENERAL

401.01 DESCRIPTION

This work shall consist of furnishing all equipment, tools, material, labor and supplies, and of performing all operations necessary to construct the concrete work as shown on the plans and as specified below.

401.02 MATERIALS

The materials used shall comply with the requirements as set out herein. No materials shall be used containing foreign matter, frost, or lumps or crusts of hardened substances.

A. CEMENT. Unless otherwise specified, Portland cement conforming to the requirements of ASTM C150 (AASHTO M 85), Type I, shall be furnished. Type III cement shall be used when so specified or when authorized by the Engineer.

Cement shall be furnished in bulk unless otherwise approved by Engineer for small quantities. The mixing or alternate use of cement from different manufacturing plants will not be permitted. The source of cement shall not be changed without the written approval of the Engineer. The use of cement salvaged from spillage will not be allowed.

B. FINE AGGREGATE. The fine aggregate shall consist of clean, hard, durable particles of natural sand and shall conform to the requirements of ASTM C33.

C. COARSE AGGREGATE. The coarse aggregate shall consist of clean, crushed stone or gravel and shall conform to the requirements of ASTM C33. The gradation and maximum size of the aggregate shall be as follows:

ASTM No. 467 (Max. Size = 1-1/2 inches) shall be used where clearances permit including in walls >8 inches thick and slabs >5 inches thick.

ASTM No. 57 (Max. Size = 1 inch) shall be used when directed by the Engineer or with the approval of the Engineer.

ASTM No. 67 (Max. Size = 3/4 inch) shall be used when minimum clear spacing between individual reinforcing bars is less than 1-1/2 inches.

D. WATER. Water used in mixing or curing shall be clean, potable, from a municipal source and free from injurious amounts of oil, salts, or other deleterious substances and shall not contain more than 1000 ppm of chlorides.

E. ADMIXTURES

(1) General. Admixtures shall be used to improve certain characteristics of the concrete when specified on the plans or may be used when requested by the Contractor and approval is given by the Engineer. The Contractor's request shall be supported with the manufacturer's certified formulation of the proposed admixture and with sufficient evidence that the proposed admixture has given satisfactory results on other similar work. Permission to use the admixture may be withdrawn at any time by the Engineer when satisfactory results are not being obtained. Chlorides shall not be added during the

manufacturing process.

The Contractor shall furnish certified copies of laboratory test reports for each admixture used in the concrete. Before using two (2) or more admixtures simultaneously, the Contractor shall furnish certified copies of laboratory test reports for each combination of admixtures and local materials. If approved, the admixture used shall be furnished at no additional cost to the Owner.

Admixtures shall be added to the mixing water by means of a mechanical dispenser that will accurately meter the additive during the mix water cycle, unless otherwise approved by the Engineer.

(2) Air Entraining Agent. Air entraining agent, when specified, shall comply with the requirements of ASTM C260 (AASHTO M 154) and be approved by the Engineer. Contractor shall furnish certified copies of laboratory test reports for any air-entrained admixtures. It shall be used in strict accordance with the manufacturer's recommendations.

(3) Retarding Agent. In order to permit the retarding of the set and extend the finishing time of the concrete, a retarding agent shall be used when specified on the plans or may be used when permission for its use is requested by the Contractor and approved by the Engineer. The retarding agent shall be a Type B or Type D admixture as defined in ASTM C494 (AASHTO M 194).

When air-entrained concrete is specified, the air-entraining agent and the retarding agent shall be so incorporated that the air content of the concrete shall fall within the percentage range stipulated in these specifications. When air-entraining concrete is not specified, the concrete to which the retarding agent has been added shall have an air content not greater than 3 percent.

(4) Other Admixtures. The use of other admixtures conforming to the requirements of ASTM C 494 (AASHTO M 194) may be used if approved by the Engineer, and if used in strict accordance with manufacturer's recommendations.

F. FLY ASH - for use with Portland cement shall comply with the requirements of ASTM C618 (AASHTO M 295), Class C. Fly ash may be used as a partial replacement for Type I cement, not exceeding, 20% by cementitious weight. Substitution shall be made at the rate of one pound of fly ash for each pound of cement replaced. Mixtures with fly ash shall meet the same requirements as mixtures without fly ash. Fly ash will not be allowed as a substitute for high early strength or blended cements.

G. REINFORCING STEEL. Reinforcing steel for concrete shall be deformed, clean, free from rust and new. Reinforcing steel shall conform to ASTM A 615 (AASHTO M 31) and shall be Grade 60 for bars No. 4 and larger and Grade 40 for No. 3 bars.

H. DOWEL AND TIE BARS. Smooth dowel bars shall be new, clean, free from rust, and free from burrs or other deformations restricting slippage in the concrete. Dowel bars shall conform to the requirements of ASTM A615 (AASTHO M 31), Grade 60. Before delivery to the jobsite, the full length of each dowel bar shall be painted with a film of epoxy, plastic, epoxy paint, zinc chromate primer, zinc strontium phospho-silicate primer, or tar paint. When bar coatings are found to be damaged prior to or during installation, such bars shall be replaced.

Tie bars shall be new, clean, free from rust, and shall conform to the requirements of ASTM A615 (AASHTO M31) Grade 60. Tie bars that are bent and later straightened to facilitate

construction shall comply with ASTM A615 (AASHTO M 31), Grade 40.

I. WIRE FABRIC. Wire fabric shall be electrically-welded wire fabric of cold-drawn wire (70,000 psi yield point) of the diameter and spacing required and shall conform to ASTM A185 (AASHTO M 55).

J. FIBER REINFORCEMENT. Fiber reinforcement shall be used in all concrete aprons, swales, curb and gutter, driveways, sidewalks, slope paving and un-reinforced channel or ditch paving.

Fiber reinforcement shall be virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials. Fibers shall be manufactured specifically for Portland cement concrete secondary reinforcement. Fiber reinforcement shall be similar and equal to Fibermesh InForce manufactured by Fibermesh Company.

A minimum of 1½ pounds of fiber reinforcement per cubic yard of concrete shall be used.

K. GROUT. Grout shall be a mixture of one (1) part Portland Cement to two(2) parts of sand plus the required water for proper flow. A bonding agent shall be used in the mortar or concrete mix for patching new concretes and for finishing vertical exposed surfaces. This bonding agent shall be "Acryl 60" by Thoro or approved equal.

L. JOINT MATERIALS

(1) Type 1 - Materials for slab expansion joints shall be as shown on the plans and shall be a preformed filler of the non-extruding and resilient type conforming to ASTM D1751 (AASHTO M 213) bituminous, or ASTM D1752 (AASHTO M153) Type 1(sponge rubber). Unless otherwise indicated within the specifications or on the plans, the joint filler shall have a thickness of ½ inch.

(2) Type 2 - Materials for filling and sealing longitudinal, warping, contraction, and other specified joints shall be as shown on the plans and shall be cold-poured single-component silicone, self-leveling Dow 890 SL by Dow Corning or approved equal. Dow 888 by Dow Corning may be used on slopes greater than 12%.

(3) Backer rod filler shall be of polyurethane or cross-linked polyethylene foam material approximately 1/8 inch larger in diameter than the width of the joint to be sealed.

All components of the joint sealant system, including the backer rod, shall be compatible. No bond shall occur between the backup material and the sealant system for Type 2 joint sealer.

M. CURING MATERIALS. Curing materials shall be one of the following types:

(1) Membrane curing compound complying with ASTM C 309 (AASHTO M 148). Type 1 shall be used for interior floor slabs. Type 2, white pigmented, shall be used for exterior slabs, sidewalks, curbs and pavements.

(2) Polyethylene-burlap mats complying with ASTM C17 (AASHTO M 171). Polyethylene-burlap mats shall consist of one 9 oz. per squarer yard thickness of burlap, impregnated on one side with one opaque 4 mil thickness of polyethylene, and free from visible defects.

(3) White polyethylene sheeting complying with ASTM C171 (AASHTO M 171) shall be 4 mil thickness, uniform in appearance, and free from visible defects.

401.03 SUBMITTALS

The following are required to be submitted to the Engineer for approval for each project at the Pre-Construction Conference:

A. CONCRETE MIX DESIGNS. One copy of the mix design for each proposed class of concrete, including test results for new mix designs or material certifications for previously accepted mix designs, shall be submitted to the Engineer for review and approval.

B. JOINT MATERIAL. For Type 2 joints, the Contractor shall submit a copy of the proposed sealant manufacturer data sheets and the recommended application procedure.

C. CURING. Contractor shall submit a copy of the proposed curing methods and manufacturer's product data sheet.

401.04 CLASSIFICATION

Concrete shall be classified as provided for below. The strengths for each classification of concrete shall be the minimum 28 days compressive strength for that class of concrete.

Class of Concrete					
Characteristic	**"AAA"**	**"AA"**	**"A"**	**"B"**	**"P"**
Minimum Compressive Strength (psi at 28 days)	4,000	3,500	3,000	2,500	4,000
Minimum Cement Factor (lbs per cubic yard)	611	585	540	495	564
Maximum Water/Cement Ratio (lb/lb)	0.44	0.49	0.49	0.58	0.45
Slump Range (inches)*	1"-4"	1"-4"	1"-4"	1"-4"	Max 2" slipform Max 4.5" handform

* When using admixtures to increase slump, concrete shall have a slump of 4 inches +/- 1 inch before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

The total air content of the concrete shall be within the following limits based upon measurements made on the concrete immediately after discharge from the mixer in accordance with ASTM C231:

Max. Size of Coarse Aggregate	Air Content
1-1/2"	4.0% to 7.0 %
1"	4.5% to 7.5%
3/4"	4.5% to 7.5%

The following general requirements shall govern unless otherwise shown on the plans or Standard Details, listed specifically otherwise in the individual specification sections, or revised in the Supplemental Specifications or in the Special Conditions:

Class "AAA" concrete shall be used in drainage facilities, retaining walls, signal pole foundations, bridge footings, piers, bents, columns, abutments, and superstructures, including girders, beams, floor slabs, and parapet walls.

Class "AA" concrete shall be used in sidewalks, curbs and gutters, driveways, pavement aprons and swales, deep patch, Portland cement concrete base, and controller cabinet foundations. Concrete for deep patch shall be high-early strength.

Class "A" concrete shall be used in sewer vaults, sewer manholes and structures, and as specified in miscellaneous construction.

Class "B" concrete shall be used in sewer and water line blockings and encasement.

Class "P" concrete shall be used in Portland cement concrete pavement.

401.05 HIGH EARLY STRENGTH CONCRETE

When High Early Strength Concrete is specified, or requested by the Contractor and approved, it shall be made with the use of high early strength cement complying with ASTM C150 (AASHTO M 85), Type III cement. Upon written approval of the Engineer, the Contractor may substitute Type I cement with a cement factor of 25% in excess of that specified for the Type III cement or Type I cement combined with approved admixtures.

If use of High Early Strength Concrete is requested by the Contractor to facilitate his operations, no additional compensation will be allowed above the price bid for use of Type III cement, the additional 25% of Type I cement or admixtures.

401.06 MIX DESIGN

The mix design shall include copies of test reports, including test dates, and a complete list of materials, including type, brand, source and amount used.

The laboratory used to develop the mix design shall meet the requirements of ASTM C1077. A certification that it meets these requirements shall be submitted to the Engineer prior to start of the mix design and contain as a minimum:

A. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

B. A statement that the equipment used in developing the mix design is in calibrations.

C. A statement that each test specified in developing the mix design is offered in the scope of the laboratory's services.

D. A copy of the laboratory's quality control system.

All concrete shall be designed to provide a 28-day strength according to the class of concrete which is stated elsewhere within these specifications or on the plans. The concrete shall be composed of Portland cement, fly ash, water, air entraining agent, fine aggregate, and coarse aggregate of the gradation, quality and proportions specified in subsection 401.02.

The water/cement ratio shall include free moisture content of the aggregate. When fly ash is used as a partial replacement for cement, the total weight of both cement and fly ash shall be used to determine the water/cement ratio.

Fine and coarse aggregates shall be added only in such proportion that satisfactory plasticity,

workability, and consistency of the mix are maintained.

The proportions to be used in the mix shall be determined by the Contractor using the absolute volume method. The Contractor may use the procedure provided in the ACI Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete", modified to comply with the maximum water/cement ration specified. The documentation submitted with the mix design shall specify which procedure was used and whether oven dry or saturated dry weights were used in calculations. The mix design shall specify the quantity of each component of the mix, including all authorized additives.

The mix design strength shall be verified by a minimum of six (6) test cylinders, the results of which shall accompany the mix design data submitted. One of the six (6) cylinders shall be tested at three days, two at 7 seven days and three at 28 days. Acceptance of the mix design by the Engineer will be based on apparent conformity to the requirements shown in subsection 401.04 "Classification."

A mix design submitted for acceptance need not be specifically for a project, but may be a previously accepted design that uses the same materials and meets the same design criteria. A certification that all materials used in the mix meets the specification requirements may be substituted for test results in previously accepted mix design submittals.

It shall remain the Contractor's responsibility during the project to produce or supply concrete conforming to the mix design and the minimum acceptance criteria specified. If the mix design fails to produce acceptable results or if there is a change in aggregates, fly ash, or cement being used, a new mix design will be required.

401.07 QUALITY CONTROL AND QUALITY ASSURANCE ACCEPTANCE TESTING

A. QUALITY CONTROL BY THE CONTRACTOR. The Contractor is responsible for product quality control during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce an acceptable mix. The Contractor, and/or his supplier, shall perform all applicable quality control sampling and testing, per the test methods below, required to ensure that the completed concrete complies with all requirements of the specifications.

Property	**Test Methods**
Coarse and Fine Aggregate	ASTM C 136 (AASHTO T 27) gradation
	ASTM C 566 (AASHTO T 255) moisture
Air Content	ASTM C 231 (AASHTO T 152)
Slump	ASTM C 143 (AASHTO T 119)
Compressive Strength	ASTM C 39 (AASHTO T 97)

Tests specimens for compressive strength determined by cylinders will be obtained according to ASTM C31 (AASHTO T23). Tests specimens for compressive strength determined by cores will be obtained according to ASTMC 42 (AASHTO T24).

The Owner may, at his option, have an inspector present at the concrete batch plant at any and all times concrete is being batched for this project. Such testing and inspection shall not relieve Contractor of his obligation to furnish materials meeting the requirements of this specification.

B. QUALITY ASSURANCE TESTING AND ACCEPTANCE. The Owner will provide for Quality Assurance tests for the purposes of determining acceptance of the concrete and materials.

At least four (4) test cylinders shall be made and tested for Quality Assurance purposes from each lot (100 cubic yards) of concrete or 1,000 linear feet of curb and/or gutter placed, or fraction thereof placed each day, unless otherwise stated in the Specifications or permitted by the Engineer. There shall be at least one strength test made each day that concrete is placed, regardless of the volume placed. Slump and temperature tests shall also be taken for each lot of concrete placed.

The average breaking strength of two cylinders from each lot tested at 28-days shall equal or exceed the minimum required 28 day strength specified. One of the additional cylinders from each lot will be tested at 7 days with the other held in reserve or tested as directed by the Engineer.

In the event that a concrete cylinder strength does not meet the minimum requirements, the Contractor shall pay for additional testing as specified herein and as directed by the Engineer. Concrete cores shall be taken from the portion of the structure represented by the low strength cylinders. Three cores shall be tested and evaluated for each strength test not meeting the previously stated requirements.

Any lot or section of concrete that does not meet the strength requirements, air content requirements, or other requirements of the specifications herein shall be removed and replaced by the Contractor at no cost to the Owner. Payment for concrete where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed.

401.08 STORAGE OF MATERIALS

Cement shall be stored in weather-tight building, bins, or silos which provide protection from dampness and contamination and will minimize warehouse set. Any cement damaged by moisture or which fails to meet any specified requirements shall be rejected and removed from the work. Aggregate stockpiles shall be arranged and used in a manner to avoid segregation or contamination with other materials or with other sizes of like aggregates. Frozen or partially frozen aggregates shall not be used.

Sand shall be allowed to drain until it has reached a uniform moisture content before it is used.

Any material which has deteriorated, been contaminated with deleterious or foreign material, or which has otherwise been damaged, shall not be used for concrete.

401.09 BATCHING AND MIXING

A. GENERAL. Ready-mix concrete shall be produced from batch plants that are on the current ArDOT Quality Products List and shall have an up-to-date ArDOT inspection decal, except as allowed herein. If a temporary on-site batch plant is proposed for use on a specific project, in lieu of the ArDOT inspection decal, the temporary batch plant shall have a certificate of inspection by the Arkansas Bureau of Standards which shall be updated after each scale move or if the accuracy of the scales is questionable as determined by the Engineer. All test data submitted in support of mix designs to be provided by the temporary on-site batch plant shall be produced from the temporary on-site batch plant after the date of the latest scale certification. All other requirements of batch plants as listed herein shall apply for temporary on-site batch plants.

Batch plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocking proportioning devices of approved type.

Measuring devices shall be operated in a manner that will consistently allow the exact weight of cement within +/- 1%, individual aggregates within +/- 2%, and total weight of aggregate within +/- 2% of the required weight. Measuring devices shall be so designed and plainly marked that the weights can be accurately and conveniently verified for the quantities of each component actually being used.

The moisture content of the sand shall be checked and recorded periodically and the mixing water quantity adjusted to keep the concrete consistency reasonably constant.

The batching plant shall be equipped with an automatic weighing system, including an automatic ticket printer, as described in subsection 109.02(e) "Measurement of Quantities." A load ticket shall accompany each load delivered to the project and shall be furnished to the Engineer at the time of delivery. The load ticket shall show the following information:

(1) Unique ticket number.
(2) Identification of the truck.
(3) Date and time of batching.
(4) Class or designation of concrete
(5) Total weights and/or volumes of each component.
(6) Total volume of mix.
(7) Total quantity of water or admixtures added after batching.
(8) Time of discharge.

Batch plants shall have sufficient capacity and transportation apparatus to insure continuous delivery at the rate required for the proper handling and placing of concrete.

For small placements (approximately 1 cubic yard or less), the concrete may be mixed onsite using a portable mixer. The size of each batch shall not exceed 80% of the manufacturer's rated capacity of the mixer. When mixing on site, and with prior approval of the Engineer, the materials for each batch may be measured by volume converting the mix design weights of each material to equivalent volumes. Concrete shall be placed within one hour after the introduction of the water to the cement and aggregates.

B. AGGREGATES. Aggregates shall be measured separately and accurately by weight. The batch plant shall include batcher bins, of either the stationary or mobile type, with adequate separate compartments for fine aggregate, each compartment designed to discharge efficiently and freely into the weighing hopper or hoppers. Means of control shall be provided in each case so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly in small quantities and shut off with precision. Means of removing any overload of any one of the several materials shall be provided.

In the type where more than one aggregate is weighed into one hopper, each aggregate shall be held in a separate compartment, so arranged that an overload of any aggregate can be removed. Hoppers shall be constructed so as to eliminate accumulations of tare materials and to fully discharge without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent mixing of adjacent materials under any working conditions. Batch plant structures shall be maintained properly leveled within the accuracy required by the design of the weighing mechanism.

The scales for weighing aggregates and cement may be the horizontal beam, the springless

dial, or the electronic type, designed as an integral unit of the batch plant, of rugged construction to withstand hard usage due to working conditions, and shall have a maximum allowable error of ±½% of one net load. When beam-type scales are used, provisions such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached, which device shall indicate at least the last 200 pounds of load. A device on weighing beams shall indicate critical position clearly. Poises shall be designed for locking in any position and to prevent unauthorized removal. The weigh beam and the "tell-tale" device shall be in full view of the operator while charging the hopper. The operator shall have convenient access to all controls.

Clearance between scale parts, hoppers, and bin structures shall be such as to avoid displacement of, or friction between, parts due to accumulations, vibration, or other causes. Pivot mountings shall be designed so none of the parts will jar loose and so as to assure unchanging spacing of knife edges. Scales shall be so designed that all exposed fulcrums, clevises, and similar working parts may readily be kept clean. Scales shall be constructed of non-corrosive materials, excluding material softer than brass. Weight beams shall have leveling lugs, and weighing parts of other types shall be provided with means for precision adjustment. Scales shall be satisfactory to the Engineer and shall be inspected, adjusted, and certified according to subsection 109.02(e) "Measurement of Quantities."

C. CEMENT. Cement shall be proportioned on the basis of 94 pounds per cubic foot and shall be measured by weight on scales as specified above.

Pneumatic charging of the weigh hopper shall be so arranged that the measurement will not be affected by air pressure in the supply line.

D. WATER. The mixer shall be equipped with an automatic water measuring device that shall be within a range of error not to exceed ±1% and shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be accurate under all construction conditions encountered. Water may be measured either by volume or by weight.

E. ADMIXTURES. The mixer shall be equipped with an approved automatic dispenser for adding to the mixing water the desired amount of admixtures within +/- 3% of the required volume or weight. The dispenser shall be constructed and connected so that the amount of admixture entering into the mixing water can be visually determined.

401.10 FORMS

The design and construction of the formwork shall be the responsibility of the Contractor.

Forms shall be mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed. Forms for concrete which is to be left exposed shall be made of dressed lumber or plywood of uniform thickness, steel, or other approved materials that will provide a smooth surface, except where special form liners or other special finish is specified. Joints in form boards for exposed areas shall be arranged to produce a uniform pattern with a minimum of joints.

Form accessories to be partially or wholly embedded in the concrete, such as ties and hangars, shall be commercially manufactured type. Non-fabricated wire is not acceptable. The portion remaining

within the concrete shall leave no metal within one inch of the surface of the concrete. Fittings for metal snap-ties shall be of such design that, upon removal, the cavities that are left will be of the smallest possible size.

Before each use, forms shall be cleaned before being set to line and grade and shall be treated with form oil prior to placing reinforcing steel in the vicinity of the forms. Materials or methods used in oiling the forms shall not result in the discoloration of the concrete or inhibit the bond of any applied finishes.

When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Contractor shall stop the work, at the direction of the Engineer, until the defects have been corrected.

Removal of forms shall be done in a manner which will assure complete safety of the structure and concrete. Except for portions of structures supported on shores, the removal of wall forms, slab edge forms and similar vertical forms may be commenced after 24 hours provided the concrete is sufficiently hard and will not be injured. In no case shall the supporting forms and shoring be removed from beneath beams or slabs until the representative concrete cylinder tests indicate that the concrete has attained the minimum 28-day design strength or better and not sooner than 7 days after the concrete is placed, except by permission of the Engineer.

401.11 REINFORCEMENT

The fabrication of all reinforcement shall be in accordance with ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Bar reinforcement shall be bent to the shapes shown on the plans. Bars shall be bent cold. No bars partially embedded in concrete shall be field bent, except as shown on the plans or specifically permitted by the Engineer. Shop drawings and bending details shall be supplied by the Contractor when requested by the Engineer.

Steel reinforcement shall be protected from damage. When placed in the work, it shall be free from dirt, detrimental rust or scale, paint, oil, or other foreign substance.

All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position so that it will not be subject to displacement during concrete operations. Bars shall be tied at all intersections except where spacing is less than 12 inches in each direction, in which case alternate intersections shall be tied.

Bar positions or clearances from the forms shall be maintained by means of stays, ties, hangers, or other approved devices. Reinforcing shall not be welded unless detailed on the plans or authorized in writing by the Engineer. Metal bar supports that are in contact with the exterior surface of the concrete shall have protection conforming with the CRSI Specifications, Class 1 for Plastic Protected Bar Supports or Class 2 for Stainless Steel Bar Supports, with the further provision that the plastic protection may be either applied by a dipping operation or by the addition of premolded plastic tips to the legs of the supports. All high chairs and bar bolsters shall be metal. Plastic bar supports shall not be used.

When concrete is to rest on an excavated surface, layers of bars shall be supported above the surface by metal chairs or by precast mortar or concrete blocks. The use of rocks, pieces of stone or brick, pipe, wooden blocks, or chunks of concrete will not be permitted as bar supports or spacers.

Reinforcement shall be placed by the Contractor and inspected and approved by the Engineer before placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required.

If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being

placed. Fabric shall be lapped not less than 6 inches on all sides.

401.12 EMBEDDED ITEMS

Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place as indicated. All such items shall be clean and free from coatings, rust, scale, oil, or any foreign matter. The embedding of wood shall be avoided. During concreting operations, the concrete shall be spaded and consolidated around and against embedded items.

401.13 HANDLING AND PLACING CONCRETE

Before any concrete is placed, the reinforcing steel, forms, and subgrade shall be thoroughly cleaned of hardened concrete, rust, chips, sawdust, mud, dried porous earth or other foreign materials. The subgrade or base course shall be moistened immediately before placing concrete. Moistening shall not be excessive to the point of forming mud or pools. The subgrade, forms and reinforcing steel shall be free of ice or frost and free of water. Concrete shall not be placed until the approval of the subgrade, forms, reinforcing steel and other related conditions has been given by the Engineer. Concrete shall not be placed in water except with the approval of the Engineer. The Contractor shall furnish the Engineer with a minimum of 24 hours notice of his intention to place concrete.

Concrete shall be delivered and discharged from the truck mixer or agitator into the paver or forms within the time limits below:

A. Air temperature 45 degrees F to 80 degrees F - 90 minutes maximum.
B. Air temperature over 80 degrees F, with a retarder added to the mix - 90 minutes maximum.
C. Air temperature over 80 degrees F, without a retarder added to the mix - 60 minutes maximum.

Concrete delivered from a non-agitating truck shall be discharged from the truck into the paver or forms within a maximum of 45 minutes after mixing. With the approval of the Engineer, the haul time may be increased to that which will not result in undue loss of slump or separation of the mixture. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete at the point of discharge is 85 degrees F or above, the time between mixing and discharge should not exceed 30 minutes.

The temperature of the concrete when placed shall not exceed 90 degrees F.

Contractor shall coordinate the delivery of concrete to permit continuous placing, with no concrete achieving initial set before placing adjacent concrete. Unless otherwise specified, concrete shall be placed continuously between authorized construction and/or expansion joints.

The concrete shall be placed as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. When placing operations involve dropping the concrete more than 5 feet, it shall be deposited through approved tremie or pipes.

Concrete placed in walls shall be placed in horizontal layers not more than 18 inches in height. Each layer shall be placed and consolidated before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be consolidated so as to avoid the formation of a construction joint with a preceding layer that has not taken initial set.

No concrete will be deposited without vibration. Vibrating shall not be continued in any one spot to the extent that pools of grout are formed. Mechanical vibrators shall have a minimum frequency of 7000 revolutions per minute while operating in concrete and shall be operated by competent workmen. Over-vibrating and the use of vibrators to transport concrete within the forms shall not

be allowed. Vibrators shall be manipulated to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms. Vibrators shall not come into contact with, or displace, the side forms, reinforcing or embedded items. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. Vibration shall be supplemented by such spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators. A spare vibrator shall be kept on the job site during all concrete placing operations.

401.14 PUMPING

Concrete may be placed by pumping. The equipment for pumping shall be arranged and operated so that no vibrations result that might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipe, if it is used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

Samples of concrete for slump and air content tests will be obtained at the discharge end of the pipe. The use of aluminum pipe as a conveyance for the concrete will not be permitted.

401.15 JOINTS

Joints shall be at the locations and of the type shown on the plans unless otherwise approved by the Engineer. Joints not shown on the drawings shall be made and located so as to least impair the strength of the structure and shall be approved by the Engineer.

If not detailed on the plans, or in case of emergency, construction joints shall be placed as directed by the Engineer. Longitudinal keys not less than 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings. All reinforcing steel shall be continued across joints, unless otherwise noted on plans.

All joints shall be constructed so that the plane of the finished joint is perpendicular to the surface of the pavement or slab and shall be uniform and not deviate more than 1/2 inch from the planned alignment within any 24 foot segment. In addition, all transverse joints shall be perpendicular to the centerline of the pavement or slab.

Dowels shall be provided at joints as shown on the plans or as directed by the Engineer. Drills used to make holes shall be held in a rigid frame to assure proper horizontal and vertical alignment. The equipment shall be operated so as to prevent damage to the concrete being drilled. When using epoxy or polyester resin system, the bars shall be installed according to information provided by the manufacturer. To secure the bars, special care must be taken to ensure that the filling system completely surrounds the bars and fills the holes.

Expansion joint filler shall be continuous from form to form, shaped to the subgrade, curb section, and to any keyway along the form. Preformed joint filler shall be furnished in lengths equal to the slab width or equal to the width of one lane of concrete pavement. Expansion joint material shall be placed the full depth of the slab, except that the top of the joint material shall be recessed 1/4 inch below the top surface of the slab. Damaged or repaired joint filler shall not be used unless approved by the Engineer.

The expansion joint filler or template shall be securely staked or fastened in place before placing concrete and in a manner to ensure the joint and dowel bars will remain in their proper position after

finishing operations have been completed. An approved installing bar or other device shall be used if necessary to ensure proper grade and alignment during placing and finishing of concrete. If joint fillers are assembled in sections, there shall be no offset between adjacent units.

Expansion and construction joints in slabs shall be constructed so as to allow the normal finishing operations to be executed and completed over the joint. After the final finish, but before the concrete has taken its initial set, the edges of the slab and on each side of expansion and construction joints shall be worked with approved tools and rounded to a 1/4 inch radius. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by the tilting of the tool during use. Tool marks shall be eliminated by brooming and refinishing the surface. The rounding of the corner of the slab shall be not disturbed in the refinishing operation. All concrete shall be completely removed from the top of the joint filler at expansion joints.

Sawed joints shall be formed by cutting the groove in the hardened concrete with an appropriate concrete saw capable of cutting the joint to the specified dimensions and true to the line within the allowable variation. Joints shall be sawed as soon as the concrete has hardened to the extent that it is strong enough to support the sawing equipment and that tearing and raveling will not occur, but before development of any random cracking. Initial sawing of all joints shall be completed within 12 hours of concrete placement with transverse joints being sawed prior to longitudinal. Second sawing for joint reservoir, where called for, can be accomplished anytime thereafter. Sufficient saws, and saw blades to accomplish the work shall be available at all times, including a standby saw. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. Should any procedure result in premature and uncontrolled cracking, the Contractor shall immediately revise the method and/or sequence of cutting the joints. Any curing media removed during sawing shall be immediately replaced.

Within 15 minutes after sawing, the joints shall be flushed with water under sufficient pressure to remove all slurry and residue left by the sawing operation. When sealing of the joint is required, just before sealer placement and when the joints are thoroughly dry, both vertical faces shall be thoroughly cleaned by sandblasting with a nozzle attached to an aiming device that directs the sand blast at approximately a 45 degree angle and a maximum of 2 inches from the face of the joint. Jet water-blasting may be used in lieu of sandblasting. The jet water-blast machine shall be capable of discharging water at a rate of 8,500 to 10,000 psi pressure and 20 to 22 gal/min. Each joint face shall be sand- or water-blasted individually. After blasting, the joints shall be blown out with compressed air that has been filtered and is completely free of oil and moisture. The joints shall be thoroughly dry before sealer is placed.

Joints shall not be filled and sealed for a minimum of 7 days following placement of the concrete, except that when high early strength concrete is used the period may be reduced to 18 hours. All recommendations of the joint sealer manufacturer shall be followed. Unless allowed otherwise by the joint manufacturer, joint sealant installation shall be accomplished only when the temperature at the concrete surface is between 40 degree F and 90 degree F. All joints shall be filled and sealed the same day of the final sandblasting. Cleaned joints left open overnight shall be re-cleaned by sandblasting before filling and sealing. In the event freshly cleaned joints become contaminated before they are sealed, they shall be re-cleaned as specified above.

Backer material shall be installed in a manner that will result in the planned depth and shape for the sealant. If primer is required, the primer shall be applied before installing the backer material.

Joint sealer shall be applied by an approved mechanical device from the inside of the joint in a manner that causes it to wet the joint surfaces. Joints shall be slightly underfilled, 3/8 inch below the top surface, to prevent extrusion of the sealer. Joint sealer application will not be permitted when the concrete surface temperature at the joint is less than the application temperature specified by the manufacturer. The joint filling shall be done without spilling material on exposed surfaces

of the concrete. Any excess material on the surface of the concrete shall be removed immediately and the concrete surface cleaned. The use of sand or similar material to cover the seal shall not be permitted.

Failure of the joint material in either adhesion or cohesion will be cause for rejection. Removal, re-cleaning, and replacement of the failed material shall be at no cost to the Owner.

401.16 HOT WEATHER CONCRETING

When the air temperature is above 80 degrees F or forecasted to rise above this temperature within 24 hours after placement of the concrete, the following shall apply:

Mixing water shall be kept cool and storage tanks and supply lines shall be shaded or adequately insulated. The use of crushed ice as part of the mixing water will be allowed up a maximum of 75% of the batch water requirement. Coarse aggregate stockpiles shall be saturated and the surfaces kept moist by intermittent sprinkling or fog spraying. Cooling by watering of fine aggregates will not be allowed.

The amount of mixing and agitating at the plant and within the truck should be held to the minimum practicable. It is recommended that the number of revolutions not exceed 125.

When approved in writing by the Engineer, a water reducing and retarding admixture or a high range water reducer (super-plasticizer) may be used.

During windy conditions, a fog spray of water shall be used to cool the air over the placed concrete before and after finishing operations to prevent plastic shrinkage cracking and cold joints. The use of Master Builders "Confilm" as an alternative to fog spray is allowed for protecting the slab prior to cure.

The time for completion of initial sawing of all joints shall be reduced such that all joints are completed within 4 hours of concrete placement during hot weather conditions.

401.17 COLD WEATHER CONCRETING

This section shall apply to all concrete work done when the air temperature is below 40 degrees F or forecasted to drop below this temperature within 24 hours after placement of the concrete.

Portland cement concrete pavement placement shall commencement only when the temperature is 35 degrees and rising and shall be suspended when temperature is 40 degrees and falling.

Plans to protect fresh concrete from freezing and to maintain temperatures above the designated minimums for the required time after placing, shall be made in advance of expected low temperatures and reported to the Engineer. The work shall be done entirely at the Contractor's risk.

Before placing concrete during cold weather the forms, embeds and reinforcing shall be free of snow, frost and ice. The subgrade shall not be frozen at time of placement. All surfaces which are to be in contact with the newly-placed concrete shall be at a minimum temperature of 35 degrees F to prevent early freezing of the concrete or seriously prolonging its hardening.

The minimum concrete temperature during placement shall be 55 degrees F. This minimum concrete temperature prior to placement may be attained by heating the mixing water, by heating the aggregates, or by a combination of these two items. Mixing water shall be heated to a maximum temperature of 150 degrees F, and shall be combined with the aggregate before the addition of cement.

Heat of hydration shall be retained in the concrete by the use of insulated forms and insulating blankets. The concrete shall be maintained at a temperature of not less than 55 degrees F., measured at the concrete surface, for a minimum of 3 days. For bridges, box culverts, retaining walls and other load bearing structures the minimum time shall be increased to 6 days. All concrete damaged by frost action shall be removed and replaced at the Contractor's expense.

Type III cement, additional Type I cement, or water reducing accelerators conforming to ASTM C 494 Type E may be used with the written permission of the Engineer in order to reduce the length of protection time.

401.18 CURING CONCRETE

Membrane curing compound shall be used on all exposed concrete unless one of the other curing materials listed in subsection 401.02(m) is approved by the Engineer. The exposed concrete, immediately after finishing, shall be covered with curing materials and kept continuously and thoroughly wet for a period of not less than 7 days after the concrete is placed. Membrane curing does not require the application of additional moisture.

When wood or steel forms are used and left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the 7-day curing period, the concrete shall then be sprayed with a curing compound as specified for exposed surfaces immediately after the forms are removed and necessary finishing has been done.

Exposed surfaces of concrete shall be cured using the approved curing compound except where special finishes require the use of other curing methods. Curing compounds shall be applied, immediately after the free water has left the surface, with approved spraying equipment so as to result in a uniform coverage at the rate of 1 gallon per 125 square feet of area. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At time of the use, the compound shall be in a thoroughly mixed condition with the pigment or dye uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. The curing compound shall not be applied during rainfall and shall be applied in accordance with the manufacturer's recommendations.

The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Should the film become damaged from any cause during the required curing period, the damaged portions shall be repaired immediately with additional compound.

401.19 PROTECTION AGAINST RAIN

In order that the concrete may be properly protected against the effects of rain before becoming sufficiently hardened, the Contractor shall have available at all times materials satisfactory for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of burlap or cotton mats, curing paper or plastic sheeting material. When rain appears imminent, all concrete operations shall stop and all personnel shall take the necessary steps for complete protection of the unhardened concrete. Areas of concrete surface where the texture has been damaged by rain or by the protective cover, shall be repaired and retextured, or removed, as directed by the Engineer's.

401.20 FINISHING CONCRETE SURFACES

A. GENERAL. Surface finishes shall be classified as follows:
   Class 1. Ordinary Surface Finish.
   Class 2. Rubbed Finish.
   Class 3. Textured Coating Finish

Class 4. Exposed Aggregate Finish.
Class 5. Hard Troweled Finish.
Class 6. Broomed Finish.
Class 7. P.C. Concrete Pavement Finish

All concrete shall be given a Class 1, Ordinary Surface Finish. In addition, if further finishing is required, such other types of finish will be as specified herein.

All surfaces which are to be exposed to view after the completion of all work shall be given a Class 2 Rubbed Finish, except when a Class 3 finish is specified on the plans. The interior of box culverts shall be given a Class 2 finish for a distance back from the headwall equal to the height of the box culvert.

Class 4 finish is to be used only when designated on the plans or directed by the Engineer.

Exterior flatwork, sidewalks and driveways shall be given a Class 6 finish, unless noted otherwise on the plans. Curbs shall be given a Class 2 or Class 6 finish. Interior flatwork shall be given a Class 5 finish, unless otherwise noted.

B. The various classes of surface finish are defined as follows:

(1) Class 1, Ordinary Surface Finish. Immediately after the forms are removed, all tie holes, honeycomb areas, depressions and voids shall be patched and all fins and other imperfections removed. Metal form ties shall be cut off in the concrete and grouted. Fins exceeding 1/4 inch in height shall be rubbed down except from those areas that are not to be exposed or are not to be waterproofed..

Loose or broken material shall be chipped away until a dense, uniform surface exposing solid coarse aggregate is obtained. Feather edges shall be cut away to form a face perpendicular to the surface being patched. All surfaces of the cavity shall be thoroughly saturated with water. Contact surfaces shall be coated with an approved bonding agent. Bonding agent may be mixed with mortar in lieu of coating the contact surface.

Patching mortar shall consist of one part cement and 2-1/2 parts sand. Mortar used in patching shall be not more than 1 hour old. The patched area shall then be rubbed, if required, and cured as specified herein. Construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The resulting surfaces shall be true and uniform. Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a float to a true and even surface. Repaired surfaces, the appearance of which is not satisfactory to the Engineer, shall be rubbed as specified under Class 2 finish. Metal tools shall not be used in finishing a patch that will be exposed.

(2) Class 2, Rubbed Finish. After removal of forms and completion of patching as specified above for Class 1 finish, the exposed surface of the concrete shall receive a grout rubbed finish. After the concrete is predampened, a mixture consisting of 1 part cement and 1-1/2 parts sand passing the No. 16 sieve shall be mixed with "Acryl 60" by Thoro, or other approved product, to form a slurry and shall be spread over the surface. Rubbing shall be continued until all form marks, projections, and irregularities have been removed, voids filled, and a uniform surface has been obtained. Any surplus shall be removed. The final rubbing shall produce a smooth texture and uniform color over the entire surface.

(3) Class 3, Textured Coating Finish. The material furnished for textured coating finish shall be a commercial paint type texturing product produced specifically for this purpose, and shall consist of a synthetic non-alkyd resin containing mica, perlite, non-biodegradable fibers, and durable tinting pigments. Material data and color sample shall be submitted to the Engineer for approval prior to use.

Surfaces to be coated shall be free from efflorescence, laitance, flaking, coatings, dirt, oil, and other foreign substances. The finish shall not be applied over surfaces cured with membrane curing compound until 30 days has elapsed from application of the membrane; however, the time may be reduced if the curing membrane is removed. Prior to application of the finish, the surfaces shall be free of moisture, as determined by sight and touch, and in a condition consistent with the manufacturer's recommendations.

The finish shall be applied at the rate recommended by the manufacturer and as approved by the Engineer. The finish shall be applied with heavy duty spray equipment capable of maintaining a constant pressure as necessary for proper application. When recommended by the manufacturer and approved by the Engineer, the finish may be applied with rollers and/or brushes.

The completed finish shall be tightly bonded to the structure and shall present a uniform appearance and texture equal to or better than that required for rubbed finish. If necessary, an additional coat or coats shall be applied to produce the desired surface texture without chipping or cracking, or if desired surface appearance cannot be attained, the coating shall be removed from the structure and the surface given a rubbed finish, or another approved finish satisfactory to the Engineer.

(4) Class 4, Exposed Aggregate Finish. This type of finish shall be produced by scrubbing the surface of green concrete with stiff wire or fiber brushes, using a solution of muriatic acid in the proportion of 1 part acid to 4 parts water, or by water- jet blasting, until the cement film or surface is completely removed and the aggregate particles exposed. Any surface treated with muriatic acid shall be thoroughly washed with water to which a small amount of ammonia has been added to remove all traces of acid. The resulting surface shall be an even pebbled texture. The type of aggregate and amount of aggregate exposure shall match adjacent exposed aggregate finish or be as designated by the Engineer

(5) Class 5, Hard Troweled Finish. All concrete flatwork shall be true, smooth, free from open or rough spaces, depressions or projections. The finished surface shall be checked for trueness of surface which shall be level within 1/4 inch in 10 feet. Irregularities shall be corrected by a method approved by the Engineer.

After the concrete has been placed, struck off, consolidated and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and/or the mix has stiffened sufficiently to permit the proper operation of a power-driven float. The surface shall then be consolidated with power-driven floats. Hand floating with wood floats shall be used in locations inaccessible to the power-driven machine.

After the moisture has disappeared, steel trowel the surface to a smooth, even, impervious finish, free from trowel marks. After the surface has set sufficiently to ring the trowel, it shall be given a second troweling to a burnished finished.

The use of a cement paste or dry cement and sand as a topping or to absorb moisture is

strictly prohibited.

Concrete specified to receive a Class 5, Hard Troweled Finish, may have the requirements for air content waived.

(6) Class 6, Broomed Finish. Broomed finished surfaces shall be finished same as specified above for Class 5, Hard-Troweled Finishes except, in lieu of the second troweling to a burnished finish, the surfaces shall be given a fine hair broom finish transverse to the centerline.

(7) Class 7, P.C. Concrete Pavement. See Section 350, "Final Finishing."

401.21 DEFECTIVE WORK

Any defective work disclosed after the forms have been removed or slabs straight-edged, shall be immediately removed and replaced. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows excessive honeycomb, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.

When allowed by the Engineer, defective or damaged work may be repaired by patching. Patching shall be accomplished by chipping away loose or broken material until a dense, uniform surface exposing solid coarse aggregate is obtained. Feather edges shall be cut away to form a face perpendicular to the surface being patched. All surfaces of the cavity shall be thoroughly saturated with water. Contact surfaces shall be coated with an approved bonding agent. Bonding agent may be mixed with mortar in lieu of coating the contact surface.

Patching material shall be used within the time limits specified by the manufacturer. The patched area shall then be rubbed, if required, and cured as specified by the manufacturer. Construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

Repaired surfaces, the appearance of which is not satisfactory to the Engineer, shall be rubbed as specified under Class 2 finish. Metal tools shall not be used in finishing a patch that will be exposed.

401.22 BASIS OF PAYMENT

Separate payment for concrete and concrete work will not be made under this section of the specifications. If payment is to be made separately for concrete and concrete work, it shall be as stated in the section of these specifications where the item is called for. Unless otherwise stated in other sections and in the Proposal, the concrete and concrete work including all labor, materials, tools, equipment, supplies and incidentals for completed work in place, will be paid for as a part of the applicable unit price listed in the Proposal for the items requiring concrete work. Said payment shall be considered full compensation for all labor, equipment, concrete, reinforcing steel, fiber reinforcement, excavation and backfill and other related items necessary for the work included in this section of the specifications.

SECTION 410
CONCRETE CURB AND GUTTER

410.01 DESCRIPTION

This work shall consist of the construction of concrete curb, integral curb, and combination curb and gutter, including all excavation, fine grading, form work, concrete, finishing, backfilling and related and incidental work necessary for completion.

410.02 MATERIALS. All materials used shall be in accordance with the following:

A. CONCRETE. Concrete for Types "A" (Barrier), "B" (Mountable), "D" (Island Mountable), and "E" (Island Barrier) curb and/or curb and gutter shall be Class "AA" (3500 psi) air entrained, fiber reinforced, as specified in Section 401 "Concrete General" of the specifications. The maximum size aggregate used shall be 1-1/2 inches with a gradation conforming to ASTM C33, Gradation No. 467. When slip-forming machine is used, maximum aggregate size shall be 3/4 inch conforming to ASTM C33, Gradation No. 67. Concrete for Type "C" (Integral) curb shall be same as mix for associated concrete paving.

B. EXPANSION JOINT MATERIAL. Expansion joint filler shall be Type 1 pre-formed expansion joint filler, as specified in Section 401 of the specifications.

C. JOINT SEALER. Joint sealer, when specified, shall be Type 2 single component silicone as specified in Section 401 of these specifications.

410.03 CONSTRUCTION REQUIREMENTS

A. SUBGRADE. The subgrade shall be excavated to the required depth below the finished surface, according to the dimensions shown on the plans, and shall be compacted to the density as determined and specified in Section 203 "Excavation and Embankment" of these specifications. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement. All soft and yielding areas shall be removed and replaced with suitable material and compacted. Any portion of the subgrade that is not accessible to normal compaction equipment shall be thoroughly compacted with manually operated mechanical tampers.

When the curb is to be constructed on a concrete surface or base previously placed, the area of the concrete surface shall be roughened sufficiently to secure a good bond.

On reconstruction projects, or when the curb is to be removed and replaced, crushed stone base course material may be placed and compacted under the new curb as shown on the plans, or as directed by the Engineer, to bring the new curb to the correct elevation. In lieu of the crushed stone base course material, the Contractor may place additional concrete under the new curb section. The cost for providing and placing this crushed stone base course material or additional concrete shall be considered incidental to the curb and gutter.

B. FORMS. Forms shall be as specified in Section 401 "Concrete" of the specifications. Face forms or templates matching the shape of the planned curb shall be required when a curb machine is not used. In the event that the Contractor requests waiver of the face form requirement, the Contractor must demonstrate the ability to obtain the required curb shape on a consistent basis.

C. MACHINE PLACEMENT. An approved self-propelled slip form/extrusion machine shall be used to place all applicable sections of curb and gutter. With approval of the Engineer, sections of curb and gutter deemed as being impractical for placement with

slip form equipment may be placed by hand formed methods. Slip form equipment shall have an automatic sensor for control of alignment and grade. The machine approved shall be so designed as to place, spread, consolidate, screed and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

Slip form equipment shall produce a section conforming to the shape and dimensions shown on the plans. The finish texture of the curb and gutter and the joint locations shall be identical for either the machine placed or formed methods.

D. PLACING AND FINISHING. Mixing, placement and finishing of concrete shall conform to Section 401 of the specifications.

Face forms shall be stripped as soon as the concrete has set sufficiently. Exposed surfaces shall be given a Class 6, Broomed Finish.

Construction of curb and gutter at storm drainage inlets shall conform to the details shown on the plans.

E. JOINTS. Joints shall be installed as specified in Section 401 of the specifications.

Expansion joints shall be provided at stationary structures such as drop inlets, catch basins, etc.; at the beginning and end of returns; at a maximum interval of 100 feet; and at the locations shown on the plans.

Contraction joints shall be placed at 20 foot intervals. Where curbing is constructed adjacent to or on rigid pavements, the locations and width of the joints shall coincide with those in the pavement, where practicable. These joints shall be filled according to the requirements of Section 350 "Portland Cement Concrete Pavement."

F. CURING. The concrete shall be cured with a liquid membrane curing compound as specified in Section 401. Pedestrian and vehicular traffic shall be excluded from the use of the concrete for at least 72 hours.

G. BACKFILL. After the concrete has set sufficiently, the area behind the curb shall be backfilled with suitable material approved by the Engineer to the grade shown on the plans and to a depth allowing for the placement of topsoil and sodding level with the top of the curb. Backfill material, placement and compaction shall be as specified in Section 203.

H. DRIVEWAYS. The Contractor may remove no more than two feet of a driveway behind the back of curb in order to remove and replace the gutter across a driveway. A temporary asphalt concrete driveway shall be installed in accordance with section 120.02 CONSTRUCTION REQUIREMENTS, Item F. PROJECTS ON EXISTING ROADWAYS. If more than two feet of the driveway is to be replaced, the Contractor may remove the additional length of driveway if it will be replaced with a permanent surface within 24 hours.

410.04 TOLERANCES

The surface of the gutter and the top of the curb shall be checked with a 10 feet straight edge. The maximum variation shall not exceed 1/4 inch in 10 feet. Curbing which has a surface variation

exceeding the specified limit shall be removed and replaced at the expense of the Contractor.

410.05 MEASUREMENT AND PAYMENT

Curbing will be measured by the linear foot along the face of the curb at the flowline. No deduction in the curb and gutter quantity will be made across drainage inlets or driveways.

Curb radii integral with concrete pavement aprons and driveways are considered incidental to the aprons or driveway and will not be measured and paid for separately.

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot for the respective types or sizes of Curb or Curb & Gutter, which price shall be full compensation for furnishing materials, including joint filler; for forms; for mixing, placing, and finishing concrete; for excavation and backfilling; and for all labor, equipment, tools and incidentals necessary to complete the work. Payment will not be made for curbing until backfilling has been completed.

Payment will be made under:

Pay Item	Pay Unit
Curb (Type __)	LF
Curb & Gutter (Type __)	LF

SECTION 420
CONCRETE APRONS, SWALES & SLABS ON GRADE

420.01 DESCRIPTION

This work shall consist of the construction of concrete pavement aprons, swales, islands, and miscellaneous slabs on grade, including all excavation, fine grading, form work, concrete, reinforcement, finishing, backfilling and related and incidental work necessary for the completed improvements.

420.02 MATERIALS. All materials used shall be in accordance with the following:

A. CONCRETE. All concrete shall be Class "AA" (3500 psi) air entrained, fiber reinforced, as specified in Section 401 "Concrete." The maximum size of aggregate used shall be 1 inch with a gradation conforming to ASTM C33, Gradation No. 57 or No. 67. If thickness of concrete is greater than 5 inches, maximum aggregate size may be 1½ inches with ASTM C33, Gradation No. 457.

If the concrete pavement apron or swale is adjacent to Portland Cement Concrete Pavement, the concrete used shall be of the same mix design and strength as the Portland Cement Concrete Pavement.

B. REINFORCEMENT. Reinforcement shall be as specified in Section 401 of these specifications.

C. EXPANSION JOINT MATERIAL. Expansion joint filler shall be Type 1 pre-formed expansion joint filler as specified in Section 401 of these specifications.

D. JOINT SEALER. Joint sealer, when specified, shall be Type 2 single component silicone as specified in Section 401 of these specifications.

420.03 CONSTRUCTION REQUIREMENTS

A. SUBGRADE. The subgrade shall be excavated to the required depth below the finished surface, according to the dimensions shown on the plans, and shall be compacted to the density as determined and specified in Section 203 "Excavation and Embankment" of these specifications. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement. All soft and yielding areas shall be removed and replaced with suitable material and compacted. Any portion of the subgrade that is not accessible to normal compaction equipment shall be thoroughly compacted with manually operated mechanical tampers.

On reconstruction projects, or when the pavement apron or swale is to be removed and replaced, crushed stone base material may be placed under the new apron or swale as shown on the plans, or as directed by the Engineer, to bring the subgrade to the correct elevation. In lieu of the crushed stone base course material, the Contractor may place additional concrete under the new curb section. The cost for providing and placing this crushed stone base material or additional concrete shall be considered incidental to the pavement apron or swale.

B. FORMS. Forms shall be as specified in Section 401 of the specifications.

C. CURBS. Concrete aprons and slabs designated to receive curbs shall have the curbs placed integral with the aprons and slabs. Curbs shall be constructed to the cross section shown on the plans.

D. PLACING AND FINISHING. Mixing, placing and finishing of concrete shall conform to Section 401 of the specifications. The concrete slab surface shall be given a Class 6, Broomed Finish, unless noted otherwise on the plans.

E. JOINTS. Joints shall be installed as specified in Section 401 of the specifications.

Contraction joints shall be placed at the locations shown on the plans, or if not shown, at 12 feet maximum spacing.

Expansion joints shall be provided at locations shown on the plans, at all adjacent structures, and at the beginning and end of curb returns.

Construction joints shall be placed at the location shown on the plans, or as approved by the Engineer, and constructed to the dimensions shown on the plans. When a preformed metal key form is used, the metal form shall be removed after the specified curing period and prior to placing of adjacent concrete.

Doweled joints, when called for, shall be constructed in accordance with Section 401.

F. CURING. The concrete shall be cured with a liquid membrane curing compound as specified in Section 401 of these specifications. Pedestrian and vehicular traffic shall be excluded from the use of the slab for at least 72 hours.

G. BACKFILL. After the concrete has set sufficiently, but no sooner than 24 hours after placement, the forms shall be removed. After forms, stakes and other debris has been removed, the spaces adjacent to the slab shall be backfilled to the grade shown on the plans with suitable material as specified in Section 203 of these specifications.

420.04 TOLERANCES

Slab surfaces shall be checked for smoothness with a 10' straight edge. Areas showing high spots of more than 1/4 inch, but not exceeding 1/2 inch, shall be reduced by diamond grinding to an elevation within the 1/4 inch tolerance. Deviations greater than 1/2 inch in 10 feet shall be corrected by removing and replacing the pavement at the Contractor's expense.

The thickness of the concrete slab shall be as shown on the plans. Any concrete of questionable thickness shall be cored in the locations selected by the Engineer. The Contractor shall repair all core holes at no cost to the Owner. Any concrete found to be less than the specified thickness shall be removed and replaced at the Contractor's expense.

420.05 MEASUREMENT AND PAYMENT

Concrete pavement aprons, swales, islands, and miscellaneous slabs on grade will be measured by the square yard.

Curbs integral with pavement aprons will be considered incidental to the apron. Pay limit of apron is measured to the back of curb.

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard for Concrete Pavement Apron, Concrete Pavement Swale, Concrete Island, and/or Concrete Slab on Grade, which price shall be full compensation for excavating and preparing the subgrade, existing base, and/or pavement; for removal and disposal of any existing Concrete Pavement Apron, Concrete Pavement Swale, Concrete Island, and/or Concrete Slab on Grade; for furnishing, transporting, and placing all materials; for all forming, concrete, reinforcement and

jointing work; for backfilling; and all labor, equipment, tools, and incidentals necessary to complete the work.

Miscellaneous slabs on grade include parking lots and other concrete slabs not considered to be pavement aprons, swales, islands or sidewalk.

Payment will not be made for items in this section until backfilling of those items have been completed.

Payment will be made under:

Pay Item	Pay Unit
Conc. Pavement Apron ((_)" Thickness)	SY
Conc. Pavement Swale ((_)" Thickness)	SY
Concrete Island	SY
Concrete Slab On Grade	SY

SECTION 430
CONCRETE DRIVEWAYS

430.01 DESCRIPTION

This work shall consist of the construction of concrete driveways, including all excavation, fine grading, form work, concrete, finishing, backfilling and related and incidental work necessary for the completed improvements.

430.02 MATERIALS. All materials used shall be in accordance with the following:

A. CONCRETE. All concrete shall be Class "AA" (3500 psi) air entrained, fiber reinforced, as specified in Section 401 "Concrete." Fiber reinforcement shall not be used in concrete for exposed aggregate finish driveways. The maximum size aggregate used shall be 1½ inches with a gradation conforming to ASTM C33, Gradation No. 457.

B. EXPANSION JOINT MATERIAL. Expansion joint filler shall be Type 1 pre-formed expansion joint filler as specified in Section 401 of these specifications.

C. JOINT SEALER. Joint sealer, when specified, shall be Type 2 single component silicone as specified in Section 401 of these specifications.

430.03 CONSTRUCTION REQUIREMENTS

A. SUBGRADE. The subgrade shall be excavated to the required depth as shown on the plans and as directed by the Engineer. All soft and yielding areas shall be removed and replaced with suitable material and the entire subgrade shall be thoroughly compacted with approved mechanical tampers. The subgrade shall have a minimum density as determined and specified in Section 203 "Excavation and Embankment."

When the driveway is to be removed and replaced, acceptable material may be placed under the new driveway as shown on the plans, or as directed by the Engineer, to bring the new driveway to the correct elevation. The cost for providing and placing this acceptable material shall be considered incidental to the driveway.

In removing old driveway, care shall be taken to leave a straight, smooth edge at the location given by the Engineer. The edge shall be sawed or otherwise cut and trimmed to a smooth straight line.

B. FORMS. Forms shall be as specified in Section 401 of these specifications.

C. CURBS. Concrete driveways designated to received radius curbs shall have these curbs placed integral with the driveway. All street gutters shall be placed separately from the driveways. Curbs shall be constructed to the cross section shown on the plans.

D. PLACING AND FINISHING. Mixing, placing and finishing of concrete shall conform to Section 401 of the specifications.

The driveway surface shall be given a Class 6, Broomed Finish, unless noted otherwise on the plans. If the existing driveway has an exposed aggregate finish, the new driveway surface shall be given a Class 4, Exposed Aggregate Finish, matching the finish of the existing portion of driveway.

E. JOINTS. Joint shall be installed as specified in Section 401 of the specifications.

Contraction joints shall be placed at the locations shown on the plans, or if not shown, at 12 foot maximum spacing. Any longitudinal joints shall coincide with those in the existing driveway section, where practicable.

Expansion joints shall be provided at all adjacent concrete and at locations shown on the plans.

F. CURING. The concrete shall be cured with a liquid membrane curing compound as specified in Section 401 of these specifications. Pedestrian and vehicular traffic shall be excluded from the use of the slab for at least 72 hours.

G. BACKFILL. After the concrete has set sufficiently, but no sooner than 24 hours after placement, the forms shall be removed. After forms, stakes and other debris has been removed, the area adjacent to the driveway shall be backfilled with suitable material approved by the Engineer to the grade shown on the plans and to a depth allowing for the placement of sodding level with the top of the driveway. Backfill material, placement and compaction shall be as specified in Section 203 of these specifications.

430.04 TOLERANCES

The thickness of the concrete driveway shall be as shown on the plans. Any concrete of questionable thickness shall be cored in the locations selected by the Engineer. The Contractor shall repair all core holes at no cost to the Owner. Any concrete found to be less than the specified thickness shall be removed and replaced at the Contractor's expense.

The surface of the driveway shall be checked with a 10 foot straight edge. The maximum variation shall not exceed 1/4 inch in 10 foot. Driveways which have a surface variation exceeding the specified limit shall be removed and replaced at the expense of the Contractor.

430.05 MEASUREMENT AND PAYMENT

Concrete driveways will be measured by the square yard.

Radius curb integral with driveways are considered incidental to the driveway and will not be paid for separately. Street gutters along driveways will be measured and paid for separately under Section 410 "Concrete Curb and Gutter."

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard for Concrete Driveway, which price shall be full compensation for excavating and preparing the subgrade; for furnishing, transporting, and placing all materials; for all forming, concrete, and jointing work; for backfilling; and all labor equipment, tools, and incidentals necessary to complete the work. Payment will not be made for driveways until backfilling has been completed.

Payment will be made under:

Pay Item	Pay Unit
Conc. Driveway ((_)" Thickness)	SY
Conc. Driveway ((_)" Thickness), Exposed Aggregate Finish	SY

SECTION 440
CONCRETE SIDEWALKS, RAMPS AND STEPS

440.01 DESCRIPTION

This work shall consist of the construction of concrete sidewalks, handicap ramps, and steps, including all excavation, fine grading, form work, concrete, finishing, backfilling and related and incidental work necessary for the completed improvements.

440.02 MATERIALS. All materials used shall be in accordance with the following:

A. CONCRETE. All concrete shall be Class "AA" (3500 psi) air entrained, fiber reinforced, as specified in Section 401 "Concrete." The maximum size aggregate used shall be 1 inch with a gradation conforming to ASTM C33, Gradation No. 57 or No. 67. If thickness of concrete is greater than 5 inches, aggregate maybe maximum size of 1½ inches, ASTM C33, Gradation No. 457.

B. EXPANSION JOINT MATERIAL. Expansion joint filler shall be Type 1 pre-formed expansion joint filler, as specified in Section 401 of the specifications.

C. DRAIN PLATE AND FRAME. Steel for sidewalk drain plate and frame shall comply with ASTM A-48, Class 35B Gray Iron. Surfaces exposed to pedestrian use shall have non-slip finish.

D. HANDICAP RAMP PANELS. The detectable warning device used in handicap ramps shall be cast-in-place tactile panels composed of a vitrified polymer composite material. The color of the tactile panels shall conform to Federal Color No. 33538, and shall be homogeneous throughout the product.

440.03 CONSTRUCTION REQUIREMENTS

A. SUBGRADE. The subgrade shall be excavated to the required depth below the finished surface, according to the dimensions shown on the plans, and shall be compacted to density as determined and specified in Section 203 "Excavation and Embankment." All soft and yielding areas shall be removed and replaced with suitable material and compacted with approved mechanical tampers.

When the sidewalk is to be removed and replaced, acceptable material may be placed under the new sidewalk as shown on the plans, or as directed by the Engineer, to bring the new sidewalk to the correct elevation. The cost for providing and placing this acceptable material shall be considered incidental to the sidewalk.

B. FORMS. Forms shall be as specified in section 401 of the specifications.

C. MACHINE PLACEMENT. At the Contractor's option an approved slipform/extrusion machine may be used to place applicable sections of the sidewalk. Slip form equipment shall have an automatic sensor for control of alignment and grade. The machine approved shall be so designed as to place, spread, consolidate, screed and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a continuous forward movement as possible. All operations of mixing, delivery and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

The finish texture of the sidewalk and the joint locations shall be identical for either the machine placed or formed methods.

If Contractor elects to use an approved slipform/extrusion machine, no additional compensation will be paid the Contractor due to changes in the alignment of the sidewalk, prior to placement, which requires the use of hand-forms for sections of the sidewalk.

D. PLACING AND FINISHING. Mixing, placement and finishing of concrete shall conform to Section 401 of the specifications. The concrete shall be deposited in one course for the entire sidewalk. The sidewalk surface shall be given a Class 6, Broomed Finish, perpendicular to the length of the sidewalk, unless otherwise noted on the plans.

E. JOINTS. Joints shall be installed as specified in Section 401 of the specifications.

Contraction joints shall be cut transversely at intervals matching the width of the sidewalk but never at intervals exceeding 6 feet. These joints shall be at right angles to the centerline of the sidewalk. The joints may be sawed at the Contractor's option.

Expansion joints shall be provided at the locations shown on the plans and shall be placed at maximum intervals of 100 feet unless otherwise noted on the plans. At locations where obstructions such as power poles, drainage inlets, and fire hydrants are encountered, excluding curbing, expansion joints shall be placed transversely in the sidewalk. The expansion material shall furthermore surround these obstructions. The transverse expansion joint shall be centered on the diameter of the obstruction.

F. CURING. The concrete shall be cured with a liquid membrane curing compound as specified in Section 401. Pedestrian and vehicular traffic shall be excluded from the use of the concrete for at least 72 hours.

G. HANDICAP ACCESS RAMP. Ramps shall be placed in sidewalk at the locations shown on the plans, or as designated by the Engineer, and constructed per the Standard Drawings. The concrete surface of the ramp shall be a broomed finish. The detectable warning device shall be located so that the nearest edge of the device is 6 to 8 inches from the face of the curb. Detectable warning device shall be 24 inches in the direction of travel and extend the full width of the ramp.

H. BACKFILL. After the concrete has set sufficiently, but no sooner than 24 hours after placement, the forms shall be removed. After forms, stakes and other debris has been removed, the area adjacent to the sidewalk shall be backfilled with suitable material approved by the Engineer, to the grade shown on the plans and to a depth allowing for the placement of sodding level with the top of the sidewalk. Backfill material, placement and compaction shall be as specified in Section 203 of these specifications.

440.05 MEASUREMENT AND PAYMENT

Concrete Sidewalk and Steps will be measured by the square yard. The area measured for steps will be that of the treads only.

Handicap Ramps will be measured by the unit. Sidewalk within the ramp area will also be measured and paid for as stated previously.

Concrete Sidewalk with Turned Down/Up Edge will be measured by the square yard of walk area. Area of turned down/up edge will be considered incidental.

Work completed and accepted and measured as provided above will be paid for at the contract unit

price bid per square yard for Concrete Sidewalks, Concrete Steps, Concrete Sidewalk w/ Turned Down/Up Edge, or per each for Handicap Ramps, which price shall be full compensation for excavating and preparing the subgrade; for furnishing transporting and placing all materials; for all forming concrete and jointing work; for reinforcement; for backfilling; and for all labor, equipment, tools and incidentals necessary to complete the work. The price bid per each for handicap ramps shall also include furnishing and placing of handicap ramp panels. For handicap ramps on reconstruction projects, if the existing curb is in good condition, the curb shall be sawcut at the gutter flowline and removed. Replacement of the curb shall be incidental to the price per each handicap ramp. Removal and disposal of the curb shall be paid for as specified in Section 201 "Site Preparation & Removals."

Sidewalk Drain will be measured by the square foot of plate and bar area. Work completed and accepted will be paid for at the unit price bid for Sidewalk Drain, which price shall be full compensation for the construction of the concrete drain channel and for furnishing and installing the steel drain plate and frame.

Payment will not be made for items in this section until backfilling of those items have been completed.

Payment will be made under:

Pay Item	Pay Unit
Concrete Sidewalk ((_)" Thickness)	SY
Concrete Sidewalk w/ Turned Down/Up Edge ((_)" Thickness)	SY
Concrete Steps	SY
Handicap Ramps	EA

SECTION 450
CONCRETE RETAINING WALLS

450.01 DESCRIPTION

This work shall consist of constructing Portland cement concrete retaining walls including earthwork and other related items.

450.02 MATERIALS

A. CONCRETE. All concrete shall be 4000 psi, air entrained as specified in Section 401 "Concrete General."

Reinforcing steel shall conform to Section 401 of these specifications.

Expansion joint material shall be a resilient type filler conforming to AASHTO M 213, latest revision.

Concrete curing compound shall conform to Section 401 of these specifications.

B. FILTER MATERIAL (GRAVEL FILL). Filter material shall be gravel or crushed stone aggregate having a nominal size range of 3/4 inch to No.4. The material furnished shall not contain more than ten percent by weight of shale and other deleterious matter.

450.03 CONSTRUCTION REQUIREMENTS

Retaining walls shall be constructed to the alignment and grades and in accordance with the details shown on the plans.

A. EXCAVATION AND GRADING. Excavation and grading shall be as specified in other sections of these specifications.

B. RETAINING WALL CONSTRUCTION. Retaining wall foundations shall be constructed on an approved subgrade. Foundations which are integral with concrete pavement or slabs shall be cast monolithically.

All concrete placement, finishing and curing and related work shall conform to Section 401 of these specifications.

C. BACKFILL. Retaining wall backfill shall be placed as shown on the plans. Granular filter material (gravel fill) shall not be intermixed with topsoil or other foreign matter.

Topsoiling, seeding and related work shall be as specified in other sections of these specifications.

450.04 MEASUREMENT AND PAYMENT

Reinforced concrete retaining walls including foundations will be measured by volume based on the lines and dimensions shown on the plans. Payment at the contract unit price per cubic yard shall be full compensation for excavation, concrete, reinforcing steel, backfilling, gravel fill and related items. Retaining wall foundations which are combined with other structures will be measured and payment made according to the limits shown on the plans.

No separate payment will be made for topsoiling, seeding, fertilizing, mulching or for removal of excess excavation or waste material unless otherwise specified and listed in the bid form.

Payment will be made under:

Pay Item	Pay Unit
Concrete Retaining Wall	CY

DIVISION 500

SECTION 501
STORM DRAINAGE IMPROVEMENTS

501.01 SCOPE OF WORK

The work shall consist of furnishing and installing storm drainage facilities, including reinforced concrete pipe, precast and cast-in-place concrete box culvert, channels, ditch paving, inlets, junction boxes and miscellaneous structures, and repair and modification of existing structures.

501.02 MATERIALS

A. REINFORCED CONCRETE PIPE (RCP). Reinforced concrete pipe shall conform to ASTM C76 (AASHTO M170), latest revision. Reinforced concrete arch pipe shall conform to ASTM C 506 (AASHTO M206), latest revision. Reinforced concrete elliptical pipe shall conform to ASTM C 507 (AASHTO M207), latest edition. Flared-end sections shall conform to ArDOT Section 606.02 (e). RCP shall have Wall "B" and shall be the class shown on the plans. Pipe shall have tongue and groove or bell and spigot joint design unless otherwise approved by the Engineer.

B. PRECAST BOX CULVERTS & PRECAST INLETS. The manufacture and furnishing of precast box culverts shall be according to ASTM C1433 (AASHTO M259 or M273), or shall be of a special design, such as BOXCAR, sealed by a State of Arkansas licensed Engineer. The manufacturer and furnishing of precast inlets shall be according to ASTM C478 (AASHTO M199). The manufacturer shall furnish a certification to the Engineer that the units comply with the applicable ASTM or AASHTO specifications, as appropriate. Units so manufactured shall bear evidence that the component materials have been tested and approved.

Precast units may be used for inlet bottoms and walls only with the Engineer's approval. Inlet tops and extensions must be cast-in-place.

C. GASKETS. Gaskets for concrete pipe and box joints for culvert and storm drainage shall be of tubular cross-sections manufactured from extruded closed-cellular rubber. The base polymer shall be a blend of nitrile and vinyl meeting the physical requirements of ASTM D1056, Class 201, and meeting the chemical resistance requirements of ASTM C990 (AASHTO M198). Gaskets shall be Omni-Flex rubber gaskets as manufactured by Superior Pipe Products, Inc. Tulsa, Oklahoma or approved equal.

Each gasket shall be a single, continuous part conforming to the joint shape, and the outer surface shall be completely covered with a natural skin. Gasket cross-sectional diameters and installation practices shall be in accordance with the manufacturer's recommendations. Joint primers, preparation or coatings shall not be utilized.

D. MANHOLE COVERS. Manhole frames and covers shall be cast iron conforming to ASTM A48 (AASHTO M105) and shall be Model No. 275-24 as manufactured by East Jordan Iron Works, Model No. R-6041-A as manufactured by Neenah Foundry Co., or approved equal. Covers which will be subject to traffic shall have machined bearing surfaces to prevent rocking of the cover.

E. GRATED COVERS & TRENCH GRATES. Grated covers and frames and trench grates and frames shall be of a type and size as specified on the plans and/or in the Special Conditions and shall be heavy duty, cast iron, and comply with AASHTO M 105, Class

35B. Trench grates and frames shall be Neenah R-4999 Vaned Type "L" Series or approved equal.

F. CONCRETE. Concrete and reinforcement shall conform to Section 401 "Concrete General." Concrete shall be air-entrained, Class "AAA" for all drainage pipe, structures, and facilities. Maximum aggregate size shall be 1-1/2" with a gradation conforming to ASTM C33, Gradation No. 467.

501.03 SUBMITTALS

The following are required to be submitted to the Engineer for approval at the Preconstruction Conference:

A. PIPE MATERIALS. Contractor shall submit a copy of the proposed pipe manufacturer's product data and certification that all materials meet the requirements of the specifications.

B. PRECAST CONCRETE BOX CULVERT & PRECAST INLET. Contractor shall submit shop drawings from the proposed box culvert or inlet manufacturer detailing size, reinforcing, opening locations and additional reinforcing required, and layout plan. A copy of the manufacturer's certification that all materials supplied meet the requirements of the specification shall also be submitted.

C. MANHOLE COVERS, GRATED COVERS, & TRENCH GRATES. Contractor shall submit shop drawings from the proposed manufacturer detailing the dimensions of any manhole covers and frames, grated covers and frames, and/or trench grates and frames. A copy of the manufacturer's certifications that the covers, grates, and frames supplied meet the requirements of the specification shall also be submitted.

501.04 CONSTRUCTION REQUIREMENTS

A. GENERAL. Prior to start of excavation, the Contractor shall pothole all existing, potentially conflicting utilities shown crossing the proposed drainage facilities and all tie-in points to existing facilities, allowing adequate time for the Engineer to resolve any found conflicts or problems. The Contractor shall provide the Engineer with all measurements, dimensions, elevations, types, and sizes of utilities, and all information necessary to determine utility conflicts with the drainage facilities.

The Contractor shall conduct his work so as to interfere as little as possible with traffic and shall not close any street until permission of the proper authorities has been obtained. All closing, detours and interference with traffic shall be handled as specified in Section 120 "Traffic Control and Maintenance."

All crossings shall be open cut unless otherwise designated on the plans or in the Special Conditions. Cutting and restoring of existing street surfaces shall be as specified in Section 205 "Trench Excavation and Backfill."

All excavation, bedding, and backfill for pipe, channel, and structures shall be in accordance with Section 205.

Existing storm drain pipe, culverts, and other structures shall be removed unless abandonment in place is noted on the plans or in the Special Conditions. Removals shall be in accordance with Section 201 "Site Preparation."

All concrete work shall conform to Section 401 "Concrete." For cast-in-place concrete structures, wall ties shall be removed both inside and outside of all structures and the holes

patched and smoothed. All formed surfaces which are to be exposed to view after the completion of work shall be given a Class 2 Rubbed Finish, and all unformed surfaces shall be given a Class 6 Broomed Finish, as specified in Section 401, unless otherwise noted on the Plans or directed by the Engineer. The interior of box culverts shall also be given a Class 2 finish for a distance back from the headwall equal to the height of the box culvert.

The Contractor is responsible for keeping all drainage facilities constructed free of siltation, debris and other obstructions until the facilities have been completed and accepted. Any downstream drainage facilities that have accumulated siltation and debris due to the construction of upstream facilities shall be cleaned by the Contractor, at no expense to the Owner, prior to acceptance of the Work.

B. INSTALLATION. The construction of all pipe and box shall begin at the outlet end or the low point of the line and shall continue uninterrupted to termination of the line. Sections of pipe shall not be skipped without authorization of the Engineer. When construction involves the installation of lateral branches, the construction of these laterals shall not be started until the main storm drainage pipe has been completed to the point where the lateral discharges into it. Storm drainage appurtenances shall be constructed as soon as the pipe which they are to become a part of is constructed to their location.

Each length of pipe shall be inspected at the point of delivery or at the trench by the Engineer. Any pipe found to be cracked, damaged or otherwise defective shall be plainly marked in such a manner that the markings will not rub or wash off, and the pipe shall subsequently be removed from the site.

Pipe shall be protected during handling against impact shock and free fall. The Contractor shall furnish and use the necessary facilities for lowering the pipe into the trench in a manner that will not damage or disturb either the pipe or the trench.

All pipe shall be laid to the established line and grade as required by the plans and specifications and as directed by the Engineer. The Contractor shall furnish and apply laser equipment or other means of controlling line and grade.

Except by special permission, no pipe shall be laid except in the presence of an inspector. No pipe shall be laid unless the trench subgrade is in a condition satisfactory to the Engineer and has been approved by the Engineer. Pipe shall not be laid on frozen ground or when the condition of the trench or the weather is unsuitable for such work. With tongue and groove pipe, the groove end shall be laid upgrade.

Contractor is required to utilize hydraulic pullers, or other approved mechanical devices, of sufficient power to obtain the required joint closure and compression of gaskets during installation of pipe greater than or equal to 60" diameter and for precast concrete box culvert sections.

When the laying of pipe has stopped for the end of the day, all joints shall be finished. The Contractor is responsible for all silt control measures and cleaning of all pipe and downstream facilities that have dirt and debris accumulation due to construction.

C. PRECAST CONCRETE BOX CULVERTS AND PRECAST INLETS. If the Contractor elects to utilize precast concrete box culverts or inlets in lieu of cast-in-place concrete box culverts or inlets, the Contractor will be responsible for any modifications required to the precast sections in order to accommodate utility line crossings and pipe penetrations.

Pre-cast concrete cannot be used for angle points, transition sections or multiple box culvert junctions. These sections of box culvert shall be cast-in-place. The space between parallel

runs of precast box culverts shall be backfilled with flowable fill material as specified in Section 206 "Flowable Fill Material," except where otherwise directed by the Engineer.

On inlets, precast units may be used for bottoms and walls only, with Engineer's approval. Inlet tops must be cast in place. Adjustments to inlets due to grade changes will be at no cost to the Owner.

Lifting holes shall be filled with mortar or concrete and cured as directed prior to backfill operations.

D. CAST-IN-PLACE INLETS, JUNCTION BOXES, BOX CULVERTS, AND TRENCH DRAINS. Concrete shall not be placed until the subgrade, form work, reinforcement and embedded items have been approved by the Engineer.

The foundations for the inlet and junction box structures shall be placed as soon as practicable after the pipe is completed through the structure location. The foundation shall be built to the correct elevation and shall be finished to provide the least possible resistance to flowing water. The interior bottom shall be sloped downward toward the outlet. After the excavation work is completed, the cleaned and leveled subgrade surface shall be approved by the Engineer prior to the placing of reinforcing steel or concrete.

All structure bottoms and sides shall be formed. Concrete in walls and top slabs shall not be placed less than 24 hours after the placement of the supporting concrete. For box culverts and inlets six feet or less in height, the walls and top slab may be constructed monolithically.

The inlets at curb opening shall be of the dimensions and shape shown on the plans. The forms shall be accurately shaped and held in a true position to maintain the proper cross section of the opening. The top of the inlet shall match the top of the adjoining curb.

Inlet and outlet pipes shall be flush with the inside wall of the structure and shall be tightly sealed in the wall. Where structures are erected on an existing line, the pipe inside the structure shall be removed flush with the inside wall of the structure.

For reconstruction or repair of, or connection to, existing structures, excavation and removals shall be accomplished in a manner which will prevent damage or displacement of the existing structure or pipe. Connection to existing structure shall be accomplished as shown on the plans.

Connection of pipe to an existing structure shall be made by removing a section of the structure wall to a radius of approximately four inches greater than the outside radius of the pipe. Methods employed in removing the wall section shall not damage the remainder of the structure. Pipe shall be positioned to the specified line and grade and shall be cast into the structure wall by forming and placing concrete to the original thickness of the structure wall.

Openings in existing structures created by abandonment or removal of pipe shall be plugged by forming and casting a concrete plug equal in thickness to the structure wall.

All castings, frames and fitting shall be placed in the position indicated on the plans or as directed by the Engineer. They shall be true to line and to correct elevation. All anchors and bolts shall be in place and in position before the concrete is placed. The unit shall not be disturbed until the concrete has set. Unless otherwise shown on the plans, the top of castings in the top slab shall be flush with the surrounding surface.

Backfill shall not be commenced until the structure has been approved by the Engineer.

Concrete structures shall not be backfilled until the concrete has been in place 7 days or until the concrete has attained a minimum compressive strength of 2000 psi as demonstrated by concrete cylinder compression tests.

E. RECONSTRUCT TOP - INLET AND JUNCTION BOXES. Existing concrete inlets and junction boxes shall be adjusted to grade by removal and reconstruction of the top portion of the structure as shown on the plans or directed by the Engineer. Excavation and removals shall be accomplished in a manner which will prevent damage or displacement of the existing structure or pipe. Connection to existing structure shall be accomplished as shown on the plans or approved by the Engineer. The existing manhole frames and covers shall be removed and reused in the reconstructed top. Structures damaged due to negligence of the Contractor shall be repaired by the Contractor without compensation.

Junction box tops located in pavement areas designated to receive an asphalt concrete overlay shall be adjusted to grade prior to start of the overlay operations. Reconstruction of inlet and junction box tops in areas designated for reconstruction shall be accomplished prior to placement of pavement surfacing.

F. CONCRETE DITCH PAVING AND CHANNELS. Concrete shall not be placed until the subgrade, form work, reinforcement and embedded items have been approved by the Engineer. Reinforced vertical wall channels shall be considered to be Concrete Channel. Reinforced and non-reinforced sloped wall channels and miscellaneous slope paving shall be considered to be Concrete Ditch Paving.

Ditch paving and channel slabs shall be constructed to the alignment and grade shown on the plans. Joints shall be placed at the locations shown on the plans unless otherwise authorized by the Engineer. All construction joints shall be cleaned prior to placement of adjacent concrete.

All structure bottoms and vertical walls and sides shall be formed. Concrete in walls and slopes shall not be placed until after supporting concrete and bottoms have been placed. Concrete in walls and slopes shall not be placed less than 24 hours after the placement of supporting concrete. Channel slopes or walls six feet or less in height can be constructed monolithically with the bottom slab.

Backfill shall not be commenced until the structure has been approved by the Engineer. Concrete structures shall not be backfilled until the concrete has been in place 7 days or until the concrete has attained a minimum compressive strength of 2000 psi as demonstrated by concrete cylinder compression tests.

G. CLEANING OF EXISTING PIPE OR DITCHES. The Contractor shall clean existing storm drainage pipe, inlet or junction boxes and other structures or ditches of siltation, debris, or other obstructions at the locations designated on the plans. Materials removed shall be disposed of off-site by the Contractor. Cleaning and disposal of materials shall be approved by the Engineer.

The Contractor is responsible for the cleaning of all pipe and downstream facilities that have dirt and debris accumulation due to construction. This cost shall be considered incidental to the price bid for installation of the drainage facility.

501.05 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section shall be as specified below unless otherwise stated in the Special Conditions.

Trench excavation, bedding and backfill will only be measured and paid for as specified in Section 205 "Trench Excavation and Backfill." Limits of pipe zone are as shown on the Plans.

Removals of existing drainage pipe and structures will be measured and paid for as specified in Section 201 "Site Preparation."

Removals and reconstruction required for connection of pipe or structures to existing pipe or structure will not be measured and paid for separately but is considered incidental to the new pipe or structure work.

No separate payment will be made for cleaning existing storm drainage pipe or structures unless otherwise specified and included in the proposal.

A. REINFORCED CONCRETE PIPE. Pipe will be measured in place along the centerline of the pipe from end to end of the pipe, excluding end treatment. Payment will be made at the contract unit price per lineal foot for the various sizes and classes of reinforced concrete pipe. Payment at the contract unit price shall be considered full compensation for furnishing and installing pipe; excavation, granular bedding within the pipe zone, and backfill utilizing native materials.

   Precast pipe end sections will be measured and paid for by each at the contract unit price bid for the various size and classes of reinforced concrete pipe end sections.

B. CONCRETE INLETS AND JUNCTION BOXES. Inlets and junction boxes will be measured by the cubic yard of concrete based upon the lines and dimensions shown on the plans. Payment will be made at the contract unit price bid per cubic yard for "Concrete Inlets/Junction Boxes" and shall be considered full compensation for excavation, forming, granular bedding, backfill utilizing native materials, concrete, reinforcing steel, finishing, and incidental items. Payment for the concrete gutter section within the limits of curb inlets and extensions shall be measured and paid for separately as specified in Section 410 Concrete Curb and Gutter.

   Modification or repair of existing inlets or junction boxes will be measured and payment made as stated above. Removal or existing structures or portion thereof will be considered incidental to the work.

   For precast units, measurement and payment will be made as stated above for cast-in-place.

C. CONCRETE BOX CULVERT. Cast-in-place box culvert will be measured by the cubic yard of concrete based on the lines and dimensions shown on the plans. Payment will be made at the contract unit price bid for "Concrete Box Culvert" and will be considered full compensation for excavation, forming, granular bedding within the pipe zone, backfill utilizing native materials, concrete, reinforcing steel, finishing, and incidental items.

   Headwalls and wingwalls for precast box culvert will be measured and paid for separately as stated below.

   If Contractor elects to use precast concrete box culvert sections in lieu of cast-in-place concrete, payment will be made for the cubic yard quantity of the cast-in-place structure as shown on the plans at the contract unit price bid under "Concrete Box Culvert." Payment will be considered full compensation for any cast-in-place transition sections required, slurry backfill required between parallel runs of boxes, gaskets, grouting of joints as required, manufacture of precast section, transport and delivery of all material, and incidental items.

D. PRECAST CONCRETE BOX CULVERT. Precast Box Culvert shall be measured in place

along the centerline of the culvert from end to end of the box for each run. Payment will be made at the contract unit price per lineal foot for the various sizes and classes of precast concrete box culvert. Payment at the contract unit price shall be considered full compensation for furnishing and installing the boxes; excavation, granular bedding, backfill utilizing native materials; backfill between parallel runs; gaskets and grouting of joints, and all incidental items.

Headwalls and wingwalls for precast box culvert will be measured and paid for separately as stated below.

E. CONCRETE CHANNELS. Reinforced concrete channel will be measured by the cubic yard of concrete based on the lines and dimensions shown on the plans. Headwalls, wingwalls, and transition section which are an integral part of the channel will be paid for as channel. Payment will be made at the contract unit price bid for "Concrete Channel" and will be considered full compensation for excavation, backfill utilizing native materials, granular bedding, forming, concrete, reinforcing steel, finishing, weep holes and underdrains, and incidental items.

F. CONCRETE DITCH PAVING/SLOPE PAVING. Reinforced and non-reinforced concrete ditch paving and slope paving will be measured by the square yard of exposed surface based on the lines and dimensions shown on the plans. Payment will be made at the contract unit price bid per square yard for "Concrete Ditch Paving" and will be considered full compensation for excavation, grading, granular bedding, backfill utilizing native materials, forming, finishing, weep holes and underdrains, concrete, reinforcing steel when called for, and miscellaneous items.

G. CONCRETE HEADWALLS/WINGWALLS/APRONS. Concrete headwalls, wingwalls, and aprons for reinforced concrete pipe and box culvert will be measured by the cubic yard of concrete based on the lines and dimensions shown on the plans. Payment will be made at the contract unit price bid per cubic yard for "Concrete Headwalls/Wingwalls/ Aprons" and shall be considered full compensation for excavation, backfill with native materials, forming, finishing, concrete, reinforcing steel, and incidental items.

H. TRENCH DRAINS. Trench drains constructed to the lines and dimensions shown on the plans shall be measured in place along the centerline of the drain from end to end. Payment will be made at the contract unit price per lineal foot. Payment at the contract unit price shall be considered full compensation for excavation, granular bedding, forming, finishing, reinforcing steel, concrete, furnishing and installing trench grates and frames, and incidental items.

I. RECONSTRUCT TOP - INLET AND JUNCTION BOXES. Reconstruction of the tops of inlet and junction boxes shall be measured according to the number of inlet and/or junction box tops acceptably removed and replaced. Payment will be made at the contract unit price bid, per each, for "Reconstruct Top – Inlets and Junction Boxes" and shall be considered full compensation for excavation, removal of existing top, removal and reuse of existing manhole frame and cover, forming, backfill utilizing native materials, concrete, reinforcing steel, finishing, and incidental items.

J. MANHOLE COVERS AND FRAMES. Manhole covers and frames will be measured with the cover and frame considered as one item. Payment at the contract unit price, per each, shall be considered full compensation for furnishing and installing manhole covers and frames.

K. GRATED COVERS AND FRAMES. Grated covers and frames will be measured with the cover and frame considered as one item. Payment at the contract unit price, per each, shall

be considered full compensation for furnishing and installing grated covers and frames.

Payment will be made under:

Pay Item	Pay Unit
RCP (Type, Size and Class)	LF
Flared End Sections (Type, Size and Class)	EA
Concrete Inlets and Junction Boxes	CY
Concrete Box Culvert	CY
Precast Concrete Box Culvert (Size)	LF
Concrete Channel	CY
Concrete Ditch Paving (Reinforced)	SY
Concrete Ditch Paving (Non-reinforced)	SY
Concrete Headwalls/Wingwalls/Aprons	CY
Trench Drains	LF
Reconstruct Top - Inlet and Junction Boxes	EA
Manhole Covers and Frames	EA
Grated Covers and Frames (Type, Size)	EA

DIVISION 600 - WATER SYSTEM

SECTION 601
WATER LINE IMPROVEMENTS (12 INCHES AND SMALLER)

601.01 SCOPE OF WORK

The work included in this section of the specifications shall consist of furnishing and installing water mains, 12-inches and smaller, and appurtenances for water distribution.

601.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least three (3) years of experience in successfully manufacturing the type of pipe specified.

Any company supplying Ductile Iron (DI) pipe shall submit a full and complete set of detailed shop drawings to the Engineer for review.

The Contractor shall furnish to the Engineer three (3) copies of certificates of shop tests on all pipe furnished under this items. The Engineer shall furnish one (1) copy to the Owner. These tests shall be witnessed by a reputable and established independent testing laboratory. The cost of this testing shall be included in the price bid for this item. No payment shall be made for the materials until the necessary certificates have been furnished.

The manufacturer shall furnish to the Engineer a certified statement that all pipe materials have been manufactured and tested in accordance with the referenced standards.

601.03 CONSTRUCTION SCHEDULING AND COORDINATION

Service to water customers shall not be disrupted during installation of the water line improvements except for the time required to change individual services as specified herein.

No commercial services shall be disrupted during business hours without the approval of the Engineer.

The Contractor shall notify the City of Fort Smith Utility Department at least 4 business days prior to scheduled connections of mains. Shut-downs shall not exceed a maximum of 4 hours, subject to change per the City of Fort Smith policy and the Arkansas Department of Health. Scheduling shall be subject to the approval of the Utility Department and the Engineer. The work of this Section shall be coordinated with the work of other Sections. The Contractor shall make field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all construction items.

The sequence of construction and change over shall be as follows:

A. Install new mains as shown on the plans, including fire hydrants in accordance with AWWA C600 and C605, latest revisions.

B. Test, disinfect and sample mains as specified by the Arkansas Department of Health and AWWA C651, latest revision. After samples are approved by the Arkansas Department of Health and Utility Department, the Utility Department shall operate the water valves to place mains in service.

C. Install new services and transfer customer services to the new main as detailed in Sections 603 and 604.

D. Water lines that are to be abandoned shall have all existing valves closed, the water line shall be cut and capped or plugged within one foot of closed valve. Remove any existing valve boxes and fire hydrants attached to the abandoned line. All removed appurtenances shall remain the property of the Utility Department and returned to 3900 Kelly Highway.

601.04 MATERIALS

All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

A. DUCTILE IRON PIPE & FITTINGS. Pipe shall be 350 pressure class, designed in accordance with AWWA C150, latest revision. Piping shall be manufactured in accordance with AWWA C151, latest revision.

Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA C104, latest revision.

Pipe joints shall be push-on, conforming to AWWA C111, latest revision. Push-on joints shall be equal to the Super Bell-Tie joint as manufactured by the Clow Corporation, or Tyton Joints as manufactured by U.S. Pipe, or equal.

When specified by the Engineer, the exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. The zinc coating system shall conform to ISO 8179-1 “Ductile iron pipe- external zinc-based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

Polyethylene encasement must be installed anytime zinc coating is specified. When specified or detailed on the plans, any installation requiring polyethylene encasement for corrosion protection of ductile-iron pipe, the encasement shall be in accordance with AWWA C105, latest revision.

Restrained, push-on joint pipe shall be similar and equal to one of the following:

American Ductile Iron Pipe's FLEX-RING JOINT pipe or U.S. Pipe's TR FLEX pipe.

Shop drawings shall show all special appurtenances, bends, fittings, joint pulls, beveled joints, depth of bury, pipe classification and strength for the existing laying conditions and all other information necessary for the Engineers approval prior to start of construction.

B. PVC PIPE. Polyvinyl chloride (PVC) pressure pipe shall conform to AWWA C900 and C909, latest revision. PVC pipe shall have the same outside diameter as cast iron pipe, shall have elastomeric-gasket type joints or fusible PVCO when called for on plans, and shall have a minimum pressure class rating of 165 psi unless otherwise specified on the plans.

C. FITTINGS. Fittings shall be ductile-iron compact fittings conforming to AWWA C153, latest revision. Fittings shall be mechanical joint, or flanged as designated on the plans and shall be cement lined, exterior bituminous coated and shall have a minimum working pressure rating of 350 psi.

Mechanical joints shall be furnished with anchor fittings or restrained glands designed for use with the pipe material when specified on the plans. Restrained glands shall be Megalug retainer glands as manufactured by EBAA Iron Sales, Inc or Utility Department approved equal.

D. MISCELLANEOUS FITTINGS. Couplings for joining sections of pipe shall be manufactured of ductile-iron or gray cast-iron in accordance with AWWA C110, latest revision. Gaskets shall be of a permanent and set resistance material in accordance with AWWA C111, latest revision. Bolts shall conform to AWWA C230, latest revision.

The Hymax 2000 Coupling shall be acceptable for working pressure up to 260 psi when installed in accordance with AWWA C219, latest revision.

Adapters for connecting pipes of dissimilar materials shall be manufactured of ductile-iron or gray cast-iron in accordance with AWWA 219, latest revision. Gaskets shall conform to AWWA C111, latest revision.

The Hymax 2100 flanged Adapter shall be acceptable for working pressure up to 260 psi when installed in accordance with AWWA C219, latest revision.

Repair clamps, straps, bolts, and nuts shall conform to AWWA C230, latest revision. Gaskets shall conform to AWWA C111, latest revision.

E. GATE VALVES AND BOXES. Gate valves shall conform to AWWA C509, latest revision or AWWA C515, latest revision. Resilient-Wedge Gate Valves shall be iron body, bronze mounted, resilient seated, non-rising stem valves designed for 250 psi minimum working pressure rating. Valves shall have O-ring packing, open counterclockwise and shall be furnished with 2 inch AWWA nut operator. Valves

furnished shall have mechanical joints for cast iron size pipe. Gate valves shall be Mueller A-2361 or Utility Department approved equal.

Valve boxes shall be of the cast iron extension type. Boxes may be of the screw type and shall be complete with lids marked with the inscription "WATER" cast into the top and a base of the proper size for the valve it is to be used with. The boxes shall be Tyler Two Piece Valve Box Series 461S or 562S, with 5-1/4 inch shaft or Utility Department approved equal. The boxes shall be of such size and length that they can be adjusted to the depth of cover required over the pipe at the valve location without using the full extension. Valve boxes shall have one priming coat and two coats of coal tar.

Valve box risers shall be cast or ductile iron and shall be Tyler Model 68-S 5 ¼-Inch 6850 Screw Type Series or Utility Department approved equal. Fixed type risers shall accommodate the original valve box lids. Adjustable type risers shall be slip type or screw type furnished with new lids. The Contractor is responsible for correct sizing of risers to fit existing valve boxes and lids.

F. TAPPING SLEEVES AND VALVES. Tapping sleeves shall be Mueller H615, or Utility Department approved equal, for C900 PVC and ductile iron and Mueller H619, or Utility Department approved equal, for AC pipe.

Tapping valves shall conform to the requirements for gate valves specified above and shall be Mueller T-2361, or Utility Department approved equal.

G. TRACER WIRE. Tracer wire shall be Trace-Safe type RT1802W or Utility Department approved equal.

H. TRACER WIRE BOX. Tracer wire shall be terminated in magnetized tracer box, Model CD14*TP as manufactured by Copperhead Industries, LLC. or Utility Department approved equal. The tracer box cover will be color coded in accordance with APWA uniform color code. The tracer wire shall not be terminated in any other location.

I. FIRE HYDRANTS. Fire hydrants shall conform to AWWA C502, latest revision. The hydrants shall have "O" Ring seals, two 2-½ inch hose nozzles, one 4-½ inch pumper nozzle, American Standard hose connection threads, 4-½ inch compression type main valve, drain valves, left (counterclockwise) opening, National Standard pentagon operation nut and a self-oiling system for stem threads. Valve and seal shall be all brass construction.

Hydrants shall have incorporated in their design, a breakable connection feature including a safety flange and safety stem coupling immediately above the bury line. This breakable connection shall have a lower breaking strength than the remainder of the unit. The inlet connection shall be 6 inches in size and shall be of the mechanical joint type conforming to AWWA C111, latest revision. Where fire hydrant extensions are required they shall be of the proper design to accommodate the make of fire hydrant installed. Public fire hydrant barrels shall be factory painted Mueller Yellow (Sherwin-Williams Polane SP

Polyurethane F63YL14) while touchup paint shall be Mueller Yellow (Sherwin-Williams KEM 400 Acrylic Enamel F75YH1) or with color as approved by the Owner. Private fire hydrant barrels shall be factory painted Mueller Red (Sherwin-Williams Polane SP Polyurethane F63RL15) while touchup paint shall be Mueller Red (Sherwin-Williams KEM 400 Acrylic Enamel F75RH1) or with color as approved by the Utility Owner. .

Fire hydrants shall be mechanical joint with anchor type fittings. Fire hydrant lead restrained joint shall be swivel hydrant adapter manufactured by Tyler Pipe Swivel by Swivel 5-199SS.

Fire hydrants shall be Mueller Super Centurion 250 A-421 or Utility Department approved equal.

J. BLOW-OFFS. Blow-offs installed on four (4) inch dead end lines shall be an Eclipse No. 85 Blow-off hydrant or Utility Department approved equal. A valve shall be installed within five (5) feet for blow off maintenance. Valves shall conform to specifications in Section 601.04. Water lines six (6) inches to twelve (12) inches shall have a fire hydrants installed at dead end. Fire Hydrants shall be in accordance to 601.04(I).

K. GRAVEL BEDDING. Gravel bedding shall conform to Section 205 "Trench & Structure Excavation and Backfill."

L. CONCRETE. Concrete shall conform to Section 401 "Concrete General." Concrete shall be Class B (2500 psi), unless noted otherwise.

M. POLYETHYLENE WRAPPING. Polyethylene wrapping shall meet the requirements of AWWA C105, latest revision.

601.05 CONSTRUCTION METHODS

A. TRENCH EXCAVATION AND BACKFILL

1. GENERAL. Trench excavation, bedding, boring, encasement, casing, and backfilling are covered in Section 205.

2. BEDDING. Pipe bedding for PVC pipe and Ductile Iron pipe shall conform to Class "B" bedding requirement covered in Section 205.02 (D).

   Bell holes shall be provided at each joint to permit the jointing to be properly made and prevent the joint of the pipe from being a point of support. Each bell hole should be no larger than necessary for joint assembly while still allowing the pipe barrel to lie flat on the trench bottom.

   Whenever any portion of the trench is excavated below grade, the un-necessary over-excavation shall be corrected as detailed in Section 205.04.

B. PIPE INSTALLATION

1. GENERAL. Pipe fittings and accessories shall be unloaded near the place where they are to be laid in the trench. Pipe shall be stored in a manner that allows it to remain clean. They shall at all times be handled with care to avoid damage. Cutting of pipe shall be done by means of a manufacturer approved type of mechanical cutter.

2. PLACEMENT OF PIPE. Section of pipe, fittings and accessories shall be cleaned and inspected for damage immediately prior to placement in the trench. All defective materials shall be rejected. Pipe, fittings and accessories shall be placed in the trench and shall be positioned utilizing hoisting equipment. Pipe shall be laid true to line and grade, with uniform bearing under the full length of the pipe barrel.

When water and sewer lines are closer than ten (10) feet of each other, sewers must be placed so that the bottom of the water line will be at least 18 inches above the top of the sewer line at its highest point. If this distance must unavoidably be reduced, the water line or the sewer line must be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing. Any joint in the encasement pipe is to be mechanically restrained. The encasement pipe may be vented to the surface if carrying water or sewer under pressure. Whenever a sewer line must unavoidably pass above a water line, at least 18 inches of separation must be maintained between the outside of the two pipes in addition to the preceding encasement requirement.

Field bending of PVC pipe will not be allowed with the following exceptions:

- Four (4”) inch lines used in cul-de-sacs shall have no less than a 100 foot radius
- When reviewed and approved by Utility Department.

All other changes in water line alignments shall be accomplished by the use of fittings.

Jointing of pipe shall be accomplished in accordance with the pipe manufacturers' recommendations. Gaskets and lubricants shall be the type recommended by the pipe manufacturer. The spigot end of the pipe shall be inserted into the bell to the required depth and in such manner as to avoid displacement of the gasket. Jointing of mechanical-joint pipe shall be accomplished such that the gland is positioned evenly by tightening alternately the bolts spaced 180 degrees apart.

At times when pipe laying is not in progress, the open ends of the installed pipe shall be closed by a watertight plug. Plug shall be Petersen Mechanical Hand Tightening Series 141, COB Industries Cast Aluminum Expansion Plug, or approved equal. This provision shall apply during the lunch period, overnight, or any other time when work is not in progress.

No pipe shall be laid in wet trench conditions that preclude proper bedding, on a frozen trench bottom, or when in the opinion of the Engineer, the trench conditions or the weather conditions are unsuitable for proper installation.

Polyethylene wrapping when specified, must be installed as detailed in AWWA C105, latest revision.

3. RESTRAINED JOINT SYSTEM. The sealed design drawing shall provide a minimum number of restrained joints to control the pipe thrust. Calculations of pipe restraint and number of restrained joints shall be submitted to the Owner for approval prior to manufacturer of the pipe.

   Restrained joints shall be used unless concrete blocking is authorized by the Engineer. Concrete thrust blocking shall be installed only at the locations shown on the plans. The concrete shall be placed between undisturbed soil and the fitting to be anchored. Care shall be taken to place the thrust block so that the pipe and fitting joints will be accessible for repair. Polyethylene wrapping, as described in Section 601.04M, shall be used to prevent contact between pipe and fittings and the concrete used for thrust blocking.

   The shape and contact area of the concrete thrust blocks shall be as shown on the plans and as directed by the Engineer. The contact area of backing shall be as required to prevent movement of the joint, but in no case shall the contact area be less than one square foot.

4. CONNECTION TO MAINS. Connection of new water mains to existing mains shall be accomplished by installation of tapping sleeves and valves, unless otherwise indicated on the plans. After the main connection is completed, a corporation stop or air relief valve shall be installed near the point of connection, or other locations as needed, to permit expelling air from the line or chlorination of the line. Installation of the tap shall be as directed by the Engineer.

5. TRACER WIRE INSTALLATION. Tracer wire shall be installed in a continuous non-interrupted circuit on all water mains. The wire shall be attached to the top center of the pipe every four feet by a method approved by the Engineer. Tracer wire boxes shall be installed at locations shown on the plans or as determined by the Engineer. A concrete collar with grout shall be placed on each tracer wire box and located outside of pavement surfaces or sidewalks. Tracer wire box spacing shall not exceed 500 feet.

C. VALVES AND APPURTENANCES

1. GATE VALVES. Valves shall be cleaned of all foreign matter before installation and shall be installed at the locations shown on the plans or as directed by the Engineer. Valves shall be set with operating stems in true vertical position. Valve box shall be centered upon the valve.

Earth fill shall be carefully tamped around each valve box for the full depth of the excavation for a distance of not less than 4 feet on all sides or the undisturbed wall of the trench if less than 4 feet. A concrete collar shall be placed on each valve box located outside of pavement surfaces or sidewalks. Precast valve collars are acceptable. All valve collars must be grouted, centered on the valve, and set flush with finished grade. Precast collars shall not be cut in any manner.

2. VALVE BOX GRADE ADJUSTMENT. Valve boxes in pavement areas to receive an asphalt concrete overlay shall be adjusted to grade prior to the start of the overlay operations. Adjustment of valve boxes in areas designated for reconstruction shall be accomplished prior to placement of final pavement surfacing. Boxes shall be set flush with the new roadway grade and cross slope. Structures damaged due to negligence by the Contractor shall be repaired at contractor's expense.

   Where designated on the plans, existing valve boxes shall be removed and replaced with new valve boxes and lids of the type specified. Extensions shall be used as required to obtain the specified grade. Valve boxes shall be backfilled and compacted as specified above. Concrete collars, utilizing Class 'A' fiber-reinforced concrete, shall be constructed around all valve boxes that have been modified. Existing valve boxes that are removed shall remain the property of the Utility Department and returned to 3900 Kelly Highway.

3. APPURTENANCES. Adapters and special fittings shall be installed at the locations shown on the plans. Repair clamps shall be used when authorized by the Engineer.

D. FIRE HYDRANTS. Fire hydrants shall be located and installed as shown on the plans or as directed by the Engineer. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Hydrants shall be set to the finished grade, with bottom of pumper nozzles at least 18 to 24 inches above finished grade. The break away shall be set above finished grade.

Each hydrant shall be connected to the main with a 6-inch ductile iron branch. A 6-inch gate valve shall be placed on this branch to provide independent control of the hydrant. A watch valve must be installed within two (2) feet of hydrant if hydrant lead is longer than ten (10) feet.

The shoe of each hydrant shall be tied to the pipe with approved restrained swivel joints.

A drainage pit shall be provided at each fire hydrant. Location and dimensions of the drainage pit shall be as shown on the plans. Gravel shall conform to paragraph 601.04 (J) of this specification or as approved by the Engineer.

E. STREET CROSSINGS. Installation of water mains at street crossings shall be by boring

unless open cut is required on the plans or is authorized by the Engineer. Excavation, trenching, backfilling and pipe installation shall be as specified in Section 205 "Trench and Structure Excavation and Backfill."

Cuts and repairs of existing asphalt or Portland cement concrete pavement shall be as specified in Section 205.

Removal and replacement of existing curbs and sidewalk shall be as specified in Sections 410 and 440.

F. ABANDONED LINES. Water lines which are to be abandoned shall remain in place except where removal is required for construction of improvements or removal is specifically called for on the plans. Any existing asbestos cement (AC) pipes are to be avoided if at all possible unless directed to be removed by the Engineer or connection to it is required according to the plans. Removal and disposal of AC pipe shall be in accordance with standard construction practices for asbestos removal and the applicable OSHA Standards and State of Arkansas regulations. Any crushed AC pipe is to be removed and disposed of properly and shall not be placed into the fill. AC pipe shall be cut using a chain cutter.

Remaining pipe ends of abandoned lines shall be filled with a concrete plug. The concrete plug length shall be 3 times the diameter of the pipe. Existing fire hydrants to be abandoned shall be removed. Gate valves which are to be abandoned in place shall have the valve boxes removed.

Any abandoned fire hydrants, gate valves, valve boxes and fittings shall remain the property of the Owner. Materials designated on the plans for Owner salvage shall be delivered to the Fort Smith Utility Department located at 3900 Kelley Highway.

All removal, salvage, plugging, and disposal of water lines and appurtenances shall be considered incidental to the project except for AC pipe which will be paid for under the bid item listed in the proposal for 'Removal and Disposal of AC pipe water line.'

601.06 DISINFECTION AND TESTING

After, segments of water line 20 feet or greater have been installed as specified, the entire system shall be given a hydrostatic pressure test, disinfected, and bacteriological test. No water line installation will be accepted until bacteriological test and hydrostatic pressure tests have been performed and results accepted by the Owner.

- Hydrostatic Pressure Test as outlined in Section 601.06(A)
- Bacteriological Tests as outlined in Section 601.06(C)

The Engineer shall provide one copy of all test results to the Utility Department for acceptance.

A. HYDROSTATIC PRESSURE TEST. This may be done in sections between valves as selected by the Contractor for his convenience. All testing must match minimum

standards set outlined in AWWA C600, latest revision, for ductile iron pipe and AWWA C605, latest revision, for PVC pipe.

These tests shall be performed by the Contractor in the presence of the Engineer. The Contractor shall furnish all necessary pressure gauges, meters and pumps and make all taps and connections.

Each valved section of pipe shall be slowly filled, in accordance with AWWA M23, with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Before applying the test pressure, all air shall be expelled from the pipe by permanent taps or corporation cocks where necessary.

It shall be the Contractor's responsibility to locate and repair any and all leaks and defects that may develop. Even though the pipe line may pass the leakage test, any leaks apparent at the ground's surface, any leaking joints, fittings or appurtenances, or any other visible defects shall be repaired to the satisfaction of the Engineer.

The hydrostatic and leakage tests may be performed simultaneously, but the duration of the test shall be not less than 2 hours. A pressure equal to, or exceeding, 1.5 times the working pressure of the pipe and never less than 150 psig at the point of testing shall be maintained throughout the test. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Visible leaks shall be repaired regardless of the amount of leakage measured.

- No pipe installation will be accepted until the leakage is less than the number of gallons per hour, permitted by AWWA C600, latest revision, as determined by the formula:

$$L = \frac{S * D * P½}{148,000}$$

Where:

L = the allowable leakage, in gallons per hour;
S = the length of pipe line tested in feet;
D = the nominal diameter of the pipe, in inches;
P = the average test pressure during the leakage test, in psi inch gage.

The Engineer shall provide one copy of test results to the Utility Department.

B. DISINFECTION. All materials, work, workmanship and methods shall be in accordance with AWWA C651, latest revision, for Disinfecting Water Mains.

The lines shall be thoroughly flushed at a velocity of not less than three (3) feet per second before the disinfection procedures commence in accordance with AWWA 651, latest revision. The disinfecting agent may then be introduced in any manner approved by the Engineer that will insure a uniform distribution in accordance with AWWA C651, latest revision.

The form of chlorine used for the disinfection may be either a liquid chlorine gas-water mixture applied by means of a solution-feed chlorinating device, or a mixture of water and a chlorine-bearing compound of known chlorine content. The chlorine-bearing compounds that may be used can be found in AWWA C651, latest revision. The preparation of these compounds shall be in accordance with AWWA C651, latest revision.

The chlorine mixture selected shall be used in such an amount as to provide a dosage of chlorine in the system of not less than twenty five (25) mg/Liter and a residual at the end of 24 hours of not less than ten (10) mg/Liter. All valves in the lines being disinfected shall be opened and closed several times during the disinfection period. Following a contact period of not less than 24 hours, the chlorinated water shall be flushed from the lines until the chlorine content of the water leaving the main is less than 1 mg/Liter unless otherwise directed by the Engineer. Chlorinated water shall be thoroughly neutralized in accordance to methods outlined in AWWA 655. The neutralized water may then be disposed of in the City's storm sewer system.

C. BACTERIOLOGICAL TEST. Samples of water collected at least 24 hours apart shall be taken by the Contractor in accordance with AWWA C651, latest revision. The samples shall be submitted for analysis to the Arkansas Department of Health (ADH). A copy of the test results from ADH shall be furnished to the Engineer. The Engineer must provide the Utility Department a copy for review. Once the test results are approved by Utility Department, the Utility Department shall operate all water valves to bring the water lines in service.

The disinfection procedures outline in Section 601.06(B) shall be repeated as necessary until two consecutive samples indicate that the water is safe as determined by the ADH. Two copies of the test results from ADH shall be provided to the Engineer. The Engineer shall provide one copy to the Owner.

601.07 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work.

A. WATER PIPE (TYPE, SIZE, CLASS, & COATING). Water pipe will be measured by the linear foot along the centerline of the pipe from center to center of intersecting lines or to the point of connection to existing mains. Payment for water pipe at the contract unit price for the size and type of pipe listed in the proposal shall be considered full compensation for coating, furnishing and installing pipe and materials, including excavation, bedding, backfilling, pipe restraints, testing and disinfection, air release taps, tracer wire, tracer wire boxes, concrete collars, removal and salvage of materials to the city, and related work except as listed below.

Rock excavation and select backfill will be paid for under Section 205 "Trench & Structure Excavation and Backfill." Flowable fill will be paid for under Section 206, "Flowable Fill Material".

B. FITTINGS. Gray and ductile iron fittings will be measured by the listed weight in pounds, excluding glands, bolts and accessories, as given in AWWA C153, latest revision.

No separate payment will be made for miscellaneous fittings, adapters, repair clamps, couplings or other appurtenances.

C. GATE VALVE WITH BOX (SIZE). Gate Valves will be measured and payment made according to the number of each size furnished and installed. Valve boxes, concrete valve box collars, and grout will not be measured separately, but will be included as a portion of the payment for gate valves.

D. VALVE BOX GRADE ADJUSTMENT. Valve boxes adjusted to grade will be measured and payment made according to the number acceptably placed and approved. Payment at the contract unit price per each for "Valve Box Adjustment" will be considered full compensation for excavation; adjustment of the existing valve box and lid; furnishing and installing any risers, if needed; backfill; compaction; concrete collar, grout, and related items.

E. VALVE BOX REPLACEMENT. Payment at the contract unit price per each for "Valve Box Replacement" will be considered full compensation for excavation; furnishing and installation of new valve box and lid; furnishing and installation of any risers, if needed; backfill; compaction; concrete collar, grout, and related items.

F. TAPPING SLEEVE AND VALVE WITH BOX (SIZE). Tapping sleeves and valves will be measured and payment made according to the number of each size furnished and installed including the valve box, concrete thrust blocking, concrete collars and related items.

G. FIRE HYDRANT ASSEMBLY (TYPE). Regular and Parallel Fire hydrant assemblies will be measured and payment made according to the number acceptably placed and approved. Payment for the fire hydrant assembly at the contract unit price listed in the proposal shall be considered full compensation for the hydrant, gate valve, valve box, concrete collar, restraint system, the extension length necessary to install the hydrant at finished grade, the ductile iron pipe length between the line and the fire hydrant, the vertical riser pipe length necessary to install the fire hydrant at finished grade, crushed rock for the drains; and removal, salvage, and delivery of any existing hydrant.

I. FIRE HYDRANT. Fire hydrants will be measured and payment made separately when replacement of only the existing fire hydrant is required, and not the full assembly. Payment for the fire hydrant at the contract unit price listed in the proposal shall be considered full compensation for the removal, salvage, and delivery of the existing fire

hydrant, furnishing and installing the new hydrant, ductile iron pipe required for moving the hydrant, the vertical riser pipe length necessary to install the hydrant at finished grade, and miscellaneous fittings, restraint system, and crushed rock for drains.

J. FIRE HYDRANT EXTENSION. Fire Hydrants adjusted to grade will be measured and payment made according to the linear feet of acceptably installed and approved fire hydrant extension. Payment at the contract unit price per linear foot for "Fire Hydrant Extension" will be considered full compensation for excavation, furnishing and installing any Fire Hydrant Extensions, backfill, compaction, and related items.

K. CONNECTION TO EXISTING LINE (SIZE). Connection to existing lines will be measured and payment made according to the number of each size connection made. Payment for the connection at the contract unit price listed in the proposal shall be considered full compensation for all labor and materials required to complete the work, including miscellaneous fittings.

L. BLOW-OFF ASSEMBLY (SIZE). Blow-off assemblies will be measured and payment made according to the number acceptably placed and approved. Payment for the blow-off assembly at the contract unit price listed in the proposal shall be considered full compensation for the blow-off, miscellaneous fittings, and crushed rock for drains.

M. POLYETHYLENE WRAP (SIZE). Polyethylene wrap will be measured by the linear foot along the centerline of the size of pipe wrapped. Payment for polyethylene wrap at the contract unit price for the size of pipe wrapped listed in the proposal shall be considered full compensation for all labor and materials required to complete the work.

N. REMOVAL AND DISPOSAL OF AC WATER PIPE. Removal and disposal of AC pipe water line will be measured and payment made according to the lineal foot of water line directed to be removed by the Engineer and acceptably removed. Payment for the removal and disposal of AC pipe water line at the contract unit price listed in the proposal shall be considered full compensation for the removal and disposal of the AC pipe water line in accordance with applicable OSHA and State of Arkansas regulations and standards, and backfilling of trench, including all labor, materials and miscellaneous items required to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Water Pipe (Type, Size, Class, and Coating)	LF
Fittings	LB
Gate Valve With Box (Size)	EA
Valve Box Grade Adjustment	EA

Valve Box Replacement	EA
Tapping Sleeve and Valve with Box (Size)	EA
Fire Hydrant Assembly (Type)	EA
Fire Hydrant	EA
Fire Hydrant Extension	LF
Connection to Existing Line (Size)	EA
Blow-Off Assembly (Size)	EA
Polyethylene Wrap (Size)	LF
Removal and Disposal of AC Water Pipe	LF

SECTION 602
WATER LINE IMPROVEMENTS (GREATER THAN 12-INCHES)

602.01 SCOPE OF WORK

The work included in this section of the specifications shall consist of furnishing and installing water mains larger than twelve (12) inches in size, and appurtenances for water distribution.

602.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least ten (10) years of experience in successfully manufacturing the type of pipe specified.

Any company supplying Ductile Iron pipe shall submit a full and complete set of detailed shop drawings to the Engineer for review.
The Contractor shall furnish to the Engineer three (3) copies of certificates of shop tests on all pipe furnished under this items. The Engineer shall furnish one (1) copy to the Owner. These tests shall be witnessed by a reputable and established independent testing laboratory. The cost of this testing shall be included in the price bid for this item. No payment shall be made for the materials until the necessary certificates have been furnished.

The manufacturer shall furnish to the Engineer a certified statement that all pipe materials have been manufactured and tested in accordance with the referenced standards.

602.03 CONSTRUCTION SCHEDULING AND COORDINATION

Service to water customers shall not be disrupted during installation of the water line improvements except for the time required to change individual services as specified herein.

No commercial services shall be disrupted during business hours without the approval of the Engineer.

The Contractor shall notify the City of Fort Smith Utility Department at least 4 business days prior to scheduled connections of mains. Shut-downs shall not exceed a maximum of 4 hours, subject to change per the City of Fort Smith policy and the Arkansas Department of Health. Scheduling shall be subject to the approval of the Utility Department and the Engineer.

The work of this Section shall be coordinated with the work of other Sections. The Contractor shall make field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all construction items.

The sequence of construction and change over shall be as follows:

A. Install new mains as shown on the plans, including fire hydrants in accordance with AWWA C200, C301, and C600, latest revisions.

B. Test, disinfect and sample mains as specified by the Arkansas Department of Health and AWWA C651, latest revision. After samples are approved by the Arkansas Department of Health and Utility Department, the Utility Department shall operate the water valves to place mains in service.

C. Install new services and transfer customer services to the new main as detailed in Sections 603 and 604.

D. Waterlines that are to be abandoned shall have all existing valves closed, the waterline shall be cut and plugged within one foot of closed valve. Remove any existing valve boxes and fire hydrants attached to the abandoned line. All removed appurtenances shall remain the property of the Utility Department and returned to 3900 Kelly Highway.

602.04 MATERIALS

All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

A. CONCRETE PIPE & FITTINGS. Concrete pipe shall conform in all respects to the AWWA C301, latest revision. The pipe shall be designed and furnished to fit the profile and head conditions shown on the Plans in accordance with AWWA C304, latest revision, and shall include the standard allowance for water hammer, in combination with earth dead load resulting from a backfill depth as shown on the plans, but in no case less than six (6) feet; plus external live load, including impact, equal to American Association of State Highway & Transportation Officials (AASHTO) HL-93. The bedding to be considered in the design shall be Type 3 embankment bedding in accordance with AWWA Manual M9, latest revision, "Concrete Pressure Pipe", Chapter 4 “Loads and Supporting Strengths”, or as specified on the Plans.

Manufacturer’s pipe design calculations shall be submitted to the Engineer for approval prior to manufacture of any pipe. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fittings, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, welded joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to the project Plans. Submit lay schedule to the Engineer for review and approval prior to production of pipe and fittings. Provide final approved lay schedule in Adobe portable document format (*.PDF) or other approved format.

Provide pipe sections in standard lengths with minimum length of sixteen (16) feet as indicated on approved lay schedule. Internally and externally mark pipe sections with durable marking to show location and pipe pressure. Prior to arrival on project site, identify pipe sections within limits of thrust restraint with permanent, brightly colored, and highly visible markings on outer coating as approved by Engineer.

Joints shall be rubber gasket push joint. Joint rings shall be protected by extra zinc metal

thickness. Minimum zinc coating shall be two-thousandths (0.002") inch. "Mechanical type" joint restraints shall be provided at every change in alignment, both vertical and horizontal. Joint restrains shall be of the type which provide uniform bearing around the entire circumference of the joint. Joints which provide restraint by concentrated point loads which permanently deform portions of the joint metal shall not be accepted.

All specials and fittings shall conform to AWWA C301, latest revision, and must be built to the details furnished by the manufacturer and approved by the Engineer. All fittings shall be provided with restrained joints of the "mechanical type" or welded.

B. DUCTILE IRON PIPE & FITTINGS. Pipe shall be designed in accordance with AWWA C150, latest revision. Piping shall be manufactured in accordance with AWWA C151, latest revision.

Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA C104, latest revision.

Pipe joints shall be push-on, conforming to AWWA C111, latest revision. Push-on joints shall be equal to the Super Bell-Tie Joint as manufactured by the Clow Valve Company, or Tyton Joints as manufactured by U.S. Pipe, or equal.

Fittings shall be furnished in accordance with AWWA C110, latest revision. Joints shall be mechanical joint conforming to AWWA C111, latest revision. A cement mortar lining and seal coat shall be furnished as detailed above for pipe. Compact fittings conforming to AWWA C153, latest revision, may be used.

When specified by the Engineer, the exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. The zinc coating system shall conform to ISO 8179-1 “Ductile iron pipe- external zinc-based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

Polyethylene encasement must be specified and installed anytime zinc coating is specified. When specified or detailed on the plans, for any installation requiring polyethylene encasement for corrosion protection of ductile-iron pipe, the encasement shall be in accordance with Section 602.04(M) and AWWA C105, latest revision.

Restrained, push-on joint pipe shall be similar and equal to one of the following: American Ductile Iron Pipe’s FLEX-RING JOINT pipe or U.S. Pipe’s TR FLEX pipe.

Shop drawings shall show all special appurtenances, bends, fittings, joint pulls, beveled joints, depth of bury, pipe classification and strength for the existing laying conditions and all other information necessary for the Engineers approval prior to start of construction.

C. STEEL PIPE & FITTINGS. All Steel pipe shall be manufactured and tested in accordance with the AWWA C200, latest revision. Flanges shall be steel fabricated in accordance with AWWA C207, latest revision, Table 2 and 3, Class D. Minimum wall thickness shall be 0.250 inches.

All pipe shall be made up in the shop in sections forty (40) feet to sixty-five (65) feet in length with not more than one (1) circumferential joint in any length. Shorter lengths shall be allowed for specials. Pipes may be made by welding two (2) longitudinal joints or by spiral welding process. No riveted pipe shall be considered. Coupons may be required to be cut from as many as one (1) in each twenty (20) lengths of pipe furnished to check the strength of welds. The strength of any weld must be at least one hundred (100) percent of the strength of the pipe. After each joint of the pipe is completed, it shall be tested under hydrostatic pressure as prescribed by AWWA C200, latest revision, except that fittings fabricated from pipe which has passed the hydrostatic test, but shall have the welds tested by the dye-check method. General sweating of the welds will not be accepted under this test.

Changes in line and grade may be made by steel specials or in the joints. Steel specials shall be used wherever the angle exceeds ten (10) degrees. Specials may be made up of straight pipe fabricated into the required shape or may be made of special rolled sections. Any specials or fittings shall be of the same character and thickness of material as the main pipeline, and shall conform to AWWA C200, latest revision, and AWWA C208, latest revision. Openings for air valves, main connections, and blow-off connections must be provided with suitable reinforcement around the openings, welded to the body of the pipe.

Openings of the sizes shown on the plans shall be furnished with blank flanges or plugs of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings.

Steel pipe shall have ends for slip joints for field welding, beveled ends for field butt welding, or plain ends for mechanically coupled field joints.

The interior of all steel pipe shall be cement mortar lined in accordance with AWWA C205, latest revision. Lining of field joints shall be in accordance with AWWA C205, latest revision.

The exterior of the pipe shall be cleaned and coated with a three layer, 80 mil polyethylene backed butyl rubber tape coating system in accordance with AWWA C214, latest revision. Coating is required on all buried pipe, even in areas where the pipe is to be encased with concrete. 80 mils shall consist of one 20 mil inner layer and two 30 mil outer layers.

Manufacturer's pipe design calculations shall be submitted to the Engineer for approval prior to manufacture of any pipe. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fittings, flange,

and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, welded joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to the project Plans. Submit lay schedule to the Engineer for review and approval prior to production of pipe and fittings. Provide final approved lay schedule in Adobe portable document format (*.PDF) or other approved format.

Pipe is to be furnished with O-ring joints unless otherwise noted on plan. Pipe fabricator shall prepare a pipe laying diagram or laying schedule showing the location of each piece by Mark Number.

O-ring joints shall consist of a flared bell end and a grooved spigot end designed to retain the "O-ring" rubber gasket. The spigot end groove may be rolled in or bar type. Bell and spigot ends shall be sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the difference in diameter between outside of spigot and inside of bell at normal engagement does not exceed .03" measured on circumference with a diameter tape. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200, latest revision. The joint shall be suitable for safe working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection (the tangent of which is not to exceed .75"/D where D is the outside diameter of the pipe in inches) or with a pull-out of 3/4".

O-ring joints shall be electrically bonded using #4 copper bonding wire and thermite welding cartridges furnished by the pipe fabricator.

Shop applied outside coating shall be continuous to the end of pipe on the bell end and shall be cut back on spigot end so that coating extends at least ½" inside of the bell end at normal engagement. Shop applied inside lining shall be continuous to the end of pipe on the spigot and shall be cut back on the bell end at the point of maximum engagement or further as shown on plans. Inside of bell and outside of spigot shall be painted one shop coat of primer (Polyken #927 or equal).

Fittings are to be fabricated in accordance with AWWA C200, latest revision, including non-destructive testing by dye penetrant of welds not previously tested in the straight pipe. Fittings shall conform to the dimensions of AWWA C208, latest revision, or may be fabricated into standard pipe lengths. Elbows 0 to 22-1/2 Degrees shall be two piece, 23 to 45 Degrees shall be three piece, 46 to 67-1/2 Degrees shall be four pieces, and laterals, and outlets shall be reinforced in accordance with ASME Pressure Vessel Code, Section VII Paragraph G-37 or AWWA M-11, latest revision. Flanges shall be in accordance with AWWA C-207, latest revision.

Couplings shall be coated with the same coating as specified for the pipe. The interior joints shall be plastered with cement-mortar as specified under AWWA C205, latest revision.

D. MISCELLANEOUS FITTINGS. Couplings for joining sections of pipe shall be

manufactured of ductile-iron or gray cast-iron in accordance with AWWA C110, latest revision. Gaskets shall be of a permanent and set resistance material in accordance with AWWA C111, latest revision. Bolts shall conform to AWWA C230, latest revision.

Adapters and couplings shall be approved by the Utility Department and acceptable for working pressure up to 260 psi when installed in accordance with AWWA C219, latest revision. Gaskets shall conform to AWWA C111, latest revision.

Adapters for connecting pipes of dissimilar materials shall be manufactured of ductile-iron or gray cast-iron in accordance with AWWA 219, latest revision. Gaskets conform to AWWA C111, latest revision.

Repair clamps, straps, bolts, and nuts shall conform to AWWA C230, latest revision. Gaskets conform to AWWA C111, latest revision.

E. VALVES.

1. BALL VALVES. Ball valves shall conform to AWWA C507, latest revision.

2. BUTTERFLY VALVES. Butterfly valves shall conform to AWWA C504, latest revision.

3. GATE VALVES AND BOXES. Gate valves shall conform to AWWA C509, latest revision, or AWWA C515, latest revision, and shall be iron body, bronze mounted, resilient seated, non-rising stem valves designed for 250 psi minimum working pressure rating. Valves shall have O-ring packing, open counterclockwise and shall be furnished with 2 inch AWWA nut operator. Valves furnished shall have mechanical joints for cast iron size pipe. Gate valves shall be Mueller A-2361 or approved equal.

Valve boxes if approved shall conform to Section 601.

F. TAPPING SLEEVE AND VALVES. Tapping sleeves shall be Mueller H615, or Utility Department approved equal, for C900 PVC and ductile iron and Mueller H619, or Utility Department approved equal, for AC pipe.

For pipe diameters of 14 inches and larger, Mueller H-304 SS and Smith-Blair 665 are acceptable with prior approval by the City of Fort Smith Utility Department. The entire assembly, including bolts, nuts, and washers, must be stainless steel.

Tapping valves shall conform to the requirements for gate valves specified above and shall be Mueller T-2361, or Utility Department approved equal.

G. TRACER WIRE. Tracer wire shall be Trace-Safe type RT1802W or Utility Department approved equal.

H. TRACER WIRE BOX. Tracer wire shall be terminated in magnetized tracer box, Model CD14*TP as manufactured by Copperhead Industries, LLC., or Utility Department approved equal. The tracer box cover will be color coded in accordance with APWA uniform color code. The tracer wire shall not be terminated in any other location.

I. FIRE HYDRANTS. Fire hydrants shall conform to AWWA C502, latest revision. The hydrants shall have "O" Ring seals, two 2-½ inch hose nozzles, one 4-½ inch pumper nozzle, American Standard hose connection threads, 4-½ inch compression type main valve, drain valves, left (counterclockwise) opening, National Standard pentagon operation nut and a self-oiling system for stem threads. Valve and seal shall be all brass construction.

Hydrants shall have incorporated in their design, a breakable connection feature including a safety flange and safety stem coupling immediately above the bury line. This breakable connection shall have a lower breaking strength than the remainder of the unit. The inlet connection shall be 6 inches in size and shall be of the mechanical joint type conforming to AWWA C111, latest revision. Where fire hydrant extensions are required they shall be of the proper design to accommodate the make of fire hydrant installed. Public fire hydrant barrels shall be factory painted Mueller Yellow (Sherwin-Williams Polane SP Polyurethane F63YL14) while touchup paint shall be Mueller Yellow (Sherwin-Williams KEM 400 Acrylic Enamel F75YH1) or with color as approved by the Owner. Private fire hydrant barrels shall be factory painted Mueller Red (Sherwin-Williams Polane SP Polyurethane F63RL15) while touchup paint shall be Mueller Red (Sherwin-Williams KEM 400 Acrylic Enamel F75RH1) or with color as approved by the Utility Department.

Fire hydrants shall be mechanical joint with anchor type fittings. Fire hydrant lead restrained joint shall be swivel hydrant adapter manufactured by Tyler Pipe Swivel by Swivel 5-199SS.

Fire hydrants shall be Mueller Super Centurion 250 A-421.

J. BLOW-OFFS. Blow-offs for water lines greater than twelve (12) inches shall conform to the design shown in City of Fort Smith Standard Drawings.

K. GRAVEL BEDDING. Gravel bedding shall conform to Section 205 “Trench & Structure Excavation and Backfill.”

L. CONCRETE. Concrete shall conform to Section 401 “Concrete General.” Concrete shall be Class B (2500 psi), unless noted otherwise.

M. POLYETHYLENE WRAPPING. Polyethylene material shall meet the requirements of AWWA C105, latest revision.

602.05 CONSTRUCTION METHODS

A. TRENCH EXCAVATION AND BACKFILL

1. GENERAL. Trench excavation, bedding, boring, encasement, casing, and backfilling are covered in Section 205.

2. BEDDING. Pipe bedding shall conform to Class "B" bedding requirement covered in Section 205.02 (D).

   Bell holes shall be provided at each joint to permit the jointing to be properly made and prevent the joint of the pipe from being a point of support. Each bell hole should be no larger than necessary for joint assembly while still allowing the pipe barrel to lie flat on the trench bottom.

   Whenever any portion of the trench is excavated below grade, the un-necessary over-excavation shall be corrected as detailed in Section 205.04.

B. PIPE INSTALLATION

1. GENERAL. Pipe fittings and accessories shall be unloaded near the place where they are to be laid in the trench. Pipe shall be stored in a manner that allows it to remain clean. Pipe shall at all times be handled with care to avoid damage. Cutting of pipe shall be done by means of a manufacturer approved type of mechanical cutter.

2. PLACEMENT OF PIPE. Section of pipe, fittings and accessories shall be cleaned and inspected for damage immediately prior to placement in the trench. All defective materials shall be rejected. Pipe, fittings and accessories shall be placed in the trench and shall be positioned utilizing hoisting equipment. Pipe shall be laid true to line and grade, with uniform bearing under the full length of the pipe barrel.

   Field bending of pipe will not be allowed.

   All changes in water line alignments shall be accomplished by the use of fittings.

   Jointing of pipe shall be accomplished in accordance with the pipe manufacturers' recommendations. Gaskets and lubricants shall be the type recommended by the pipe manufacturer. The spigot end of the pipe shall be inserted into the bell to the required depth and in such manner as to avoid displacement of the gasket. Jointing of mechanical-joint pipe shall be accomplished such that the gland is positioned evenly by tightening alternately the bolts spaced 180 degrees apart.

   At times when pipe laying is not in progress, the open ends of installed pipe shall be closed by a watertight plug. Plug shall be Petersen Mechanical Hand Tightening Series 141, COB Industries Cast Aluminum Expansion Plug, or approved equal. This provision shall apply during the lunch period, overnight, or any other time when work is not in progress.

No pipe shall be laid in wet trench conditions that preclude proper bedding, on a frozen trench bottom, or when in the opinion of the Engineer, the trench conditions or the weather conditions are unsuitable for proper installation.

Polyethylene wrapping when specified, must be installed as detailed in AWWA C105, latest revision.

C RESTRAINED JOINT SYSTEM. Restrained joints shall be used unless concrete blocking is authorized by the Engineer. Concrete thrust blocking shall be installed only at the locations shown on the plans. The concrete shall be placed between undisturbed soil and the fitting to be anchored. Care shall be taken to place the thrust block so that the pipe and fitting joints will be accessible for repair. Polyethylene wrapping, as described in Section 602.04M, shall be used to prevent contact between pipe and fittings and the concrete used for thrust blocking.

The shape and contact area of the concrete thrust blocks shall be as shown on the plans and as directed by the Engineer. The contact area of backing shall be as required to prevent movement of the joint, but in no case shall the contact area be less than one square foot.

The Design Engineer must provide a sufficient number of restrained joints to control the pipe thrust. Calculations of pipe restraint and number of restrained joints shall be submitted to the Owner for approval prior to manufacturer of the pipe for this project.

602.06 DISINFECTION AND TESTING

After, segments of water line 20 feet or greater have been installed as specified, the entire system shall be given a hydrostatic pressure test, disinfected, and bacteriological test. No water line installation will be accepted until bacteriological test and hydrostatic pressure tests have been performed and results accepted by the Owner.

- Hydrostatic Pressure Test as outlined in Section 602.06(A)
- Bacteriological Tests as outlined in Section 602.06(C)

The Engineer shall provide one copy of all test results to the Owner for acceptance.

D. HYDROSTATIC PRESSURE TEST. This may be done in sections between valves as selected by the Contractor for his convenience. All testing must match minimum standards set outlined in AWWA C600, latest revision, for ductile iron pipe and AWWA C605, latest revision, for PVC pipe.

These tests shall be performed by the Contractor in the presence of the Engineer. The Contractor shall furnish all necessary pressure gauges, meters and pumps and make all taps and connections.

Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner

satisfactory to the Engineer. Before applying the test pressure, all air shall be expelled from the pipe by permanent taps or corporation cocks where necessary.

It shall be the Contractor's responsibility to locate and repair any and all leaks and defects that may develop. Even though the pipe line may pass the leakage test, any leaks apparent at the ground's surface, any leaking joints, fittings or appurtenances, or any other visible defects shall be repaired to the satisfaction of the Engineer.

The hydrostatic and leakage tests may be performed simultaneously, but the duration of the test shall be not less than 2 hours. A pressure equal to, or exceeding, 1.5 times the working pressure of the pipe and never less than 150 psig at the point of testing shall be maintained throughout the test. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Visible leaks shall be repaired regardless of the amount of leakage measured.

- Leakage is less than the number of gallons per hour, permitted by the latest AWWA revisions of C600 for Ductile Iron Pipe, C604 for Steel Pipe, and M9 for Concrete Pressure Pipe.

The Engineer shall provide one copy of test results to the Owner.

E. DISINFECTION. All materials, work, workmanship and methods shall be in accordance with the latest revision of the AWWA C651, latest revision, for Disinfecting Water Mains.

The lines shall be thoroughly flushed at a velocity of not less than three (3) feet per second before the disinfection procedures commence in accordance with AWWA 651, latest revision. The disinfecting agent may then be introduced in any manner approved by the Engineer that will insure a uniform distribution in accordance with AWWA C651, latest revision.

The form of chlorine used for the disinfection may be either a liquid chlorine gas-water mixture applied by means of a solution-feed chlorinating device, or a mixture of water and a chlorine-bearing compound of known chlorine content. The chlorine-bearing compounds that may be used can be found in AWWA C651, latest revision. The preparation of these compounds shall be as outlined in AWWA C651, latest revision.

The chlorine mixture selected shall be used in such an amount as to provide a dosage of chlorine in the system of not less than twenty five (25) mg/Liter and a residual at the end of 24 hours of not less than ten (10) mg/Liter. All valves in the lines being disinfected shall be opened and closed several times during the disinfection period. Following a contact period of not less than 24 hours, the chlorinated water shall be flushed from the lines until the chlorine content of the water leaving the main is less than 1 mg/Liter unless otherwise directed by the Engineer. Chlorinated water shall be thoroughly neutralized in accordance to methods outlined in AWWA 655. The neutralized water may then be disposed of in the City’s storm sewer system.

F. BACTERIOLOGICAL TEST. Samples of water collected at least 24 hours apart shall be taken by the Contractor in accordance with AWWA C651, latest revision. The samples shall be submitted for analysis to the Arkansas Department of Health (ADH). A copy of the test results from ADH shall be furnished to the Engineer. The Engineer must provide the Owner a copy for review. Once the test results are approved by Owner, the Owner shall operate all water valves to bring the water lines in service.

The disinfection procedures outline in Section 602.06(B) shall be repeated as necessary until two consecutive samples indicate that the water is safe as determined by the ADH. Two copies of the test results from ADH shall be provided to the Engineer. The Engineer shall provide one copy to the Owner.

602.06 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work. Valve Boxes, Fire Hydrants, Polyethylene Wrap, Removal and Disposal of AC Water Pipe, and associated items will be paid for under Section 601.

A. WATER PIPE (WATER LINE GREATER THAN 12-INCHES) (TYPE, SIZE, CLASS, & COATING). Water pipe will be measured by the linear foot along the centerline of the pipe from center to center of intersecting lines or to the point of connection to existing mains. Payment for water pipe at the contract unit price for the size and type of pipe listed in the proposal shall be considered full compensation for coating, furnishing and installing pipe and materials, including excavation, bedding, backfilling, pipe restraints, testing and disinfection, air release taps, tracer wire, tracer wire boxes, concrete collars, removal and salvage of materials to the city, and related work except as listed below.

Rock excavation and select backfill will be paid for under Section 205 "Trench & Structure Excavation and Backfill." Flowable fill will be paid for under Section 206, "Flowable Fill Material".

B. FITTINGS (WATER LINE GREATER THAN 12-INCHES). Gray and ductile iron fittings will be measured by the listed weight in pounds, excluding glands, bolts and accessories, as given in AWWA C153.

No separate payment will be made for miscellaneous fittings, adapters, repair clamps, couplings or other appurtenances.

C. VAULT ADJUSTMENT. Valve vaults adjusted to grade will be measured and payment made according to the vertical feet acceptably placed and approved. Payment at the contract unit price per each for "Vault Adjustment" will be considered full compensation for excavation; adjustment of the existing vault and lid; furnishing and installing any

risers, if needed; backfill; compaction; and related items.

D. VAULT. Payment at the contract unit price per each for "Vault" will be considered full compensation for excavation; furnishing and installation of new vault and lid; furnishing and installation of any risers, if needed; backfill; compaction; and related items.

E. TAPPING SLEEVES AND VALVES WITH BOX (WATER LINE GREATER THAN 12-INCHES). Tapping sleeves and valves will be measured and payment made according to the number of each size furnished and installed including the valve box, concrete thrust blocking, concrete collars and related items.

F. BLOW-OFF ASSEMBLY (WATER LINE GREATER THAN 12-INCHES). Blow-off assemblies will be measured and payment made according to the number acceptably placed and approved. Payment for the blow-off assembly at the contract unit price listed in the proposal shall be considered full compensation for the blow-off, miscellaneous fittings, and crushed rock for drains.

Payment will be made under:

Pay Item	Pay Unit
Water Pipe (Water Line Greater Than 12-Inches) (Type, Size, Class, and Coating)	LF
Fittings (Water Line Greater than 12-Inches)	LBS
Vault Adjustment	VF
Vault	EA
Tapping Sleeve and Valve with Box (Water Line Greater than 12-Inches)	EA
Blow-off Assembly (Water Line Greater than 12-Inches)	EA

SECTION 603
WATER SERVICES (1 and 2 Inch Service Lines)

603.01 SCOPE OF WORK

The work included in this section of the specifications shall consist of furnishing and installing water services and appurtenances for one (1) inch and two (2) inch service lines.

603.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least five (5) years of experience in successfully manufacturing the type of pipe specified.

The Contractor shall furnish to the Engineer three (3) copies of certificates of shop tests on all pipe furnished under these items. Engineer shall provide one (1) copy to the Owner. These tests shall be witnessed by a reputable and established independent testing laboratory. The cost of this testing shall be included in the price bid for this item. No payment shall be made for the materials until the necessary certificates have been furnished.

The manufacturer shall furnish to the Engineer a certified statement that all pipe materials have been manufactured and tested in accordance with the referenced standards.

603.03 CONSTRUCTION SCHEDULING AND COORDINATION

Service to water customers shall not be disrupted during installation of the water line improvements except for the time required to change individual services as specified herein. No commercial services shall be disrupted during business hours without the approval of the Engineer.

The Contractor shall notify the City of Fort Smith Utility Department at least four (4) business days prior to scheduled connections to mains and installation of water meters. Scheduling shall be subject to the approval of the Utility Department and the Engineer.

It shall be the Contractor's responsibility to notify the water customer 48 hours prior to interruption of service. Service shall not be interrupted for more than 4 hours during service tie-over. The Contractor shall connect the service line and the customer service line to the meter. A licensed plumber is required to modify a customer’s service lines.

The work of this Section shall be coordinated with the work of other Sections. The Contractor shall make field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all construction items.

The sequence of construction and change over shall be as follows:

A. Install new mains as shown on the plans and specified in Sections 601 & 602.

B. Test, disinfect and sample mains as specified by the Arkansas Department of Health requirements and specified in Sections 601 & 602. After samples are approved by the Arkansas Department of Health and Utility Department, the Utility Department shall operate the water valves to place mains in service.

C. Install new services, including saddles, flush service lines, and transfer customer services to the new water service line.

D. Service lines that are to be abandoned shall have all existing valves closed, the waterline shall be cut and plugged within one foot of closed valve.

603.04 MATERIALS

All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

A. SERVICE LINE. Water service line shall be either copper or flexible plastic tubing. Copper tubing shall be in accordance with ASTM Specification B88, "Seamless Copper Water Tubing." All copper pipe shall be Type K suitable for flared fittings.

Flexible plastic tubing shall be ADS or JM Eagle HDPE Water Service Tubing or Utility Department approved equal. Flexible plastic tubing shall be manufactured of polyethylene plastic and in accordance with AWWA C901, latest revision. The outside diameter of all plastic tubing shall be same as copper tubing. All plastic tubing shall be capable of maintaining a pressure of 200 psi at 73 degrees Fahrenheit (23 degrees Celsius) for 1000 hours, shall have a minimum working pressure rating of 200 psi and SIDR of 9, and shall be approved by the National Sanitation Foundation.

B. WATER METER. Meters shall be supplied by the Fort Smith Utility Department.

C. METER BOXES AND YOKES. Meter boxes shall be of cast iron with cast iron locking lid. The words "WATER METER" shall be cast in the lid. Inlet and outlet connections shall be waterworks brass. A meter clamping devise within the box shall be provided to enable wrench-free changing of the meter and shall be of waterworks brass. The outlet shall be straight. The inlet shall incorporate a quarter-turn valve with "O" ring seal. The inlet connections shall be in line with meter connections. Meter Boxes shall be from the list below or Utility Department approved equal to:

METER SIZE	METER BOX
5/8"	**Commercial, Residential, & Irrigation** **Ford LYLBB 111-444-95539-008-NL with A14 fitting**
1"	**Commercial, Residential, & Irrigation** **Ford LYLBB 244-444-95539-008-NL**
1-1/2"	**28"X30" Meter Box Assembly as manufactured by East Jordan Iron Works, Product Number 32143001A14** **Meter setter shall be Ford VV77-18H-1177-NL with A67 fitting**
2"	**28"X30" Meter Box Assembly as manufactured by East Jordan Iron Works, Product Number 32143001A14** **Meter setter shall be Ford VV77-18HB-11-77-NL**

D. CORPORATION STOPS AND SERVICE SADDLES. Corporation stops shall be 1-inch nominal size and shall be bronze with AWWA thread on inlet end. Outlet end shall be flared or compression fittings. Corporation stops to be Ford F1000-4-G-NL for 1 inch and in accordance with AWWA C800, latest revision.

Service saddles body shall be ductile iron epoxy coated and shall be tapped for AWWA thread. A neoprene gasket shall be cemented in place to saddle body. Saddle straps shall be stainless steel flat straps with stainless steel bolts. Service saddles shall be Smith-Blair 317 or Utility Department approved equal and conform to AWWA C800, latest revision.

E. MISCELLANEOUS FITTINGS. Miscellaneous fittings and adapters for service lines shall be wrought copper, cast bronze, or brass and conform to AWWA C800, latest revision.

F. SERVICE LINE CASING. Installation and payment of casing shall be as specified in Section 205 TRENCH STRUCTURE AND BACKFILL. One (1) inch service lines shall have a two (2) inch casing. Two (2) inch service lines shall have a four (4) inch casing.

603.05 CONSTRUCTION METHODS

Service lines and appurtenances shall be installed in conformance with the plans and as specified in these specifications.

Trench excavation and backfill and related work shall conform to Section 205.

A. SERVICE CONNECTION AND SERVICE LINE. Service connections shall be made by use of a service saddle for all mains. Service taps shall be made at an approximate 45 degree angle from the vertical.

Service lines shall be placed to the line and grade shown on the plans or established by the Engineer. Service lines shall be placed at right angles to the water main. Service lines shall be laid to a minimum depth of 18 inches below the finish ground surface except when stated in Section 205.06.

Trenching, Bedding, and Backfilling shall conform to the appropriate subsections in Section 205.

Tubing shall be connected using the specified fittings and in such a manner to avoid excessive stress on the line.

B. SERVICE LINE CASING. Service line conduit shall be installed as shown on the plans and as directed by the Engineer in accordance with the requirements for pipe casing in Section 205.

Service lines extending beneath existing pavements which are to remain in place shall be installed in an encasement by boring or other subsurface method. The method used shall be approved by the Engineer and shall be a method which will avoid subjecting the service tubing to excessive stress. If obstructions are encountered and installation of a

service line cannot be accomplished by boring, the service line shall be installed by the open trench method. Cutting and replacement of existing pavements shall be in accordance with Section 205.09.

C. WATER METER. Water meters shall be installed by city personnel unless otherwise directed by Utility Department.

D. WATER METER BOX. Water meter boxes shall be installed with the top of the box flush with the finished grade or sidewalk surface. The meter and yoke shall be centered within the box.

E. CUSTOMER SERVICE. The abandoned meter, meter box, yoke and curb stop shall remain the property of the Owner. These materials shall be removed and delivered to the Fort Smith Utility Department located at 3900 Kelley Highway.

603.06 TESTING

Service line connections shall be inspected with normal system pressure on the service lines. The Contractor shall correct all leaks.

603.07 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications, shall be at the contract unit prices listed in the proposal for water line service in the various sizes specified. Payment at the contract unit price shall be considered full compensation for furnishing all materials, labor, professional services, equipment, tools, supplies and incidentals necessary to install service lines, connect to the main, and to reconnect to the customer's meter.

A. WATER SERVICE CONNECTION (SIZE). Service connections shall be measured and payment made according to the number of each size furnished and installed. Payment for service connections will be full compensation for furnishing and installing corporation stops, service saddles, tapping of main line, excavation, trenching, backfilling, compaction, and related work.

B. WATER SERVICE LINE (SIZE, TYPE, CLASS). Service line tubing will be measured by the linear feet of the size and type installed. Payment for water service line will be full compensation for furnishing and installing tubing, excavation, trenching, backfilling, compaction, connections to corporation stop, and meter box and related work.

Service line casing will be measured and paid for as casing under Section 205.

C. WATER METER BOX (SIZE). Water meter box will be measured and payment made according to the number of each size and type furnished and/or installed. Payment for water meter boxes will be full compensation for meter boxes, meter stops, yokes, adapters, fittings, removal and disposal of any existing meter box, connection to customer service line and for excavation, backfilling, compaction, installation of meters and related work.

D. ADJUST WATER METER BOX TO GRADE. Adjust water meter box to grade will be measured and payment made according to the number of boxes adjusted. Payment will be full compensation for the adjusting of the existing meter box to grade, for excavation and backfilling, and all related work.

If replacement of existing meter box is required, payment will be made under Water Meter Box pay item.

Payment will be made under:

Pay Item	Pay Unit
Service Connection (Size)	EA
Service Line (Size & Type)	LF
Water Meter Box (Size)	EA
Adjust Water Meter Box to Grade	EA

SECTION 604
WATER SERVICES (Service Lines Greater Than 2 Inch)

604.01 SCOPE OF WORK

The work included in this section of the specifications shall consist of furnishing and installing water services and appurtenances for service lines greater than two (2) inches.

604.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least five (5) years of experience in successfully manufacturing the type of pipe specified.

Any company supplying pipe shall submit a full and complete set of detailed shop drawings to the Engineer for review. Shop drawings shall show all special appurtenances, joint pulls, beveled joints, depth of bury, pipe classification and strength for the existing laying conditions and all other information necessary for the Engineers approval prior to start of construction.

The Contractor shall furnish to the Engineer three (3) copies of certificates of shop tests on all pipe furnished under these items. Engineer shall provide one (1) copy to the Owner. These tests shall be witnessed by a reputable and established independent testing laboratory. The cost of this testing shall be included in the price bid for this item. No payment shall be made for the materials until the necessary certificates have been furnished.

The manufacturer shall furnish to the Engineer a certified statement that all pipe materials have been manufactured and tested in accordance with the referenced standards.

604.03 CONSTRUCTION SCHEDULING AND COORDINATION

Service to water customers shall not be disrupted during installation of the water line improvements except for the time required to change individual services as specified herein.

No commercial services shall be disrupted during business hours without the approval of the Utility Department or Engineer.

The Contractor shall notify the City of Fort Smith Utility Department at least four (4) business days prior to scheduled connections to mains and installation of water meters. Scheduling shall be subject to the approval of the Utility Department and the Engineer.

It shall be the Contractor's responsibility to notify the water customer 48 hours prior to interruption of service. Service shall not be interrupted for more than 4 hours during service tie-over. The Contractor shall connect the service line and the customer service line to the meter. A licensed plumber is required to modify a customer’s service lines.

The work of this Section shall be coordinated with the work of other Sections. The Contractor shall make field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all construction items.

The sequence of construction and change over shall be as follows:

A. Install new mains as shown on the plans and specified in Sections 601 & 602.

B. Test, disinfect and sample mains as specified by the Arkansas Department of Health requirements and specified in Sections 601 & 602. After samples are approved by the Arkansas Department of Health and Utility Department, the Utility Department shall operate the water valves to place mains in service.

C. Install new services, including tap and sleeves, valves, and vaults as shown on plans. Disinfect service lines longer than 20 feet, perform bacteriological tests per ADH requirements, and once the tests pass, and transfer customer services to the new main.

D. Water lines that are to be abandoned shall have all existing valves closed, the water line shall be cut and plugged within one foot of closed valve. Remove any existing appurtenances attached to the abandoned line. All removed appurtenances shall remain the property of the Utility Department and returned to 3900 Kelly Highway.

604.04 MATERIALS

All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

A. SERVICE LINES. Water service line shall be ductile iron.

1. Ductile Iron Pipe & Fittings.
   Pipe shall be designed in accordance with AWWA C150, latest revision. Piping shall be manufactured in accordance with AWWA C151, latest revision.

   Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA C104, latest revision.

   Pipe joints shall be push-on, conforming to AWWA C111, latest revision. Push-on joints shall be equal to the Super Bell-Tie joint as manufactured by the Clow Corporation, or Tyton Joints as manufactured by U.S. Pipe, or equal.

   Fittings shall be furnished in accordance with AWWA C110, latest revision. Joints shall be mechanical joint conforming to AWWA C111, latest revision. A cement mortar lining and seal coat shall be furnished as detailed above for pipe. Compact fittings conforming to AWWA C153, latest revision may be used.

   When specified by the Engineer, the exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. The zinc coating system shall conform to ISO 8179-1 “Ductile iron pipe- external zinc-based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

   Polyethylene encasement must be installed anytime zinc coating is specified. When specified or detailed on the plans, any installation requiring polyethylene encasement

for corrosion protection of ductile-iron pipe, the encasement shall be in accordance with AWWA C105, latest revision.

Restrained, push-on joint pipe shall be similar and equal to one of the following: American Ductile Iron Pipe's FLEX-RING JOINT pipe or U.S. Pipe's TR FLEX pipe

B. WATER METERS. Meters shall be supplied by the Fort Smith Utility Department. Water meters greater than two (2) inches have significant lead times. Meters should be requested a minimum of eight (8) weeks in advance to insure there are no delays in procurement.

C. METER VAULT. Meter vaults shall be designed and constructed in a manner that meets or exceeds the design shown in the Standard Details.

D. TAPPING SLEEVES AND VALVES. Tapping sleeves shall be Mueller H615, or Utility Department approved equal, for C900 PVC and ductile iron.

For pipe diameters of 14 inches and larger, Mueller H-304 SS and Smith-Blair 665 are acceptable with prior approval by the City of Fort Smith Utility Department. The entire assembly, including bolts, nuts, and washers, must be stainless steel.

Tapping valves shall conform to the requirements for gate valves specified in Section 601 and shall be Mueller T-2361, or Utility Department approved equal.

E. SERVICE LINE CASING. Installation and payment of casing shall be in accordance with "water main casings" as specified in Section 205.06. Service line casings for services greater than two (2) inches shall have a minimum clearance of two (2) inches at each bell of the encased service line.

604.05 CONSTRUCTION METHODS

Service lines and appurtenances shall be installed in conformance with the plans and as specified in Section 601.05 CONSTRUCTION METHODS.

A. SERVICE LINE CASING. Installation and payment of casing shall be in accordance with water main casings specified in Section 205.06.

B. WATER METER. Water meters shall be installed by city personnel unless otherwise directed by Utility Department.

C. WATER METER VAULT. Vaults shall be installed by city personnel unless otherwise directed by Utility Department. Vaults shall be installed with the top of the box flush with the finished grade or sidewalk surface.

D. CUSTOMER SERVICE. The abandoned meter and appurtenances shall remain the property of the Owner. These materials shall be removed and delivered to the Fort Smith Utility Department located at 3900 Kelley Highway.

604.06 TESTING

Service line connections shall be inspected with normal system pressure on the service lines. The Contractor shall correct all leaks. Lines greater than twenty (20) feet in length shall be disinfected and tested in accordance with Arkansas Department of Health regulations and AWWA C651, latest revision and further detailed in Section 601.06 DISINFECTION AND TESTING.

604.07 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications, shall be at the contract unit prices listed in the proposal for water line service in the various sizes specified. Payment at the contract unit price shall be considered full compensation for furnishing all materials, labor, professional services, equipment, tools, supplies and incidentals necessary to install service lines, connect to the main, and to reconnect to the customer's meter.

Pipe and Valves for service lines greater than two (2) inches shall be paid for in accordance with Section 601 WATER LINE IMPROVEMENTS (12 Inches and Smaller).

A. WATER METER VAULT (TYPE). Water meter vault will be measured and payment made according to the number of each type furnished and installed. Payment for water meter vaults will be full compensation for meter vault, adapters, fittings, removal and disposal of any existing meter box, vault, connection to customer service line, excavation, backfilling, compaction, and related work.

Payment will be made under:

Pay Item	Pay Unit
Water Meter Vault (Type)	

DIVISION 700 - SANITARY SEWER SYSTEM

SECTION 701
CLEANING AND CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION

701.01 SCOPE OF WORK

The work specified in this Section includes furnishing all necessary labor, materials, equipment, services and incidentals required to properly clean and visually inspect, by means of color closed-circuit television (CCTV), all proposed sewer sections, including, but not limited to, all recording and playback equipment, materials and supplies.

Cleaning shall include proper pressure water jetting, rodding, root cutting, bucketing, brushing and flushing of sewers and manholes prior to inspection by CCTV, pipeline rehabilitation or replacement, point repairs, manhole preparation, and testing operations. CCTV inspection shall also be performed after new installation, or after rehabilitation of, sewer mains, service lines, and manholes.

The goal of cleaning is to remove debris, roots, intruding services, deposits, and other blockages to a minimum of 95 percent open. Contractor shall perform sewer cleaning work to an acceptable level as necessary to perform a thorough CCTV inspection of sewer mains and sewer services. If the pipe condition is such that cleaning may cause a potential collapse, then the pipe shall be televised without cleaning, pending approval by Owner or Engineer.

The Engineer will designate the location of all manhole access points. Unless specified by the Owner, the Contractor shall be responsible for providing all traffic control barricades, signage and flaggers as necessary to access all manhole entry points. See Section 120 – Maintenance of Traffic and Traffic Control.

The Contractor shall coordinate all water meter devices with the City of Fort Smith's Meter Department, at 3900 Kelley Highway, 479-784-3953. The meter shall be installed by the City. The Contractor is responsible for all deposits and service charges for the use of the City's meter, including service fees when the meter is moved. The Contractor is responsible for providing all piping, hoses and connections to use the water.

The Contractor shall properly dispose of all debris removed from the pipe at the City of Fort Smith Landfill, 5900 Commerce Road, Fort Smith. Tipping fees are the responsibility of the Contractor. Any hazardous waste material encountered during this project will be considered as a changed condition.

Each designated sewer main section, sewer service line, and manholes shall be inspected by means of a CCTV camera. For sewer mains, the inspection will be done one section at a time and the section being inspected will be suitably isolated from the remainder of the sewer line as required.

The Contractor shall provide copies of video inspections and reports.

Scheduling and coordination shall conform to Section 702 – New Sanitary Sewer Lines.

701.02 SUBMITTALS

All submittals must be approved by the Engineer unless otherwise noted. The Contractor shall submit the following items for approval:

A. CERTIFICATIONS. A copy of all certifications must be submitted to the Engineer. The Contractor evaluating and reporting pipeline defects must be certified through the Pipeline Assessment and Certification Program (PACP) and Manhole Assessment and Certification Program (MACP) as administrated by the National Association of Sewer Service Companies (NASSCO).

B. CLEANING METHODS. Proposed cleaning methods and equipment for all sizes of sewer mains and sewer services, and all flow diversion procedures shall be submitted to the Engineer.

C. TRAFFIC CONTROL PLAN. Proposed traffic control plan shall be submitted to the Owner. All traffic control plans shall comply with the requirements in Section 120 – Maintenance of Traffic and Traffic Control.

D. WORK SCHEDULE. Two (2) copies of a work schedule showing the planned cleaning and inspection reaches shall be submitted to the Engineer, which will be updatedmonthly, and submitted with pay applications. . The Engineer shall provide one (1) copy to the Owner.

E. EXPERIENCE. The Contractor shall submit documentation of have a minimum of three (3) years of experience in sewer main, sewer service line, and manhole cleaning and video work. The Contractor shall submit a list of at least three (3) customers with whom they have completed similar work.

F. CLOSEOUT DOCUMENTS. Two (2) copies of the completed sewer inspection reports, digital recordings, photos, and other data must be submitted to the Engineer. Engineer shall provide one (1) copy to the Owner.

CCTV inspection logs shall be kept by the Contractor and will clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. In addition, other data of significance including the locations of building and house service connections, along with an estimation of infiltration from such services, joints, unusual conditions, roots, storm sewer connections, sags, collapsed sections, presence of scale and corrosion and other discernible features will be recorded and a copy of such records will be supplied to both the Owner and Engineer.

Video recordings of the data on the television monitor shall be made by the Contractor and copies of which, on an external storage device acceptable to the Utility Department, shall be provided to the Owner. Recordings shall be labeled in such a way to indicate Owner's project number and name, date of CCTV inspection, description of item inspected, Contractor's name, and whether the inspection is pre-repair or post-construction CCTV recording (or both).

G. SAMPLE NOTIFICATION. Notifications shall be distributed as provided in Section 711 – Notification.

701.03 QUALITY ASSURANCE

The Contractor shall furnish trained and qualified technicians with proper experience to operate all equipment to be used on this project.

The Contractor shall provide sufficient cleaning and inspection equipment, including standby units, to complete all sewer main and sewer service cleaning and inspections within the designated contract time. The Contractor shall allow the Owner or Engineer to become familiar with the Contractor's monitoring and recording equipment before commencement of work.

The Contractor shall provide at all times a competent field supervisor on site who is in charge of the cleaning and inspection. Engineer must be notified of any changes to the field supervisor role. Any change of supervision must also be approved by the Owner or Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions, as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

701.04 CLEANING

A. NORMAL CLEANING. Cleaning accomplished using water jets to scour and remove debris, grease, light roots, etc. from pipe and manhole in 1 to 3 complete passes of the nozzle. This Work shall be classified as light hydraulic cleaning that shall be performed in conjunction with the repair, rehabilitation, pre-construction and post-construction inspections, etc. of existing or new sewer mains, sewer services lines, or manholes as specified herein.

B. HEAVY CLEANING. Cleaning accomplished using water jets or other mechanical means, to scour and remove debris, mineral deposits, removal of roots larger than fine roots (as defined by PACP), hardened grease, and debris from pipe and manhole in 4 or more complete passes of the nozzle. Heavy Cleaning also includes trimming of intruding sealing ring material, and the trimming of protruding lateral and/or service pipes that extend into the sewer main, the cutting of other debris that cannot be removed by normal cleaning methods, , and using a robotic cutter specifically designed for this purpose.

C. CLEANING EQUIPMENT. Equipment used shall be of a movable dam type and be constructed so that a portion of the dam may be collapsed at any time during cleaning

operation to protect against flooding of sewer. Movable dam shall be same diameter as pipe being cleaned and shall provide flexible scraper around outer periphery to ensure total removal of grease. If sewer cleaning balls or other such equipment which cannot be collapsed instantly are used, take special precautions against flooding of sewers and public or private property.

D. GENERAL. During sewer cleaning operations, satisfactory precautions shall be taken in use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard flow in sewer line are used, precautions shall be taken to ensure that water pressure created does not damage or cause flooding of public or private property being served by sewer.

It is preferred that sewer cleaning shall take place in an order of upstream to downstream. If cleaning is done in a downstream pipe segment in order to facilitate overall cleaning operations, any downstream segments requiring additional cleaning shall be re-cleaned at no additional cost to Owner, after pipes upstream of that segment have been cleaned.

If cleaning of an entire section cannot be successfully performed from one manhole, equipment shall be set up on other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or equipment fails to traverse entire manhole section, it will be assumed that a major blockage exists. The line shall be CCTV inspected to determine the cause of blockage. With the Engineer's approval the cleaning effort shall be repeated with other types of Utility Department approved equipment. Immediately report any blockages to Owner or Engineer.

No fire hydrant shall be obstructed.

Remove pipe, hoses and related equipment from fire hydrant meters at end of each work day. Fire hydrant meters shall only be removed by the Utility Department.

Vacuum trucks may be used to remove debris from manholes.

E. PERFORMANCE. Pre-repair CCTV inspection shall be conducted by Contractor and use to evaluate conditions of manholes and sewer lines to select appropriate cleaning scope and equipment.

Contractor shall provide appropriate screening to prevent passage of materials into downstream sewers. Sludge, dirt, sand, rocks, grease, and other solid or semisolid residue, debris, and material resulting from cleaning operations shall be removed at downstream manhole of section of sewer being cleaned.

Debris, residue, and other materials resulting from cleaning operations shall be removed from site at end of each workday and shall be disposed of in accordance with Section 701.01.

Obtain video proof of heavy cleaning by acquiring a 'before' video of accessible portions of obstructed reach; submit to Owner or Engineer along with completed inspection. A submerged camera does not justify a need for heavy cleaning; proof that submergence was due to a blockage or heavy debris and not a sag in the line will be required.

Flushing of sanitary sewer mains and/or sewer services to facilitate cleaning activities without the capture of solids and debris is expressly prohibited.

Retrieval of equipment lodged in pipes or a wet well is Contractor's responsibility and shall be performed at Contractor's expense.

701.05 CLOSED CIRCUIT TELEVISION INSPECTION (CCTV)

The Contractor shall inspect sewer mains and service lines with pan, tilt and zoom conventional television imagery to record relevant features and defects.

A. CCTV EQUIPMENT. The camera shall be mounted on a tractor or skid such that the central axis of the camera is aligned with the central longitudinal axis of the sewer pipe. The camera shall be kept upright while moving through the sewer.

The camera light head shall include a high-intensity side viewing lighting system to allow illumination of internal sections of lateral sewer connections. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe for a distance of 30 feet ahead of the camera. The lighting system shall minimize reflective glare and be of adjustable intensity.

The camera lens shall be capable of rotating 360 degrees and turning at least 240 degrees (pan and tilt) and of proper height to allow inspection of the sewer, service lateral connections, manhole structure (including cone section and corbel), and all defects. The radial view camera shall be solid-state color and have remote control of the rotational lens. Cameras incorporating mirrors for viewing sides or using exposed rotating heads will not be allowed. The camera lens shall be an auto-iris type with remote controlled manual override.

Sewer mains shall be inspected with a camera that shall provide an image in full color, have a minimum High Definition 720 Progressive resolution, and shall be operative in 100 percent (100%) humidity conditions. Camera shall be operative in 100% humidity conditions, have a minimum 10X optical zoom lens, and have a footage counter that indicates travel distance to 1/10 of a foot. The camera shall provide digital video image, and a minimum 3.1 megapixel digital photo image, suitable for recording on a digital storage device.

Sewer service line inspections will utilize a lateral launch inspection camera from the sewer main, or from the cleanout. The camera shall be full-color video capability, have a minimum High Definition 720 Progressive resolution, shall be operative in 100 percent (100%) humidity conditions, and include a sonde device for identification of the location

of the unit from above ground. The camera shall be able to extend to at least 80 feet from mainline, have variable light intensity, and rotation control.

B. CCTV OPERATION. Perform all CCTV inspection using personnel who are trained and certified (current standing) in the use of NASSCO's Pipeline and Assessment Certification Program (PACP) and Manhole Assessment and Certification Program (MACP).

Move the camera through the line in either direction (direction versus flow must however be noted) at less than or equal to 30 feet per minute rate, stopping at all service locations and when necessary to permit proper documentation of the construction features and pipe condition. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

Do not float the camera unless permitted by the Owner or their designated representative.

If pre-repair video (CCTV) inspection reveals an obstruction in the existing sewer main or service line (heavy solids, dropped joints, protruding service laterals, protruding utility lines, or collapsed pipe) which cannot be removed by conventional sewer cleaning equipment, the Contractor shall remove the obstruction with the Owner or Engineer's approval. Obstruction removal shall be performed by digging an obstruction elimination pit, removing the obstruction, and making point repairs as needed. Collapsed pipe shall be replaced by pipe replacement or by other measures as approved by the Owner or Engineer.

The camera must be stopped at all service laterals and pan at such an angle that an internal view of the service lateral is available. Digital photographs must be made of every service lateral or deficiency observed in the sewer line and the photograph itself must contain a brief description of the issue. The descriptions must also be noted in the inspection condition record within the database. All digital photos must be cataloged in the CCTV database and linked to the specific length along the inspection via linkage to the defect record in the database.

Provide a complete CCTV inspection for the upstream and downstream manholes in accordance with MACP. The CCTV operator shall pan and zoom up the manhole from the invert for each manhole, and obtain the best possible image of the manhole including cone and corbel sections. In addition, digital photos shall be taken for each pipe connection within each manhole. The CCTV operator shall zoom in on each pipe connection so the photos capture each pipe connection's size, location, and approximate elevation.

If, during the inspection operation, the television camera will not pass through the entire main or service line due to obstruction, set up the CCTV equipment so that the inspection can be performed from the opposite manhole. Reverse setups must be noted in the CCTV

database submittal in a separate database field to indicate that the inspection was performed in the reverse direction of flow.

C. DATA DELIVERY. The Contractor shall provide all recording and playback equipment for real-time monitoring of CCTV inspection. The digital inspection files shall be provided to the Owner or Engineer in an external storage device acceptable to the Utility Department.

CCTV videos shall be submitted in one continuous video section from manhole to manhole, and not in multiple files, unless specifically approved by Owner.

If the data is available, the Owner will provide the Contractor information on the location of known active service lines and cleanouts; however, this list may not be interpreted as all-inclusive. The Contractor shall be responsible for verifying active customer service connection prior to rehabilitation. The Contractor shall compare the service connections from the CCTV video with above ground measurements. Any discrepancies between the CCTV data and above ground measurements of laterals shall be brought to the attention of the Owner or Engineer for a determination of lateral reinstatements. If the Contractor discovers an error or addition to the list provided, the Contractor shall notify the Owner or Engineer for additional investigation. Upon completion of the rehabilitation work, a list of all service laterals abandoned or reconnected as part of the work shall be submitted to the Owner in .PDF format. The compiled list shall include the following information:

(1) Location of each service line based on the CCTV inspection logs. Location shall include both accurate distance measured from the wall of starting manhole as well as a notation (by clock-reference) of where on the circumference of the pipe, the service lateral connects.

(2) Status (Active or Inactive).

(3) The address of each customer and associated active service line.

All service line connections must be identified as reestablished or abandoned in post rehabilitation CCTV.

If pre-installation video (CCTV) inspection reveals a sag in the existing sewer that is greater than 1/4 of the existing pipe's diameter or causes the CCTV camera lens to be underwater, the Owner or Engineer should be notified to determine if the sag is acceptable or if repair is required.

D. SANITARY SEWER LINES TO BE VIDEOED. The Contractor is responsible for completing CCTV work on the following categories of line segments:

(1) Pre-CCTV Work
   a. Pipe Burst Lines
   b. CIPP Lines

c. Service Lines Rehabilitated by CIPP
d. Point Repairs

(2) Post-CCTV Work
a. New Sanitary Sewer Lines
b. Existing Sanitary Sewer Lines Replaced by Open Cut
c. Existing Sanitary Sewer Lines Replaced by Pipe Burst
d. Existing Sanitary Sewer Lines Rehabilitated by CIPP
e. Service Lines Rehabilitated by CIPP
f. Point Repairs made by Open Cut
g. Point Repairs made by CIPP

701.06 SEWER INSPECTION SOFTWARE

All software shall be capable of providing complete survey reports in compliance with current PACP standards and the software shall be the latest version of the PACP compliant software available from the software vendor for the particular software package used by the Contractor, and shall be viewable using Cues GraniteNet software.

The PACP defect and construction codes shall be pre-programmed in the certified NASSCO CCTV software and grouped in accordance with PACP.

The software shall be capable of customization with the ability to modify or add to the pipeline condition and group them for ease of use.

The footage reading from the camera equipment shall be automatically entered into the database and shall directly correspond to the noted defect location throughout the pipe graphic and tabular reports generated.

All NASSCO PACP mandatory fields and any additional available fields requested by the Owner or his representative shall be populated during the inspections.

The software shall maintain a database of underground pipe and manhole assets referencing the pipe and manhole structure asset identifier codes provided in GIS format by the Owner in accordance with PACP and Utility Department standards. The pipe segment information shall be entered prior to the actual survey based on the numbering convention provided by the Owner. Surveys for pipes found not to be included in the Owner's GIS database will be numbered. The software shall also have the capability to import and export survey results in the current NASSCO PACP Exchange digital format and to manage the database to meet the specifications herein.

701.07 DATA DELIVERY REQUIREMENTS

Contractor shall submit in electronic format digital videos, digital photographs, databases in PACP Exchange format, and evaluation reports to Owner.

If digital photos and videos are of such quality that Owner is unable to evaluate the condition of the sanitary sewer main, locate the sewer service line connections, or verify the cleaning, then the Contractor shall be required to CCTV the sanitary sewer and provide new digital photos and videos of good quality, at no additional cost to Owner.

All digital photos and videos will become the property of Owner.

Data is to be delivered to Engineer for review prior to starting any repairs. Sections of a single segment of sewer main shall not be delivered on more than one submittal item. Video footage of recorded segments shall be grouped by area and shall be submitted in sequential order relating to the areas agreed upon by the Engineer. Throughout the duration of the project, should the Engineer discover inaccuracies in any of the videos, Contractor shall re-inspect those segments at no additional cost to the Owner.

Contractor shall provide inspection database data in the most current version of PACP Exchange format. The data shall specifically include video indexing for all observations including a direct linkage to Owner's GIS database features (manholes and pipe segments using Owner's numbering convention) and the electronic video and still image files delivered with each delivery data set. Data to be submitted shall include: 1) NASSCO PACP exchange database file, 2) still images of all defects in .jpg image format, 3) .mpg video inspection files for each pipe segment. Files shall be named in accordance with the Owner's requirements provided and agreed to in writing prior to commencing any work.

The CCTV equipment/software shall be capable of producing digital still images of all sewer line defects, and sewer line service connections in .jpg image format. Contractor shall take digital still images of each defect, construction features and service connections to clearly depict it. The screen captures or digital images shall include an onscreen display with date, sewer main reach number, footage, and type of defect/PACP Code. The filename of each .jpg shall be in accordance with this specification.

A final, compiled version of the inspection database in PACP Exchange format must be delivered at the end of the project. The final database must include all inspection records previously delivered in the individual inspections as well as incorporate all requested changes by the Owner. The database filename will use the following format using upper case letters:

(1) For Contractors:

P_ABC _1600C1_YYYYMMDD.MDB

Where P = PACP database; ABC = Contractor name code, 1600C1 = Contract Number (ex. Contract 16-01-C1), and YYYYMMDD = 8 digit date.

(2) For Developers:

P_ABC _XXXXX_YYYYMMDD.MDB

Where P = PACP database; ABC = Developer name code, XXXXX = Permit Number, and YYYYMMDD = 8 digit date.

All database inspection records must be linked to the Owner's unique pipe numbering system which is based on the upstream and downstream structure numbers for the pipe end structures (manhole, outfall, cleanout, etc.). The unique pipe identifier must take the form of UPSTREAM STRUCTURE NUMBER followed by DOWNSTREAM STRUCTURE NUMBER separated by a colon (:). For example: S008-2510:S008-2500 would be the pipe between structure numbers S008-2510 and S008-2500. These values will be provided within the Owner's GIS database however, if additional intermediate structures are located the naming convention described below must be used.

During the inspection work, if a previously unknown manhole not shown in the GIS is found, the letter "A" will be added to the end of the upstream manhole ID (no spaces or special characters allowed) to form a new manhole ID in the inspection records. The data / video files shall then be re-named to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found between two named manholes, subsequent new manhole IDs will be formed using the letters "B", "C" etc. Individual and final deliverables must include database records that link to the Owner's GIS database using unique manhole identification numbers per the Owner's standard manhole identification number (Facility_ID field in the Owner's GIS) format. The newly located manholes must be documented on a printed map showing the location relative to the existing known up and downstream structures.

Example file names for pipe segments that may be encountered while performing sanitary sewer CCTV inspections include:

Example file name for pipe segment between an Upstream structure and Downstream structure:

(1) S008-2510_S008-2500_YYYYMMDD.MPG

Where S008-2510 = the upstream structure ID, S008-2500= the downstream structure ID, and YYYYMMDD = 8 digit date.

There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised heading upstream. The name of additional database files etc. produced in these circumstances shall be that unique upstream structure ID followed by the unique downstream structure ID followed by "_1", "_2" etc.

Examples:

(1) Initial file name: S008-2510_S008-2500_YYYYMMDD.MPG

(2) Additional file name(s): S008-2510_S008-2500_YYYYMMDD_1.MPG

Where S008-2510 = the upstream structure ID, S008-2500= the downstream structure ID, YYYYMMDD = 8 digit date, 1 = a subsequent video of the same sewer ID).

The direction of camera pull versus the pipe flow must be noted in the inspection record in the database.

The name of each digital still image shall be based on the video / data file name of the sewer reach in which the image was taken. The name shall be recorded as follows:

Examples:

(1) S008-2510_S008-2500_YYYYMMDD_HSV-37_YYYYMMDD_2.jpg

(2) S008-2510_S008-2500_YYYYMMDD_1_MCU-113YYYMMDD_7.jpg

Where S008-2510 = the upstream structure ID, S008-2500= the downstream structure ID, HSV and MCU are PACP defect codes, 37 and 113 are the footage counts for the defect locations along the pipe, YYYYMMD is the 8 digit date, and 2 and 7 are the sequential defect photo numbers along the pipe.

Sewer services shall be identified as follows:

(1) S008-2510_Address Of Sewer Service Line_1_YYYYMMDD.MPG or jpg

Where S008-2510 is the upstream manhole number; Address Of Sewer Service Line is the address of the structure connected to the sewer service; 1 is the number of service line from the structure, and increases by 1 for each sequential service connected from that address; YYYYMMDD is the 8 digit date.

Contractor shall provide a digital summary in Microsoft Excel or Access formats that lists the contents of each delivery of required data. Each delivery must include:

(1) A single CCTV inspection database in PACP format containing the inspection results for the agreed upon delivery area.

(2) Digital video records corresponding only to the inspections delivered in the above database.

(3) Digital photographs of significant features or issues noted during each inspection as specified herein.

At the end of the Project, Contractor shall provide a digital summary listing of all videos provided under this Project in Microsoft Excel or Access formats as well as a final inspection database containing the combined inspection records from all previous deliveries.

701.08 ACCEPTANCE

Acceptance of sewer main line cleaning and/or service line cleaning shall be contingent on satisfactory completion of television CCTV inspection. If television CCTV inspection shows cleaning to be unsatisfactory, sewer line and/or service line shall be re-cleaned and re-inspected until cleaning is shown to be satisfactory at no additional cost to the Owner.

701.09 OVERFLOWS OR SPILLS

It shall be the responsibility of the Contractor to schedule and perform the contract work in a manner that does not cause or contribute to incidences of overflows, spills of sewage from the sewer systems, or backup of sewage flow into public or private services/property. In the event that work activities contribute to overflows, spills or backups, the Contractor shall immediately notify the Owner and take all appropriate actions to contain and stop the overflow or backup, clean the spillage, and disinfect the area affected.

The Contractor will indemnify and hold harmless the Owner and Engineer for any fines or third-party claims for personal or property damage arising out of a spill, overflow or backup that is the responsibility of the Contractor, including but not limited to legal, engineering and administrative expenses of the Owner in defending such fines and claims.

701.10 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work. Data collection shall be considered incidental to construction.

CCTV and normal cleaning shall be incidental to pipe bursting and/or cured in place pipe (CIPP) operations and shall be paid for under Specification Section 705 Rehabilitation of Existing Sewer Lines with CIPP and/or Section 707 Pipe Bursting.

Sewer service line CCTV and cleaning shall be incidental to the rehabilitation of service lines. Sewer service line rehabilitation shall be paid for under Specification Section 708 Service Lateral Connection Lining Process.

A. HEAVY CLEANING. Heavy cleaning of the specified size shall be measured by the actual number of linear feet of pipe cleaned as approved by the Owner or Engineer. Measurement shall be to the nearest foot of the actual footage of what was cleaned. Heavy cleaning of the existing sewer pipe shall be paid for the respective quantities as determined at the Contract unit price bid. This price and payment shall be full compensation for locating existing manholes, the removal, transportation, and disposal of debris within the sewers in accordance with these Specifications, for obtaining water, maintenance of flow in existing sewers including bypass pumping and plugs necessary for heavy cleaning and all other incidentals thereto for which separate payment is not

provided for under other Items. Pre-CCTV SEWER MAIN and NORMAL CLEANING must be performed before Heavy Cleaning payment will be allowed.

B. POST-CCTV SEWER MAIN (SIZE). Post-CCTV of the existing sanitary sewer main of the specified size shall be measured in place on a linear foot basis to the nearest foot. Measurement shall be along the horizontal centerline of the pipe with no deductions for manholes and shall be from wall of manhole to wall of manhole. Payment for CCTV of the sanitary sewer main shall include, but not limited to, providing all equipment, materials and labor for inspecting the sewer pipe in accordance with NASSCO PACP standards prior to acceptance; maintenance of flow in existing mains including bypass pumping and plugs; furnishing and creating copies of the inspections on external hard drives to be delivered to the Owner and Engineer; creating copies of inspection logs to be delivered to the Owner and Engineer; and all else incidental thereto for which separate payment is not provided under other Items.

C. POST-CCTV SEWER SERVICE LINE: Sewer service line Post-CCTV shall be measured from the wall of the sanitary sewer main to the clean out, on a linear foot basis. CCTV of the sewer service line shall include, but not be limited to, providing all equipment, materials and labor for inspecting the sewer service; maintenance of flow in existing sewer service lines; furnishing and creating copies of the inspections on external hard drives to be delivered to the Owner and Engineer; creating copies of inspection logs to be delivered to the Owner and Engineer; and all other incidentals thereto for which separate payment is not provided under other Items.

Payment will be made under:

Pay Item	Pay Unit
Heavy Cleaning	LF
Post-CCTV Sewer Main (Size)	LF
Post-CCTV Sewer Service Line	LF

SECTION 702
NEW SANITARY SEWER LINES

702.01 SCOPE OF WORK

This work shall consist of furnishing all labor, materials, tools, equipment, incidentals, testing and construction methods required to install all gravity sanitary sewer pipe, service pipe, and fittings including sewer testing; cleaning; and collecting GPS data at services; complete and accepted, in accordance with the Contract Documents.

Excavating, trenching, backfilling and sewer appurtenances are specified in Section 205.

702.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least three (3) years of experience in successfully manufacturing the type of pipe specified.

Certification shall be the basis of all acceptance of materials as required below. The Contractor shall submit two (2) copies of the manufacturer's test report to the Engineer with results or a statement by the seller stating the material has been sampled, tested, and inspected. Each certification shall be signed by an authorized agent of the seller or manufacturer. Engineer shall provide one (1) copy to the Owner. All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

702.03 CONSTRUCTION SCHEDULING AND COORDINATION

Service to sewer customers shall not be disrupted during installation of the sewer line improvements except for the time required to change individual services as specified herein.

No commercial services shall be disrupted during business hours without the approval of the Engineer.

The Contractor shall notify the City of Fort Smith Utility Department at least 48 hours prior to scheduled connections of mains. Scheduling shall be subject to the approval of the Utility Department and the Engineer.

The work of this Section shall be coordinated with the work of other Sections. The Contractor shall make field measurements at the site to verify or supplement indicated dimensions and to ensure proper coordination of all construction items.

702.04 MATERIALS

All gasket and joint materials, lubricants, adhesives and other incidental materials shall conform to the pipe manufacturer's recommendations.

A. SOLID WALL PVC PIPE. Solid Wall PVC. Pipe, sizes 6 inch to 15 inch, shall be Poly Vinyl Chloride (PVC) Sewer Pipe conforming to ASTM D3034, latest revision. Solid Wall PVC Pipe, sizes 18 inch to 36 inch, shall be Poly Vinyl Chloride (PVC) Sewer Pipe conforming to ASTM F679, latest revision. Minimum wall thickness shall conform to SDR 35. Joints shall be elastomeric gasket type. Fittings shall be PVC, elastomeric joint, conforming to ASTM D3034 or ASTM F679. All pipe sections shall be straight and true in alignment. All pipe and fittings shall be tested at the factory in accordance with ASTM D2152, D2412 and D2444. Acceptable Manufactures include Diamond Plastics Corp., J-M Manufacturing, National Pipe and Plastics, Inc., North American Pipe Corp., or approved equals.

B. PROFILE POLYPROPYLENE PIPE. Profile Polypropylene Pipe for gravity-flow sanitary sewer applications, sizes 12-inch through 30-inch, shall have a smooth interior and annular exterior corrugations and shall conform to ASTM F2736. Profile Polypropylene Pipe for gravity-flow sanitary sewer applications, sizes 30-inch through 60-inch, shall have a smooth interior and exterior surface with annular inner corrugations and shall conform to ASTM F2746. Profile Polypropylene Pipe shall be joined with a gasketed, watertight integral bell and spigot joint conforming to ASTM D3212. Spigot shall have two gaskets conforming to ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with removable, protective wrap to ensure the gaskets are free from debris. Pipe shall have a reinforced bell with polymer composite band installed by manufacturer. A flexible, water tight connection utilizing pipe manufacturer adaptors for exterior corrugated pipe together with the appropriate water tight connector shall be used at manhole connections. All pipe sections shall be straight and true in alignment.

C. DUCTILE IRON PIPE. Ductile iron pipe shall conform to AWWA C151, latest revision, and shall be pressure class 350, push-on joint, with bituminous interior and exterior coating as detailed in the latest revision of AWWA C111. Fittings shall be gray iron or ductile iron conforming to AWWA C110, latest revision, or compact fittings shall conform to AWWA C153, latest revision. Pipe and fitting shall be protected with a minimum 40-mils Tnemec epoxy interior lining applied by a certified manufacturer, and bituminous exterior coating as detailed in the latest revision of AWWA C111.

D. SERVICE LINES. Service lines shall be Schedule 40 PVC manufactured from Type I, Grade I polyvinyl Chloride compound conforming to ASTM D1785 or approved equal.

E. POLYETHYLENE WRAPPING. Polyethylene material for pipe encasement shall meet the requirements of AWWA C105, latest revision. Wrapping shall completely shield the pipe from contact with the concrete encasement.

F. TRACER WIRE. Tracer wire shall be Trace-Safe type RT1803W or Utility Department approved equal.

G. TRACER WIRE BOX. Tracer wire shall be terminated in magnetized tracer box, Model CD14*TP as manufactured by Copperhead Industries, LLC. The tracer box cover will be

color coded in accordance with APWA uniform color code. The tracer wire shall not be terminated in any other location.

702.05 QUALITY ASSURANCE

A. All sewer pipe and fittings of a similar type (e.g., solid wall or profile wall) shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034, ASTM F1760 or ASTM F789 as applicable. In addition, all sewer pipe to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the Owner or Engineer.

B. Inspections of the pipe may also be made by the Owner or Engineer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

702.06 PIPE HANDLING AND STORAGE

Pipe and fittings shall be handled and stored in such a manner as to protect them from damage. The pipe manufacturer's recommendations shall be followed with regard to special storage requirements.

702.07 CONSTRUCTION REQUIREMENTS

Connections to structures and related work shall be as specified in Section 703.

A. TRENCH EXCAVATION AND BACKFILL

(1) GENERAL. Trench excavation, bedding, boring, encasement, casing, and backfilling are covered in Section 205.

(2) BEDDING. Pipe bedding for PVC pipe and Ductile Iron pipe shall conform to Class "B" bedding requirement covered in Section 205.02 (D).

(3) BELL HOLES. Bell holes shall be provided at each joint to permit the jointing to be properly made and prevent the joint of the pipe from being a point of support. Each bell hole should be no larger than necessary for joint assembly while still allowing the pipe barrel to lie flat on the trench bottom.

(4) OVER EXCAVATION. Whenever any portion of the trench is excavated below grade, the over excavation shall be corrected as detailed in Section 205.04.

B. PIPE INSTALLATION

(1) GENERAL. Pipe fittings and accessories shall be unloaded near the place where they are to be laid in the trench. Pipe shall be stored in a manner that allows it to remain clean. They shall at all times be handled with care to avoid damage. Cutting of pipe shall be done by means of a manufacturer approved type of mechanical cutter.

(2) PLACEMENT OF PIPE. Pipe, fittings and accessories shall be cleaned and inspected for damage immediately before and after placement in the trench. Any pipe found to be cracked, damaged or otherwise defective shall be rejected, and plainly marked in such a manner that the markings will not rub or wash off, and the pipe shall subsequently be removed from the site. Pipe, fittings and accessories shall be placed in the trench and shall be positioned utilizing hoisting equipment. Pipe shall be laid true to line and grade, with uniform bearing under the full length of the pipe barrel. The Contractor shall be responsible for maintaining the specified elevations, lines and grades. All sewer pipe installed at incorrect elevations, lines and grades shall be removed and reinstalled by the Contractor at their expense. The Contractor shall furnish and operate laser equipment or other devices required for aligning and grading pipe.

The construction of all sewers shall begin at the outlet or the low point of the line. When the construction involves the installation of lateral branches, the construction of the laterals shall not be started until the main sewer has been completed to the point where the lateral discharges into it.

All changes in sewer line alignments shall be accomplished by the use of manholes.

Jointing of pipe shall be accomplished in accordance with the pipe manufacturers' recommendations. Gaskets and lubricants shall be the type recommended by the pipe manufacturer. The spigot end of the pipe shall be inserted into the bell to the required depth and in such manner as to avoid displacement of the gasket. Bell and spigot pipe shall be laid with the bell end upstream unless otherwise directed by the Engineer.

At times when pipe laying is not in progress, the open ends of the installed pipe shall be closed by a watertight plug. Plug shall be Petersen Mechanical Hand Tightening Series 141, COB Industries Cast Aluminum Expansion Plug, or approved equal. This provision shall apply during the lunch period, overnight, or any other time when work is not in progress.

No pipe shall be laid in wet trench conditions that preclude proper bedding, on a frozen trench bottom, or when in the opinion of the Engineer, the trench conditions or the weather conditions are unsuitable for proper installation.

(3) TRACER WIRE INSTALLATION. Tracer wire shall be installed in a continuous non-interrupted circuit on all sewer mains. The wire shall be attached to the top center of the pipe every four feet by a method approved by the Engineer. Tracer

wire boxes shall be installed at locations shown on the plans or as determined by the Engineer. Tracer wire box spacing shall not exceed 500 feet. Tracer wire boxes shall have concrete collars installed for protection.

(4) WATER CROSSINGS. When water and sewer lines are closer than ten (10) feet of each other, sewers must be placed so that the bottom of the water line will be at least 18 inches above the top of the sewer line at its highest point. If this distance must unavoidably be reduced, the water line or the sewer line must be encased in watertight pipe with sealed watertight ends extending at least ten feet either side of the crossing. Any joint in the encasement pipe is to be mechanically restrained. The encasement pipe may be vented to the surface if carrying water or sewer under pressure. Whenever a sewer line must unavoidably pass above a water line, at least 18 inches of separation must be maintained between the outside of the two pipes in addition to the preceding encasement requirement.

702.08 SEWER BYPASS

All sewer bypass operations shall comply with Section 709.

702.09 SERVICE LINES

Service lines including wyes, risers and other fittings shall be installed at the locations and in accordance with the details shown on the plans unless otherwise directed by the Engineer.

Service lines of four (4) inches shall be connected to new sewer mains through a manhole or standard wye or tee fittings that are of the same material used in the main. Service lines greater than four (4) inches shall connect to mains through a manhole. Service lines of two (2) inches are for pressure applications only and shall tie into manholes. Taps into existing mains shall utilize a gasketed or solvent cement saddle or shall consist of a standard fitting inserted into the main using repair sleeve couplings. Street crossings shall be marked with “SS” etched or stamped into the curb.

Service lines shall be installed on a uniform slope at a minimum grade of two (2) percent for four (4) inch lines and one (1) percent grade for six (6) inch lines and greater unless otherwise directed by the Engineer. Where the depth of the sewer main is greater than eight (8) feet, a riser shall be installed.

A dual clean-out shall be installed consisting of a double sweep tee, riser, metallic cap and concrete collar at the property line for all service lines as shown on the plans. A clean-out system conforming to ASTM F3097-15 is also acceptable.

Service lines shall not be backfilled or covered until they have been inspected, approved and coordinately located by the Engineer. After approval and before backfilling, service stubs shall be capped or plugged and marked with a nylon rope. The nylon rope shall be a minimum size of ¼-inch diameter shall be tied to service stubs and extended vertically while backfilling. After

backfilling, the rope shall be tied to an anchor stake. Unless otherwise noted, the stub-out pipe shall extend for a minimum distance of 3 feet from the edge of the manhole and the ends shall be capped with a standard glued fitting.

702.10 CONCRETE ENCASEMENT

Where shown on the plans or as directed by the Engineer, sewers shall be encased or cradled in concrete in accordance with Section 205 "Trench and Structure Excavation and Backfill". Unless otherwise noted on the plans, concrete encasement shall encircle the pipe and shall be a minimum thickness as shown in the Plans. All sewer mains to be encased in concrete shall be wrapped with polyethylene material meeting AWWA C105, latest revision.

702.11 INSPECTION AND TESTING

All sewer lines installed shall be tested unless otherwise directed by the Engineer. The Contractor shall furnish all labor, materials and equipment required to perform the specified tests. All testing shall be performed in the presence of the Engineer.

All sewer lines shall be clean prior to performing tests.

The Contractor shall, at his expense, correct and retest all sections of line which fail to pass the tests.

A. ALIGNMENT TEST. All sewer mains shall be inspected visually using lights and/or mirrors, to verify accuracy of alignment. The full diameter of the pipe shall be visible when viewed between consecutive manholes.

B. LEAKAGE TEST. A leakage test shall be performed and shall be a low pressure air test. ASTM F-1417 leakage test procedures shall be used for PVC and for Polypropylene Pipe

The Contractor shall temporarily cap or plug mains and service lines as required for testing. Caps and plugs shall be glued securely against blow-off during testing.

The air test shall be performed after the sewer line backfill has been placed and compacted. The sewer line shall be tested in sections between manholes.

All air testing equipment shall be supplied by the Contractor. The pressure gauge shall have minimum divisions of 0.1 psi and shall have an accuracy of at least 0.04 psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at 6-month intervals or when requested by the Engineer. The Contractor shall, at his own expense, locate and repair defective pipe and/or joints until leakage or deflection is within the specified allowances.

Air shall be introduced into the line until the internal air pressure is 4.0 psig. Pressure applied to the line shall not exceed 9.0 psig. The line shall be allowed to stabilize between 4.0 and 3.5 psig for a period of no less than 5 minutes. After the stabilization

period the pressure shall be decreased to no less than 3.5 psig. When the internal pressure has reached an initial reading of 3.5 psig or greater, a stop watch or other timing device shall be used to determine the time lapse required for the pressure to decrease to 2.5 psig (a pressure drop of 1 psig). If the time lapse required for the air pressure to drop 1.0 psig exceeds the test time specified, the line has passed the test.

If groundwater is present above the top of the pipe, the air pressure shall be adjusted as directed by the Engineer. When directed by the Engineer, the Contractor shall install an observation well to determine the depth of ground water. Immediately before air testing, the groundwater height in feet of water over the invert of the sewer pipe shall be determined. The air pressure correction, which must be added to the 3.5 psig normal test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result gives the air pressure correction in pounds per square inch to be added.

Minimum times for a 1 psig pressure drop for all types of pipe shall be computed by the following equation:

$$T = 0.085 * D * \left[\frac{K}{Q}\right]$$

Where:

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds
K = 0.000419*D*L, but not less than 1.0
D = average inside diameter in inches
L = length of line, of same pipe size, being tested in feet
Q = rate of loss, 0.0015 ft3/min/ ft2

C. DEFLECTION TEST. A deflection test shall be performed on all PVC sewer mains. All deflection testing equipment shall be supplied and operated by the Contractor. The test shall consist of pulling a rigid mandrel through the pipe. The cross section of the mandrel shall have a diameter equal to 95 percent of the inside diameter of the pipe, and the minimum length of the circular portion of the mandrel shall be equal to the diameter of the pipe.

The test shall not be made sooner than 30 days after the line has been installed and backfilled.

All sections of the line which exceed five (5) percent deflection shall be reconstructed and retested.

702.12 ABANDONED LINES

Lines designated to be abandoned shall be plugged at the locations shown on the plans. Plugging of lines shall consist of placing concrete or mortar inside the line to form a watertight plug. Remaining pipe ends of abandoned lines shall be filled with a concrete plug. The concrete plug

length shall be 3 times the diameter of the pipe.

Sewer lines which are to be abandoned shall remain in place except where removal is required for construction of improvements or removal is specifically called for on the plans. Any existing asbestos cement (AC) pipes are to be avoided if at all possible unless directed to be removed by the Engineer or connection to it is required according to the plans. Removal and disposal of AC pipe shall be in accordance with standard construction practices for asbestos removal and the applicable OSHA Standards and State of Arkansas regulations. Any crushed AC pipe is to be removed and disposed of properly and shall not be placed into the fill. AC pipe shall be cut using a chain cutter.

The abandoned manhole rings and lids shall remain the property of the Owner. Materials designated on the plans for Owner salvage shall be delivered to the Fort Smith Utility Department located at 3900 Kelley Highway.

702.13 DATA DELIVERY REQUIREMENTS

Data delivery requirements shall conform to Section 150, data delivery requirements, and Section 709, GIS Database Update.

702.14 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work. Data collection shall be considered incidental to construction.

A. SEWER PIPE. Sewer pipe will be measured by the linear feet of the various sizes of pipe installed and will be measured along the center lines of the pipe from center to center of manholes. Payment for furnishing and installing sewer lines measured as specified above, will be made at the contract unit prices per linear foot for the applicable sizes of pipe listed in the bid form. Payment will constitute full compensation for furnishing and installing pipe, including joints, testing, removal of existing pipe, maintenance of sewage flows, tracer wire, tracer wire boxes, and for all incidental labor and materials necessary to complete the work.

   All removal, salvage, plugging, and disposal of sewer lines shall be considered incidental to the project, except for AC pipe which will be paid for under the bid item listed in the proposal for “Removal and Disposal of AC sewer pipe”.

   Rock excavation and select backfill will be paid for under Section 205 "Trench & Structure Excavation and Backfill.” Flowable Fill will be paid for under Section 206, “Flowable Fill Material”.

Connection of sewer lines to existing manholes will be paid for under Section 706, "Existing Sewer Structures". No separate payment will be made for tying into and reinstating existing sewer service lines.

B. SEWER SERVICE LINE. Service lines will be measured by the linear foot of the size of line installed and method of installation, either open-cut or pipe burst. The length of line measured will be the actual length of pipe laid from the wye to the plug or connection. Payment for service lines will be made at the contract unit price per linear foot for the sizes of lines listed in the bid form. Payment shall be full compensation for furnishing and installing service lines including fittings, risers, plugs, connections, excavation, trenching, gravel bedding, backfilling and related work. Connection of sewer service lines to existing manholes shall be paid for under Section 706, Existing Sewer Structures. Surface restoration shall be paid for separately under applicable pay item. No separate payment will be made for tying into and reinstating existing sewer service lines.

C. SEWER SERVICE WYES. Service wyes will be measured by the number of furnished and installed wyes. Payment for service wyes will be made at the contract unit price per each listed in the bid form. Payment shall be full compensation for furnishing and installing service wyes, connections, riser pipe, concrete, excavation, gravel bedding, backfilling, GPS data collection as stated in Section 710, and for all incidental labor and materials necessary to complete the work.

D. SEWER SERVICE CLEAN-OUTS. Clean-outs will be measured by the number of furnished and installed clean-outs. Payment for sewer service clean-outs will be made at the contract unit price per each listed in the bid form. Payment shall be full compensation for furnishing and installing clean-outs, connections, riser pipe, concrete, excavation, gravel bedding, backfilling, GPS data collection as stated in Section 710, and for all incidental labor and materials necessary to complete the work. Surface restoration shall be paid for separately under applicable pay item

E. REMOVAL AND DISPOSAL OF AC SEWER PIPE. Removal and disposal of AC sewer pipe will be measured and payment made according to the lineal foot of sewer line directed to be removed by the Engineer and acceptably removed. Payment for the removal and disposal of AC sewer pipe at the contract unit price listed in the proposal shall be considered full compensation for the removal and disposal of the AC sewer pipe in accordance with applicable OSHA and State of Arkansas regulations and standards, and backfilling of trench, including all labor, materials and miscellaneous items required to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Sewer Pipe (Size, Type, Class)	LF

Sewer Service Line (Size, Type, Class, Method)	LF
Sewer Service Wyes (Size)	EA
Sewer Service Clean-Outs (Size)	EA
Removal and Disposal of AC Sewer Pipe	LF

SECTION 703
NEW SEWER STRUCTURES

703.01 SCOPE OF WORK

This work shall consist of furnishing all labor and materials required for the construction of new manholes, concrete cradles, other structures, appurtenances, and connections.

Excavating, trenching, and backfilling of sewer appurtenances are specified in Section 205.

703.02 QUALIFICATIONS AND SUBMITTALS

Certification shall be the basis of acceptance of materials as required below. The Contractor shall submit two copies of the manufacturer's test report with results or a statement by the seller, that the material has been sampled, tested and inspected. Each certification shall be signed by an authorized agent of the seller or manufacturer. All manufacturers shall have at least three (3) years of experience in successfully manufacturing the materials specified, unless approved otherwise by the Owner.

703.03 MATERIALS

A. CONCRETE. All concrete and concrete work shall be in accordance with Section 401 "Concrete." Concrete shall be a minimum of Class "A", unless noted otherwise.

B. MORTAR. Mortar shall consist of one part Type II Portland cement and two parts clean sand with only enough water for workability.

C. NEW PRECAST MANHOLES. Precast reinforced concrete manholes shall be of the concentric cone type unless eccentric cone type is shown on the plans. All precast reinforced concrete manholes shall conform to ASTM C478, latest revision. Lifting lugs shall be EZ Lift Pins or approved equal. No holes will be allowed for lifting precast manholes. Joints and Neoprene O-ring gaskets shall conform to ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets. All pipe entrances through manhole wall shall utilize a flexible waterstop pipe connector conforming to ASTM C-923. The pipe connector shall be A-LOK as manufactured by A-LOK Products Inc., NPC Kor-N-Seal as manufactured by Trelleborg Pipe Seals Milford, Inc. or an approved equal. All new manholes shall be precast unless specified otherwise by the Owner.

D. MANHOLE FRAMES AND COVERS. Manhole frames and covers shall be made of cast iron and shall conform to ASTM A48-76 Class 30. Manhole covers shall be 23½ inches in diameter; frame height shall be 6 inches. All casting shall be free from cracks, holes and swells. Frames and covers shall have machined bearing surfaces to prevent rocking of the cover. Manhole covers and frames shall be of heavy duty type as manufactured by EJ Corp. 1348-1, Deeter Foundry 1266 from Neenah, or approved equal.

Manhole frames and covers located in the 100-Year Floodplain, creek beds, river beds, or drainage channels/ditches shall be ERGO SELFLEVEL Assemblies with Cam-Lock systems, or approved equal. Bolt-down manhole frames and covers shall not be allowed.

E. CONCRETE CAP. Concrete caps shall be constructed around manhole frames and covers and shall match the surface elevation and slope of the manhole frame and the surrounding pavement. Concrete caps shall have dimensions of 6 feet by 6 feet, shall be a minimum of 8 inches thick or match existing pavement thickness, whichever is greater, and shall be constructed of Class "AAA" (4,000 psi) concrete as specified in Section 401 "Concrete General." The concrete cap shall be centered over the manhole frame and reinforced with fiber mesh. In concrete pavement areas, expansion joint material complying with Section 401 "Concrete General" shall be placed between the concrete pavement and the concrete cap.

F. MANHOLE ADJUSTING RINGS. Manhole adjusting rings shall be cast iron conforming to ASTM A48 or ductile iron conforming to ASTM A536. Adjusting rings shall be R-1979 series manufactured by Neenah Enterprises, Inc., or approved equal. The maximum height of stacked rings shall not exceed 24 inches. The Contractor shall determine all dimensions and shall ensure correct sizing of the adjusting rings.

G. ADJUSTING COLLARS. Adjusting collars, used for setting the cast iron frame and covers to the required elevation, shall be made of concrete or shall be Cretex Pro-Ring, or approved equal. Concrete adjusting collars shall have a minimum wall thickness of 6 inches. All adjusting collars shall have an inside diameter the same as the existing inside diameter of the top of the manhole.

H. ELASTOMERIC WATERSTOP GASKETS. Elastomeric waterstop gaskets for pipe entrances into cast-in-place manholes shall be made of elastomeric PVC and shall be Fernco Concrete Manhole Adapters (CMA's) for pipe diameters 12-inches and smaller or Fernco Large-Diameter Waterstops for pipe diameters larger than 12-inches or approved equal.

I. FLEXIBLE PLASTIC GASKETS. Flexible plastic gaskets used for connecting cast iron frames to top of manhole shall conform to ASTM C990 and shall be Ram-Nek or Rubr-Nek LTM as manufactured by Henry Company, or approved equal.

J. JOINT SEALING MATERIAL. Sealing material for sealing exterior joints in precast manhole section and cast iron frames shall be Wrapidseal manufactured by Canusa, Infi Shield manufacture by Sealing Systems, Inc., or approved equal.

703.04 QUALITY ASSURANCE

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places and the materials

shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

B. Imperfections in manhole sections may be repaired, subject to the approval of the Owner, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Repairs shall conform to the specifications outlined in Section 706 Cement mortar used for repairs shall be Class AAA, as specified in in Section 401. Epoxy mortar may be utilized for repairs subject to the approval of the Owner.

703.05 EXCAVATION AND BACKFILLING

Trench excavation, bedding, encasement, casing, and backfilling are covered in Section 205 "Trench and Structure Excavation and Backfill."

703.06 CONSTRUCTION REQUIREMENTS

Manholes shall be constructed at locations shown on the plans and shall be of the type and depth indicated thereon. Detailed drawings of the various types of manholes to be employed in the work are included in the plans and each manhole shall be constructed in strict accordance with these detailed drawings. Manholes may be constructed of precast concrete segments or cast-in-place concrete. Manholes constructed of fiber-glass or other non-approved material may be allowed with written consent of the Owner. Concrete caps shall be installed around all manhole rings located within pavement unless otherwise directed by the Engineer.

The finished manhole shall have a minimum inside diameter of 4 feet from the base to the sloping cone section at the top of the manhole. The inside diameter at the opening in the top of the cone section shall not be less than 24 inches for 4-foot diameter manholes. The inside diameter and corresponding lid diameter for manholes greater than 4-foot in diameter shall be as indicated on the plans. The sloping cone section may be of the concentric or eccentric type, unless otherwise specified on the plans, and shall have a height not less than 24 inches and not more than 36 inches.

Manholes installed on existing sewer lines shall be constructed in a manner which will not disturb the alignment and grade of the existing pipe except for required alterations. Existing pipes within the manhole shall be removed as required to permit construction of the manhole invert. When authorized by the Owner, the manhole may be constructed with the sewer pipe in place and the upper half of the pipe removed after the invert has been placed.

Where shown on the plans or where directed by the Owner, pipe stub-outs shall be installed in manholes as a connection for future extensions or for service stub-outs. Unless otherwise noted,

the stub-out pipe shall extend for a minimum distance of 3 feet from the edge of the manhole and the ends shall be capped with a standard glued fitting. Manhole penetrations for pipe stub-outs added in the field shall be cored.

A. MANHOLE BASE. The bottom of the concrete base of the manhole base shall be level.

(1) Regardless of the type of manhole construction, manholes shall be provided with invert channels at the bottom of the manhole. The invert channels shall be smooth, shall be accurately shaped to a semi-circular bottom conforming to the inside shape of the adjacent sewer section, shall have a uniform slope from the inlet to the outlet pipe, shall extend up to at least half of the diameter of the pipe, shall have smooth curves with radii as large as the size of the manhole will permit. Unless indicated on the plans, a minimum 0.1 foot drop from the inlet invert to the outlet invert of each manhole shall be maintained.

(2) All manholes shall contain a concrete shelf on each side of the invert channel. The top of the shelf at the edge of the channel shall be a minimum of ½ of the largest diameter of the connecting pipe above the invert of the channel. The shelf shall rise a minimum of one inch per foot from the edge of the channel to the wall of the manhole. Dips or projections capable of holding water or solid materials will not be permitted.

B. CAST-IN-PLACE MANHOLES. The concrete foundation for cast-in-place manholes shall be placed as soon as practicable after the sewer pipe has been installed through the manhole location. The concrete for the base of the manhole shall be placed on a 6-inch minimum thick gravel bed. Invert channels shall be formed in the concrete base during or immediately after the placing of the manhole base and shall have a brush finish as soon as the concrete has sufficiently set. Where required to correct deficiencies in the constructed concrete invert, invert channels shall be shaped and smoothed with cement mortar, as detailed in Section 703.04B.

(1) In manholes where there is only one inlet and one outlet pipe and the sewer pipe does not change direction, the invert through the manhole shall be of split pipe or the pipe may be laid through the manhole and the upper half of the pipe removed. The pipe shall be cut in a neat and workmanlike manner prior to removing the top section of the pipe. The concrete shall set for 24 hours before any pipe inside the manhole is trimmed.

(2) The minimum thickness of the base below the invert of the channel shall be 12 inches of concrete.

C. PRECAST MANHOLES. Where precast manholes are used that include a bottom section containing the invert flow channel, the flow channel and shelf shall be formed during the manufacturing process of the precast manholes. Flexible waterstop pipe connectors, as specified in paragraph 703.03-G, shall be installed at locations where sewer main pipe and sewer service pipe enter the manhole.

(1) The bottom of the base section shall be level and shall be placed on a 6-inch minimum thick gravel bed.

(2) Where the manhole base is not constructed as part of the precast manhole assembly, the base shall be constructed as previously set forth for Cast-In-Place Manholes and shall extend a minimum of 4 inches beyond the edge of the precast manhole walls. A minimum of 3 inches of the bottom precast manhole wall section shall be embedded in the concrete base. The bottom precast section shall be in place prior to pouring the base or shall be set in the base prior to initial set of the concrete.

D. MANHOLE WALLS

(1) CAST-IN-PLACE MANHOLES. Cast-in-place manholes shall have minimum wall thickness as shown below. The wall shall be poured monolithically with the base or the base shall be provided with a construction joint and waterstop gasket.

Manhole Depth	Minimum Thickness of Wall
Up to 12 feet	6 Inches
Over 12 feet	8 Inches

The forms used for construction of the barrel shall be of such fabrication and set so that the walls of the manhole constructed are to the minimum thickness noted previously and shall be smooth with no form marks on the interior or exterior wall exceeding ¼ inch. The concrete shall be placed uniformly around the manhole in 2 feet maximum lifts. Each lift shall be thoroughly vibrated prior to placement of succeeding lifts. All concrete shall be free of honeycomb or other defects. The Contractor shall correct all defective areas as directed by the Owner.

(2) PRECAST MANHOLES. Precast manhole sections shall have minimum wall thickness of 5 inches or as specified by the manufacturer to conform to the requirements of ASTM C478, latest revision, "Precast Reinforced Concrete Manhole Sections". Any precast section which has been damaged such that the water tightness of the section or joint is affected shall not be utilized.

a. Pre-formed neoprene O-ring gaskets shall be used in the joint between precast manhole wall sections. The exterior of the joint shall be grouted as necessary to form a smooth and uniform surface. Joint sealing material, as specified in section 703.03-I and having a minimum width of 12 inches, shall be wrapped around the outside of the manhole and centered over the joint. The installation of the joint sealing material shall conform to the manufacturer's written recommendations.

b. Prior to ordering any precast manhole units, the Contractor shall verify the location and depth of all existing and proposed pipe connections to the

manhole. The Contractor shall also verify that existing sewer services, connected to an existing manhole to be replaced, are active.

E. CAST IRON FRAME AND COVERS. All manholes shall have cast iron frame rings cast into the cone of the manhole and covers installed on the top of the manhole. Cast iron frames and covers shall be centered over the manhole cone section and shall be carefully leveled and placed to the elevations shown on the plans or to an elevation as directed by the Owner. Unless otherwise directed by the Owner, the top of the frame and cover shall conform to the following general requirements:

(1) WITHIN OR ADJACENT TO PAVED STREET OR DRIVE SURFACES. The top is to be at the same elevation and slope as the adjacent paved surface. Where precast manholes are used and sloping of the frame and cover is required, adjusting collars shall be used to set the frame and cover to the required slope. Within paved areas, a concrete cap shall be constructed around the manhole frame and cover unless otherwise indicated on the plans.

(2) WITHIN MAINTAINED LAWN AREAS. The top is to be level with the adjacent ground.

(3) WITHIN PASTURE LAND OR OPEN AREAS EXCEPT NEAR DRAINAGE CHANNEL OR DITCHES. The top is to be a minimum of six (6) inches above the adjacent ground.

(4) NEAR DRAINAGE CHANNEL, DITCHES, CREEK RIVER BEDS, AND BELOW 100-YEAR FLOODPLAIN. The top is to be a minimum of 12-inches above the adjacent ground or as indicated on the plans. Manhole frames and covers shall be ERGO SELFLEVEL Assemblies with Cam-Lock systems, or approved equal. Bolt-down manhole frames and covers shall not be allowed.

(5) MANHOLE DROPS. Manhole drops shall be constructed at locations where the invert of the inlet sewer main pipe enters a manhole at a greater depth than two (2) feet above the invert of the outlet pipe. Internal drops shall not be allowed, unless approved by the Owner. The pipe and fittings for the drops shall be of the same material, type, and size as the horizontal inlet pipe. The drops shall be constructed to the dimensions and in accordance with the details shown on the plans. The horizontal sewer pipe shall extend through the manhole wall. Class B concrete shall be used to backfill around the vertical pipe drops and fittings from the bottom of the excavation to 6 inches above the top of the horizontal inlet pipe.

703.07 PIPE CONNECTIONS TO MANHOLES

A. NEW PRECAST MANHOLES. Flexible waterstop pipe connectors shall be used for all pipe connections to the precast manhole. The connectors shall be installed during the manufacturing process of the precast manholes. The pipe shall be inserted through the connector to the depth recommended by the manhole manufacturer. After the pipes have

been installed, the invert channel shall be grouted to provide a smooth flow through the manhole. The grout shall be applied up to the spring line of the pipe. Grout shall not be applied at the pipe connection on the outside of the manhole.

B. NEW CAST-IN-PLACE MANHOLES. All pipes extending through manhole walls shall have an elastomeric waterstop gasket, installed around the pipe and centered in the manhole wall to insure a watertight connection. The pipe with gasket shall be in place prior to placing of the concrete and the concrete shall be placed around the pipe during the construction of the manhole base.

C. PIPE CONNECTIONS TO EXISTING MANHOLES. Pipe connections to existing manholes must conform to specifications in Section 706.

703.08 CONCRETE STRUCTURES

All piers, collars, anchors and other reinforced concrete structures shall be constructed as shown on the plans and in accordance with Section 401 "Concrete."

703.09 INSPECTION AND TESTING

Each new manhole shall be vacuum tested prior to acceptance. The vacuum test shall be performed after all pipe connections have been made and prior to backfilling. The vacuum test shall be conducted in accordance with ASTM C1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test". All pipes connected to the manhole shall be temporarily plugged using suitable sized pneumatic or mechanical plugs.

A metal cover, with suitable gasket, shall be placed over the top of the manhole frame. The metal cover shall be provided with valved pipe connections for attaching the vacuum pipe and a vacuum gage reading inches of mercury or psi. A vacuum pump shall apply a vacuum of 10 inches of mercury (5 psi). For the manhole to pass the test, the time it takes for the vacuum to drop to 9 inches of mercury (4.5 psi) shall not be less than the value listed in the following Table.

The Contractor shall provide all vacuum pumps, gauges, testing equipment and plugs necessary for the testing of manholes. The vacuum test shall be performed by the Contractor in the presence of the Owner, Engineer, or his representative. Any manholes which do not pass shall be repaired and/or resealed and shall be retested.

MINIMUM TEST TIME FOR MANHOLE VACUUM TEST

Manhole Inside Diameter (in.)				Manhole Inside Diameter (in.)			
Depth (ft.)	48	60	72	Depth (ft.)	48	60	72
	Time (sec.)				Time (sec.)		
4	10	13	16	18	45	59	73
6	15	20	24	20	50	66	81
8	20	26	33	22	55	72	89
10	25	33	41	24	59	78	97
12	30	39	49	26	64	85	105
14	35	45	57	28	69	91	113
16	40	52	65	30	74	98	121

703.10 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the Specifications shall be based on the units and the contract unit prices listed in the Bid Proposal for such work. Payment for the actual completed work, as measured in the field, will be paid at the contract unit price bid for each appropriate item listed in the Bid Proposal which price shall be considered full compensation for furnishing all materials, labor, equipment, tools supplies, data collection, and incidentals necessary to complete each item of work including maintenance of sewage flows and control of drainage water.

The payment for all excavations and backfilling with excavated material required to construct the manhole and other structures and the construction of gravel beddings shall be included with the payment for the manhole or structure and no additional compensation will be made. The measurement and payment for pavement removal, disposal, and replacement, the backfilling within streets and drives, and related items are set forth in other sections of these Specifications.

No separate payment will be made for connection of sewer lines to new manholes. No separate payment will be made for stub-outs.

A. STANDARD DEPTH MANHOLE (6 FEET AND LESS). Measurement for construction of new manholes of the diameter specified up to a maximum depth of 6 feet, as measured from the top of the manhole cover to the invert of the outlet pipe, will be based on the number each of such manholes actually constructed. Such measurement shall include excavation and backfill, construction of the manhole base, construction of cast-in-place walls and cone section or furnishing and installing precast units, furnishing and installation of new cast iron frame and cover, furnishing and installation of manhole grade adjusting rings and/or adjusting collars, furnishing and installing joint sealing material, connections of all pipes (main and service laterals), vacuum testing and GPS data collection as stated in Section 703.10. Surface restoration shall be paid for separately under applicable pay item

B. ADDITIONAL DEPTH FOR MANHOLE. Measurement for construction of that portion of new manholes of the diameter specified greater than 6 feet deep, as measured from the top of the manhole cover to the invert of the outlet pipe, will be based on the vertical feet of manhole that is over 6 feet deep. Such measurement shall include the items required to complete the work as stated above for Standard Manholes.

C. MANHOLE DROPS (4 FEET AND LESS). Measurement for construction of manhole pipe drops, up to a maximum height of 4 feet, as measured from the external invert of the upper horizontal pipe to the invert at the entrance to the manhole, will be based on the number each of such drops actually constructed. Such measurement shall include the installation of vertical drop pipe, all required fittings, extension of horizontal pipe through manhole wall, and backfilling drop pipe with concrete. Only external drop manholes are allowed.

D. ADDITIONAL HEIGHT FOR MANHOLE DROPS. Measurement for construction of that portion of manhole drops greater than 4 feet deep, as measured from the invert of the upper horizontal pipe to the invert at the entrance to the manhole, will be based on the vertical feet of drop that is over 4 feet high. Such measurement shall include the 9 foot concrete encasement, PVC pipe for drop, and all other items required to complete the work as stated above in Section 703.14C.

E. SEWER LINE PIERS AND ANCHORS. Measurement of piers, anchors, and other reinforced concrete structures will be based on the cubic yards of class "AA" concrete required to construct such structure to the lines and dimensions shown on the plans. Such measurement shall include the forming, concrete, reinforcing steel, and related work necessary for a complete facility.

F. CONCRETE CAPS. Measurement of concrete caps will be based on the number each of such concrete caps actually constructed. Such measurement shall include saw cutting and removal and disposal of pavement, excavation and removal and disposal of any base and/or subgrade material to the required depth, placement of expansion joint material (in concrete pavement areas only), placement and finishing of concrete cap, and furnishing all materials, tools, labor, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Standard Depth Manhole (Size, 6 Feet and Less)	EA
Additional Depth for Manhole (Size)	VF
Manhole Drops (4 Feet and Less)	EA
Additional Height for Manhole Drops	VF

Sewer Line Piers and Anchors	CY
Concrete Cap	EA

SECTION 704
SEWAGE FORCE MAINS

704.01 SCOPE OF WORK

This work shall consist of the furnishing of all labor, materials, tools, equipment, incidentals, testing and construction methods to install sewer force mains as required by the Plans, Special Conditions and these Specifications.

Excavating, trenching, backfilling and sewer appurtenances are specified in section 205.

704.02 QUALIFICATIONS AND SUBMITTALS

All pipe shall be manufactured by an established manufacturer having at least three (3) years of experience in successfully manufacturing the type of pipe specified, unless approved otherwise by the Owner.

Certification shall be the basis of acceptance of materials as required below. The Contractor shall submitted a copy of the manufacturer's test report with results or a statement by the seller, that the material has been sampled, tested and inspected. Each certification shall be signed by an authorized agent of the seller or manufacturer.

704.03 MATERIALS

Materials for pressure sewage force mains shall conform to the following requirements:

A. DUCTILE IRON PIPE. Ductile iron pipe shall be push-on joint, pressure, bituminous exterior coated and shall conform to AWWA C151, latest revisions. For 12-inch and smaller pipe provide minimum Pressure Class 350. For piping from 14-inch to 20-inch provide minimum Pressure Class 250 and for 24-inch and larger piping provide Pressure Class 200. Where pipe laying conditions require greater strengths than the minimum pressure class, Thickness Design shall be according to AWWA C150. Pipe shall have an internal polyethylene lining with a minimum thickness of 0.035 inch. Polyethylene material shall conform to ASTM D1248.

(1) For any installation requiring polyethylene encasement for corrosion protection of ductile-iron pipe, the encasement shall be in accordance with AWWA C105.

(2) Restrained, push-on joint pipe shall be similar and equal to one of the following: American Ductile Iron Pipe's FLEX-RING JOINT pipe or U.S. Pipe's TR FLEX pipe.

B. PVC PIPE. Polyvinyl chloride (PVC) pressure pipe shall conform to AWWA C900, latest revision for piping 12-inch and smaller. PVC pipe shall have cast iron outside diameter, elastomeric-gasket type joints and shall have a minimum working pressure

rating of 235 psi. Pipe manufacturer shall furnish certification of compliance with the reference standards.

C. FITTINGS. Fittings shall be gray-iron or ductile-iron conforming to AWWA C153 Standard for Ductile Iron Compact Fittings. Fittings shall be mechanical joint, polyethylene lined, exterior bituminous coated and shall have a minimum working pressure rating of 250 psi. Polyethylene lining shall conform to ASTM D1248 and shall be 0.035 inch minimum thickness.

D. MISCELLANEOUS FITTINGS. Couplings, adapters and related fittings shall conform to Section 601 of these specifications.

E. TRACER WIRE. Tracer wire shall be Trace-Safe type RT1803W or Utility Department approved equal.

F. TRACER WIRE BOX. Tracer wire shall be terminated in magnetized tracer box, Model CD14*TP as manufactured by Copperhead Industries, LLC. The tracer box cover will be color coded in accordance with APWA uniform color code. The tracer wire shall not be terminated in any other location.

G. GRAVEL BEDDING. Gravel bedding shall conform to Section 205 "Trench and Structure Excavation and Backfill."

H. CONCRETE. Concrete shall conform to Section 401 "Concrete." Concrete shall be Class B (2500 psi), unless noted otherwise.

I. COMBINATION AIR VALVES. Combination air valves shall be of the size shown on the plans and shall be Model D-020 as manufactured by A.R.I. Flow Control Accessories or an approved equal.

704.04 QUALITY ASSURANCE

It is a requirement of these Contract Documents to have all of the force main pipe under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. Similarly, it is a requirement of these Contract Documents to have all of the fittings under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. All connections between the pipe and fittings shall be compatible.

704.05 HANDLING AND STORAGE

A. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

B. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

704.06 CONSTRUCTION REQUIREMENTS

A. TRENCH EXCAVATION AND BACKFILL. Trench excavation, bedding, boring, encasement, casing, and backfilling are covered in Section 205.

Pipe bedding for PVC pipe and Ductile Iron pipe shall conform to Class "B" bedding. Bell holes shall be provided at each joint to permit the jointing to be properly made and prevent the joint of the pipe from being a point of support. Whenever any portion of the trench is excavated below grade, it shall be corrected with thoroughly compacted material approved by the Engineer.

B. PIPE INSTALLATION. Pipe fittings and accessories shall be unloaded near the place where they are to be laid in the trench. They shall at all times be handled with care to avoid damage. Cutting of pipe shall be done by means of an approved type of mechanical cutter.

Section of pipe, fittings and accessories shall be cleaned and inspected for damage immediately prior to placement in the trench. All defective materials shall be rejected. Pipe, fittings and accessories shall be placed in the trench and shall be positioned utilizing hoisting equipment. Pipe shall be laid true to line and grade, with uniform bearing under the full length of the pipe barrel.

Field bending of PVC pipe or Ductile Iron pipe will not be allowed. Fittings shall be used to accomplish radius bends. Pipe deflections will be allowed up to the degree specified by the manufacturer, but shall not exceed this amount.

Jointing of pipe shall be accomplished in accordance with the pipe manufacturers' recommendations. Gaskets and lubricants shall be the type recommended by the pipe manufacturer. The spigot end of the pipe shall be inserted into the bell to the required depth and in such manner as to avoid displacement of the gasket. Jointing of mechanical-joint pipe shall be accomplished such that the gland is positioned evenly by tightening alternately the bolts spaced 180 degrees apart.

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug. Plug shall be Petersen Mechanical Hand Tightening Series 141, COB Industries Cast Aluminum Expansion Plug, or approved equal. This provision shall apply during the lunch period, overnight, or any other time when work is not in progress.
No pipe shall be laid in wet trench conditions that preclude proper bedding, or on a frozen trench bottom, or when in the opinion of the Engineer, the trench conditions or the weather are unsuitable for proper installation.

C. CONCRETE THRUST BLOCKING. Concrete thrust blocking shall be installed only at the locations shown on the plans. Restrained joints shall be used unless concrete blocking is authorized by the Engineer. The concrete shall be placed between undisturbed soil and the fitting to be anchored. Care shall be taken to place the thrust block that the pipe and fitting joints will be accessible for repair.

The shape and contact area of the concrete thrust blocks shall be as shown on the plans and as directed by the Engineer. The contact area of backing shall be as required to prevent movement of the joint, but in no case shall the contact area be less than one square foot.

D. TRACER WIRE INSTALLATION. Tracer wire shall be installed in a continuous non-interrupted circuit on all sewer force mains. The wire shall be attached to the top center of the pipe every four feet by a method approved by the Engineer. Tracer wire boxes shall be installed at locations shown on the plans or as determined by the Engineer. Tracer wire box spacing shall not exceed 500 feet.

E. STREET CROSSINGS. . All liner pipe shall be installed within casing using restrained joints and shall be installed in accordance with the requirements in Section 205.06.

704.07 INSPECTION AND TESTING

All force main piping shall be subject to a hydrostatic and leakage test.

These tests shall be performed by the Contractor in the presence of the Engineer. The Contractor shall furnish all necessary pressure gauges, meters and pumps and make all taps and connections.

Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Before applying the test pressure, all air shall be expelled from the pipe by permanent taps or corporation cocks where necessary.

It shall be the Contractor's responsibility to locate and repair any and all leaks and defects that may develop. Even though the pipe line may pass the leakage test, any leaks apparent at the ground's surface, any leaking joints, fittings or appurtenances, or any other visible defects shall be repaired to the satisfaction of the Engineer.

The hydrostatic and leakage tests may be performed simultaneously, but the duration of the test shall be not less than 2 hours. A pressure equal to, or exceeding, 1.5 times the working pressure of the pipe and never less than 150 psig at the point of testing shall be maintained throughout the test. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. No pipe installation will be accepted until the leakage is less than the number of gallons per hour, permitted by AWWA C600 as determined by the formula:

$$L = \frac{S * D * \sqrt{P}}{133200}$$

Where:
L = the allowable leakage, in gallons per hour;
S = the length of pipe line tested in feet;
D = the nominal diameter of the pipe, in inches;
P = the average test pressure during the leakage test, in pounds per square inch gage.

If testing results in leakage greater than the allowed maximum; the defective pipe and joint(s) shall be located and repaired. When repair work is complete, tests shall be performed again to determine that leakage is within the allowable limit.

704.08 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work.

A. SEWER PRESSURE PIPE. Force main will be measured by the linear foot along the centerline of the pipe from point of connection to lift station, manhole or other designated location. Payment for force main at the contract unit price for the size and type of pipe listed in the proposal shall be full compensation for furnishing and installing pipe and fittings, and for excavation, trenching, backfilling, gravel bedding, tracer wire, concrete blocking, testing and related work.

Rock excavation and select backfill will be paid for under Section 205 "Trench & Structure Excavation and Backfill." Flowable Fill will be paid for under Section 206, "Flowable Fill Material".

Street and highway crossings and driveway and sidewalk removal and replacement will be measured and payment made as specified in other sections of these specifications.

B. FORCE MAIN FITTINGS. Ductile iron fittings will be measured by the listed weight in pounds, excluding glands, bolts and accessories, as given in AWWA C153, latest revision.

No separate payment will be made for miscellaneous fittings, adapters, repair clamps, couplings or other appurtenances.

C. COMBINATION AIR VALVE. Combination air valves will be measured and payment made according to the number of each size and type furnished and installed. Valve vaults and appurtenances will not be measured separately, but will be included as a portion of the payment for combination air valves.

D. RESTRAINED JOINT. Restrained joints will be measured and payment made according to number of joints furnished and installed. Any thrust blocking required shall be considered incidental to this item.

E. POLYETHYLENE WRAP. Polyethylene wrap will be measured by the linear foot along the centerline of the pipe wrapped. Payment for polyethylene wrap at the contract unit price for the size of pipe wrapped listed in the proposal shall be considered full compensation for all labor and materials required to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Sewer Pressure Pipe (Size and Type)	LF
Force Main Fittings	LBS
Combination Air Valve (Size)	EA
Restrained Joint	EA
Polyethylene Wrap	LF

SECTION 705
REHABILITATION OF EXISTING SEWER LINES WITH CIPP

705.01 SCOPE OF WORK

This work shall consist of furnishing all labor, materials, tools, equipment, incidentals, testing, and construction methods or processes required to rehabilitate existing sewer lines including pre-CCTV inspection, bypass pumping and performing sample testing, for the installation of cured-in-place pipe (CIPP) lining of existing sanitary sewer main lines and CIPP spot repair short liners, including; installing end seals; reinstatement of active service lines; stopping active leaks that might interfere with the integrity of the liner to be installed; providing water; complete and accepted, in accordance with the Contract Documents.

CCTV inspection, cleaning, excavation, trenching, backfilling, sewer structures, and other sewer appurtenances are specified in other sections of these specifications.

Point repairs required prior to the sewer line receiving a CIPP liner shall be made per Section 702 – New Sanitary Sewer Lines.

705.02 QUALIFICATIONS AND SUBMITTALS

A. SUBMITTAL ITMES. Contractor required to submit the following:

(1) Work Schedule

(2) CIPP Manufacturer Installation Instructions

(3) CIPP Manufacturer Design Calculations

(4) CIPP Manufacturer Material Data

(5) CIPP Material Test Results

(6) CIPP Curing Schedule

(7) CIPP Installation Logs

(8) Resin Manufacturers Data, Including Resin Spectral Graph, Statement of Compatibility, Curing Schedule

(9) CIPP Contractor Experience Record

(10) Name and Experience of Person Preforming Service Line Reinstatements

(11) List of Subcontractors, with Experience

(12) Bypass Pumping Plan (Per Specification Section 709 – Bypass Pumping)

(13) CIPP Repair Methods (if required)

(14) Point Repair Methods (if required)

(15) Pre-Liner/Reinforced Pre-Liner

(16) Hydrophilic End Seals

(17) Testing Laboratory Information

(18) Physical Samples

(19) Temperature and Cook Logs

(20) Sample Notification (Per Specification Section 711 - Notification)

(21) CCTV Camera Specifications

B. FIBERGLASS CURED LINER. If a fiberglass cured liner is used, the Contractor shall provide third party test results that document styrene residual levels are within acceptable levels defined by the manufacturer, without flushing.

C. REPORT FORMAT AND LABELING. Reports shall be submitted on 8-1/2" x 11" paper. Larger drawings shall be folded to this format. Submittals shall be stamped by Contractor to indicate Contractor, date of submittal, Owner's project title and number, applicable Section of Specifications to be referenced, and signature of preparer.

CCTV recordings shall be submitted to the Owner in accordance with Section 701-Cleaning and closed Circuit Television (CCTV) Inspection..

H. BYPASS PUMPING PLAN. The Contractor shall submit a bypass plan for any proposed bypass or dewatering activity within seven (7) days of any planned bypass, in accordance with Section 709-Bypass Pumping..

705.03 MATERIALS

A. FELT TUBES (CIPP). The tube shall be fabricated to a size that when installed will neatly fit the internal circumference of the receiving sanitary sewer main. Allowance shall be made for circumference stretching during insertion. Folds or abnormal wrinkles in the tube after installation will not be acceptable.

The Contractor shall furnish a general purpose, unsaturated, polyester resin and catalyst system compatible with the utilized process that provides cured physical strengths.

The liner shall have a uniform thickness such that when compressed at installation, pressures will meet or exceed the design thickness specified by the Manufacturer.

An "inner liner" or "outer liner" film used for resin control may be used, provided the liner film is made an integral part of the carrier tube by bonding or fusing to the carrier tube. Any plastic coatings on the tube that will become the inside surface of the finished CIPP shall be a translucent flexible material that is compatible with the resin system used, and must be fully bonded to the absorbent tube material.

The wall color of the interior pipe surface of the CIPP after installation shall not be of a dark or non-reflective nature that could inhibit proper CCTV inspection.

The tube shall contain no intermediate or encapsulated elastomeric layers. No materials that are subject to delamination in the cured state shall be included in the tube.

No glass fiber reinforcement shall be used without Engineer's authorization. If glass fiber reinforcement is used in the tube, there must be layers of unreinforced, resin absorbent material on the inside and outside of the tube to protect the fibers from being exposed to the pipe flow and external water.

Sewing of pieces of the liner together to form the length desired for a particular run will not be allowed without the approval of the Engineer.

Holes made in the felt liner shall be identified with an identifiable marker and repaired before delivery to the job site. Repaired puncture marks or tears must be approved by the Engineer before insertion into the pipe line.

B. GLASS REINFORCED PLASTIC (GRP) UV CURED LINER. The GRP UV cured liner shall be a resin-impregnated fiberglass material tubing impregnated with a UV light-setting resin to seal against the internal circumference of the pipe.

The resin shall be a chemically resistant UV cured vinyl ester resin as reviewed by the Engineer, and shall withstand the elevated pH conditions at the site.

The resin used to impregnate the liner shall produce a cured liner pipe resistant to shrinkage, corrosion, abrasion and shall have a proven resistance to conditions at the site.

The liner shall be fabricated from materials which, when cured, will be chemically resistant to chemicals and gases typically found in sanitary sewer collection systems.

Individual insertion runs can be made over one or more manhole sections.

The liner shall consist of an innerfilm and outerfilm material that are impervious to airborne styrene. The outerfilm shall be UV light resistant and translucent to allow visual inspection of the impregnation of the resin within the glass fibers.

The cured liner shall meet the following initial structural properties:

(1) Flexural Strength (ASTM D790) 30,000 psi min.

(2) Flexural Modulus (ASTM D790) 1,500,000 psi min.

The liner shall be fabricated to a size which will neatly fit the internal circumference of the pipe in accordance with the manufacturer's requirements. The tube shall not have a longitudinal seam. The Subcontractor shall verify all inside dimensions of the pipe to be lined.

The finished liner shall maintain the flow carrying capacity of the original pipe.

C. RESINS. The liquid resin used in this rehabilitation project shall produce a properly cured tube which will be resistant to abrasion caused by solids, grit, and/or sand. The cured tube shall also be resistant to corrosion due to acids or gases such as sulfuric acid, carbonic acid, hydrogen sulfide, methane, and carbon monoxide. The resin used shall have proven resistance to municipal sewage.

The resin system to be used shall be manufactured by an approved company selected by the CIPP process manufacturer. Only corrosion resistant polyester, vinyl ester and epoxy resins shall be used:

Any resin enhancers, bond enhancers, and other additives must be compatible with material used and submitted, reviewed, and approved by the Engineer.

D. HYDROPHILIC END SEALS. The use of Hydrophilic end seals shall be used in all liner installations.

Contractor shall install hydrophilic pipe end seals at all manhole penetrations prior to the sanitary sewer main CIPP rehabilitation. The end seals shall be composed of hydrophilic rubber and molded as a one-piece cylinder with a minimum width of three (3) inches. When installed, the end seal shall form a 360 degree seal between the host pipe and the newly installed liner.

Hydrophilic end seals shall be Insignia End Seal Sleeve by LMK technologies, or approved equal.

E. PRE-LINER. The use of a pre-liner shall be used when the Engineer or CIPP liner manufacturer require the use of a pre-liner to protect the CIPP liner while being installed in the pipe, to provide a suitable surface for the CIPP liner to mold against, or to prevent water infiltration that may wash away the resin. The pre-liner may be of the reinforced type when needed. The pre-liner provided shall be compatible with the host pipe and the CIPP liner.

705.04 QUALITY ASSURANCE

A. CURED-IN PLACE PIPE. Contractor performing CIPP lining work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by CIPP lining manufacturer. Contractor's personnel shall have successfully installed a minimum of 50,000 feet (total) of proposed CIPP liner within the last three (3) years in pipe of a similar size, length and configuration as contained in this contract as documented by verifiable references.

Full-time, on-site superintendent/foreman that will supervise CIPP lining installation shall have successfully installed a minimum of 50,000 feet (total) of proposed size range of CIPP liner within the last three (3) years as documented by verifiable references.

CIPP felt and resin manufacturer(s) shall have successfully supplied a minimum of 500,000 feet of proposed liner and one million pounds of resin as documented by verifiable references.

B. CIPP SPOT REPAIR SHORT LINERS. The Contractor or subcontractor to furnish and install CIPP spot repair short liner shall be fully qualified, experienced and equipped to complete the work in a timely and satisfactory manner.

Full-time, on-site superintendent/foreman that will supervise CIPP spot repair short lining installation shall have successfully installed a minimum of 100 CIPP spot repair short liners of proposed size range of CIPP spot repair short liners within the last three (3) years as documented by verifiable references.

All CIPP spot repair short liners, regardless of pipe size or length, shall be furnished and fabricated by a single manufacturer.

As directed by the Owner or Engineer, Contractor shall replace all short liner that utilized materials or methods of installation other than that approved. Remove and replace the short liner section or replace the affected pipe with new pipe at no cost to the Owner.

C. SERVICE LINE REINSTATEMENT. The Contractor or subcontractor to provide service line reinstatement shall be fully qualified, experienced and equipped to complete the work in a timely and satisfactory manner.

D. TESTING LABORATORY. The Testing Laboratory selected for testing services shall be fully qualified, experienced and equipped to complete testing of samples as provided for in the contract documents.

705.05 NOTIFICATION

Refer to Section 711 for notification details and information.

705.06 HANDLING AND STORAGE

A. Care shall be taken in shipping, handling and storage to avoid damaging the CIPP liners and CIPP spot repair short liners. Any liner damaged in shipment shall be replaced as directed by the Engineer.

B. Any CIPP liner or CIPP spot repair short liner showing a split or tear, or which has received a blow that may have caused damage, even though damage may not be visible, shall be marked as rejected and removed at once from the job site.

C. The liner or short liner shall be maintained at a proper temperature in refrigerated facilities to prevent premature curing at all times and shall be protected from UV light prior to installation. Any liner or short liner showing evidence of premature curing will be rejected for use and will be removed from the site immediately.

705.06 FIELD MEASUREMENTS.

All pipe sizes and lengths will be stated on the Contract Documents and shall be verified by CCTV inspection as provided in Section 701-Cleaning and Closed Circuit Television (CCTV) Inspection prior to ordering any rehabilitation materials, to ensure that all materials will have sufficient length to extend the entire length of the run, which is defined as the length of the existing host pipe measured from the interior walls of the manholes, and/or from the ends of the pipe when/if the pipe extends into the manholes or as needed to perform a spot repair. Contractor shall also measure inside diameter and circumference of existing pipelines at face of each manhole in field prior to ordering liner so that liner can be installed in a tight-fitted condition with little or no wrinkling.

705.07 GENERAL

Work performed under this Specification shall be done in accordance with Municipal, State, and Federal standards. Warning signs, barricades (lighted after dusk), and flaggers shall be provided by the Contractor for safety and traffic control. All traffic control is the responsibility of the Contractor, and must be in accordance with Section 120 – Maintenance of Traffic and Traffic Control. All signage for work on state highway rights-of-way shall conform to the state highway department requirements.

All water used during rehab processes shall be collected and transported to a proper disposal facility or, upon approval, at the City of Fort Smith Wastewater treatment facility.

The Contractor shall provide whatever measures are required to prevent the movement or discharge of gases, liquids or solids associated with the rehabilitation materials and processes into any adjacent buildings upstream or downstream of the sewers being rehabilitated. The Contractor shall be responsible and liable for any damages or violations associated with such actions. The Contractor shall also be responsible for monitoring and protecting the discharge of any by-products caused by the installation of any rehabilitation materials or processes.

Immediately prior to installing the CIPP liner or CIPP spot repair short liner, the sanitary sewer main shall be CCTV inspected and cleaned. This is to verify that the condition of the sanitary sewer main line has not changed since the pre-inspection work. This CCTV inspection video is not to be submitted to the Engineer, except, any discrepancies noted shall be recorded and reported to the Engineer.

Noise related to CIPP to activities shall be attenuated to not exceed the limits discussed in City of Fort Smith Ordinance, Chapter 16, Article II – Noise.

Manholes are considered as a confined space area. Proper procedures are to be followed when accessing manholes.

Construction scheduling and coordination shall conform to Section 702 – New Sanitary Sewer Lines.

705.08 CURED IN PLACE PIPE (CIPP) DESIGN PARAMETERS

CIPP Design Parameters are as follows:

A. STRUCTURAL REQUIREMENTS. The CIPP design shall assume no bonding to the original pipe wall. The bond between all CIPP layers shall be strong and uniform. All layers, after cure, must form one, uniform structural pipe wall with no part of the tube left unsaturated by resin.

Design parameters in the following table shall be used:

Table 1. CIPP Design Parameters

Parameter	**CIPP System**
Pipe Condition	Fully deteriorated
Soil Type	Saturated/unsaturated
Design Thickness	The output product thickness needs to meet the minimum design thickness
Groundwater Depth	Ground surface level
Ovality of Pipe	2% of circumference (min.)
Soil Load	120 lbs./cf
Traffic Loads	AASHTO HS-20 live load
Modulus of Soil	Max 1,000 psi
Long Term Flexural Strength	50% of initial (ASTM D790)
Long Term Flexural Modulus of	50% of initial (ASTM D790)

Elasticity	
Maximum Deflection (vertical axis)	7.5% (for standalone purposes)
Minimum Safety Factor	2.0

Liner thicknesses for the work specified, will be calculated by the Contractor for each specific line segment shown in the Contract Documents. The Contractor shall verify depth of cover for all line segments shown as part of the CIPP design. Contractor's design shall be based on actual depth of cover for each pipe segment shown. It shall be the Contractor's responsibility to ensure that infiltration does not affect the curing or strength of the final product.

The cured tube shall conform to the minimum structural standards, as listed below.

Table 2. Cured Liner Minimum Structural Standards

Property	**ASTM**	**Initial Value (psi)**	**Long Term (psi)**
Tensile Strength	D-638	4,000	4,000
Flexural Strength	D-790	4,500	4,500
Flexural Modulus	D-790	350,000	175,000
Maximum Pipe Deflection Allowed is 7.5%			
Strength values are Median Values for temperature Ranging from 40ºF (4ºC) - 70ºF (21ºC)			

705.09 CONSTRUCTION REQUIREMENTS

A. INSTALLATION OF FLET LINER. By beginning the installation of the liner, the Contractor implies, by their actions, the line is an acceptable candidate for lining.

The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. The resin shall be uniformly distributed throughout the tube.

The Contractor shall designate a location where the fiber tube will be impregnated ("wet out") with resin to thoroughly saturate the fiber tube prior to its dispatch for installation. The Contractor shall inform the Engineer in advance of the materials and wet out procedure to be used. A catalyst system or additive(s) compatible with the resin and tube may be used for viscosity control as provided by the resin manufacturer.

No absorbent layers of tube shall be inserted into the existing pipe without being fully impregnated with resin.

Tube installation forces or pressures shall be limited so as to meet manufacturer's recommendation for maximum longitudinal stretching.

Any bladders or tubes used to inflate the tube material against the original pipe that were not fully bonded to the tube material prior to insertion into the original conduit shall be completely removed after CIPP installation.

The existing pipe must be dewatered per manufacturer's specification.

The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed between the impregnated tube and the pipe invert at both the insertion and the remote manhole to determine the temperature during cure. The use of a fiber optic sensor cable may be used to monitor the temperature while curing. Water temperature in the line during the cure period shall be recommended by the resin manufacturer.

Initial cure shall be deemed to be completed when the exposed portions of CIPP appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer, as modified by the designated process during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature continues.

The Contractor shall cool the hardened CIPP to a temperature below 100^{o} F before relieving any bladders or tubes used to inflate the tube material against the original pipe. Water temperature must be less than 100^{0}F prior to disposal into sewer collection system.

The finished CIPP shall be continuous over the entire length of the run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes and delamination. It shall also meet the leakage or pressure test requirements for the main line and lateral connections.

If the Contractor fails to make a tight seal due to broken or misaligned pipe at the manhole wall, the Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with the CIPP and at no additional cost to the Owner.

For CCTV inspection, the Contractor is responsible for adhering to the same requirements as noted in Section 701-Cleaning and Closed Circuit Television (CCTV) Inspection within this specification.

Video CCTV inspections shall be performed as specified in Section 701-Cleaning and Closed Circuit Television (CCTV) Inspection. Cutting and trimming equipment shall be able to satisfactorily perform the operations. Satisfactory operation of cameras and other

equipment must be demonstrated and approved before lining operations begin. After the tube has been cured in place, the Contractor shall reconnect all the existing service connections. The Owner reserves the right to use means such as dye testing to confirm activity, as necessary at the cost of the Owner. Opening the service line connections shall be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of CCTV and a cutting device that re-establishes them to not less than 90% capacity. The cuts shall be trimmed to a neat, clean, circular opening concentric with the service line pipe with the bottom cut flush, free of jagged edges, "sawteeth", resin plugs or resin shelves. All cuts shall be brushed with a like resin or wire brush to form a smooth opening, so as not to catch floatables in the sewage. The Contractor shall provide a fully functional backup cutting device anytime that reinstatement of service lines are being made.

The CIPP shall make a tight seal at the manhole opening with no annular gaps using hydrophilic end seals as specified herein. Where the liner continues through the manhole, the upper portion of the liner will be removed and the bottom half to remain, resulting in a smooth, continuous flowline through the manhole. Inverts may be rebuilt using epoxy grout or the CIPP liner material should be sealed to the invert and bench with quick-set epoxy mortar or high viscosity epoxy. These procedures shall be completed before proceeding to the next manhole section.

The Contractor shall make sure through CCTV inspection that each active lateral connection is opened, free to discharge and is not plugged or backed up as a result of the lining operation.

B. INSTALLATION OF GLASS REINFORCED PLASTIC (GRP) UV CURED LINER. By beginning the installation of the liner, the Contractor implies, by their actions, the line is an acceptable candidate for lining.

It is the intent of this Article of the specifications to provide for the lining of sanitary sewer main by the installation of a GRP UV cured resin -impregnated tube, inserted into the existing sewer from an approved access point and fully extended to the next designated manhole or termination point in accordance with ASTM F2019, utilizing a winch.

A slip sheet may be installed on the bottom half of the pipe prior to liner insertion, for the purpose of smoothing out the bottom of the liner and bridging any missing areas of the host pipe.

The winch must have the capability of documenting the amount of tension and speed used to pull the liner into the pipe. The Manufacturer's maximum pulling tension and speed shall not be exceeded. Care shall be exercised not to damage the tube during the pulling phase.

Once the liner is inserted, end plugs shall be used to cap each end of the fiberglass liner to prepare for pressurizing the liner to form an air tight seal. The end plugs shall be

secured with straps to prevent them from being expelled due to pressure. Liner restraints shall be used as necessary.

The fiberglass liner shall be cured after insertion with a UV light source at a constant inner pressure as specified by the Manufacturer. The resin shall cure into a hard impermeable pipe liner in accordance with applicable ASTM F2019. A camera shall be located on the ultraviolet light assembly to enable the video inspection of the liner and to ensure that the liner has been properly inflated and any liner problems can be identified before curing begins.

For the liner to achieve the required water tightness and specified mechanical properties, curing speed, UV bulb wattage, inner air pressure, and exothermic (curing) temperatures must be controlled during the entire curing process, and are defined in the quality protocol issued by the Manufacturer. The Owner or Engineer shall be given a record of the curing parameters over every segment of the entire length of the liner. This shall be accomplished using a computer and database that are tamper proof. During the curing process, infrared (IR) sensors shall be used to record curing data that will be submitted to the Owner or Engineer with a post CCTV inspection.

The inner film material shall be removed and discarded after curing.

Flushing of the GRP UV cured liner is not required if 3rd party test results document styrene residual levels are within acceptable defined levels without flushing.

The finished liner shall be continuous over the entire length of the insertion run, and as free as commercially practicable from visual defects such as folds, foreign inclusions, dry spots, pinholes, and delamination.

(1) Any defect which the Owner or Engineer determines will affect the flow channel, capacity, integrity or strength of the liner shall be repaired or the entire liner replaced at the Contractor's expense.

(2) All inlets and outlets of the cured liner shall be cut flush at the inlet and outlet points in the manhole or other access point, and sealed with an epoxy or resin mixture compatible with the liner/resin system, providing a watertight seal per Manufacturer's recommendation. Sealing material and installation method shall be submitted and approved by the Owner or Engineer prior to start of construction.

(3) Connecting manholes shall be rehabilitated in accordance with Section 706-Existing Sewer Structures.

Video CCTV inspections shall be performed as specified in Section 701-Cleaning and Closed Circuit Television (CCTV) Inspection. Cutting and trimming equipment shall be able to satisfactorily perform the operations. Satisfactory operation of cameras and other equipment must be demonstrated and approved before lining operations begin. After the tube has been cured in place, the Contractor shall reconnect all active existing service line

connections. The Owner reserves the right to use means such as dye testing to confirm activity, as necessary at the cost of the Owner. Opening the service line connections shall be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of CCTV and a cutting device that re-establishes them to not less than 90% capacity. The cuts shall be trimmed to a neat, clean, circular opening concentric with the service line pipe, free of jagged edges, "sawteeth", resin plugs or resin shelves. All cuts shall be brushed with a like resin or wire brush to form a smooth opening, so as not to catch floatables in the sewage. The Contractor shall provide a fully functional backup cutting device anytime that reinstatement of service lines are being made.

The CIPP shall make a tight seal at the manhole opening with no annular gaps using hydrophilic end seals as specified herein. Where the liner continues through the manhole, the upper portion of the liner will be removed and the bottom half to remain, resulting in a smooth, continuous flowline through the manhole. Inverts may be rebuilt using epoxy grout or the CIPP liner material should be sealed to the invert and bench with quick-set epoxy mortar or high viscosity epoxy. These procedures shall be completed before proceeding to the next manhole section.

The Contractor shall make sure, through CCTV inspection, that each active service line connection is opened, free to discharge, and is not plugged or backed up as a result of the lining operation.

C. INSTALLATION OF CIPP SPOT REPAIR SHORT LINERS. The CIPP spot repair short liner material shall be measured, cut, and impregnated with resin to the measurements determined from the CCTV inspections. The installation and curing of the CIPP Spot Repair Short Liner shall be in accordance with the manufacturers' installation instructions.

The inflatable element and hydrostatic pressure used during the installation process shall be sufficient to tightly hold the CIPP Spot Repair Short Liner to the existing pipe wall and squeezing surplus resin into any cracks in the pipe. This pressure shall be great enough to overcome or prevent infiltration from entering the existing pipeline during the curing process.

If the CIPP Spot Repair Short Liner connects to a manhole, a tight seal shall be obtained at the manhole opening using hydrophilic end seals as specified herein.

If the CIPP Spot Repair Short Liner is installed over an active service connections, the service connections shall be re-established to not less than 90% capacity. The cuts shall be trimmed to a neat, clean, circular opening concentric with the service line pipe, free of jagged edges, "sawteeth", resin plugs or resin shelves. All cuts shall be brushed with a like resin or wire brush to form a smooth opening, so as not to catch floatables in the sewage.

D. CLEAN-UP OPERATIONS. All materials removed from the pipe line and from the pipe lining process shall be satisfactorily disposed of offsite by the Contractor.

Prior to final acceptance, the Contractor shall demonstrate, in the presence of the Owner, the capability of the liner to perform as specified. Any deficiencies found in the liner shall be corrected at no additional cost to the Owner.

705.10 INSPECTION AND TESTING

A. GENERAL. For each continuous length of sanitary sewer main that receives a CIPP liner, one liner sample shall be prepared from a section of the cured pipe at the termination point. (Note: In areas with limited space and larger diameter pipes, other sampling techniques may be required).

The Contractor shall submit the samples taken from the first three liners, and every fifth liner thereafter, for laboratory for testing. The Engineer may request that a sample taken from a particular liner be substituted for one of the samples identified for laboratory testing. The samples not selected for laboratory testing shall be provided to the Engineer.

The liner samples selected for laboratory testing shall be tested in accordance with the applicable ASTM procedures for the resin being used (i.e. ASTM F1216).

A final CCTV inspection shall be made following installation of the CIPP to document all work performed and copies shall be submitted to the Owner and Engineer, as specified in Section 701-Cleaning and closed Circuit Television (CCTV) Inspection. Visual inspection of the CIPP shall be made in accordance with ASTM F1743 and Section 701-Cleaning and Closed Circuit Television (CCTV) Inspection.

If the liner fails to meet the laboratory test criteria, it will be repaired as necessary by the Contractor, and retested, at no additional expense to the Owner. The pipe line will not be considered acceptable until it successfully passes the requirements of this test.

The Contractor shall be responsible for all costs, and delays incurred due to efforts to locate and repair any leaks in any sanitary sewer main which fails the test, regardless of whether the failure is due to workmanship, material failure or the result of improperly installed liner.

B. TESTING. Samples shall be collected, and field testing shall be performed, by the Contractor, or approved Subcontractor, in the presence of the Owner's representative. The Contractor or Subcontractor shall keep a written record that will show the results of the field tests conducted. The records shall include sufficient data on length of line, time, and related features noted during the testing of each segment of the line. A copy of records shall be provided to the Engineer.

The Contractor shall collect all samples. Samples that are selected for testing shall be sent by the Contractor, at the Contractor’s expense, to an independent testing laboratory.

The Contractor will pay for all initial tests and retests described herein. The laboratory shall provide the results of the tests directly to the Engineer.

Testing of the completed liner consists of:

(1) Field testing

(2) Laboratory testing

The samples taken shall be identified as follows:

(1) Samples: Samples removed for testing will be individually labeled and logged to record the following:
    a. Owner's project number and title
    b. Sample number
    c. Segment number of line identified by upstream and downstream manhole numbers.
    d. Date and time of sample
    e. Name of Contractor
    f. Date, location, and by whom tested
    g. Results of the test

The sample shall be a restrained sample at one of the pipe ends. Two cured plates, 6" x 16" in size, shall be taken from the cook down tube, not the liner in the pipe. No destructive test will be allowed to liner that is to be left in place. The samples shall be numbered as follows:

    a. Sample #/A: resin sample
    b. Sample #/B: flat plate sample
    c. Sample #/C: upstream thickness test
    d. Sample #/D: downstream thickness test
    e. Additional samples will be lettered consecutively after "D".

(2) Field Test (Thickness): The liner shall be run through a 24" long section of similar line-size to act as a mold for the liner and cured. One such sample shall be taken from liner at the ending manhole of the section being lined. One core sample shall be taken from the middle of each molded section and thickness measured using calipers, in millimeters. The measurement shall be verified by the Engineer, or the Engineer's designated representative, and recorded.

(3) Laboratory Testing – Resin, Physical Properties: Samples obtained for these tests will be sent by the Contractor to an approved laboratory for the following tests.

    a. Resin: Using the cured resin sample, an infrared spectrography chemical fingerprint shall be run and compared to the submitted fingerprint to verify the resin used is the resin submitted for use on this project. Unapproved

resins or resins not submitted with the approved submittals are rejected and any liner installed with unapproved resin will be removed and replaced at Contractor's expense.

b. Physical Properties: The cured 6" x 16" plate will be used to test modulus of elasticity and flexural strength and to verify the requirements have been met. Thickness measurement shall be determined in accordance with ASTM D5813, Paragraph 8.1.2.

(4) Laboratory Testing – Chemical Resistance: The CIPP shall meet the minimum chemical resistance for standard domestic sewer applications unless directed otherwise by the Owner. Chemical resistance tests should be completed in accordance with Test Method D 543. Exposure should be for a minimum of one month at 73.4º F (23º C). During this period, the CIPP test specimens should lose no more than 20% of their initial flexural strength and flexural modulus. A makeup of the chemical solutions is as defined below.

Table 3. CIPP Chemical Resistance

Chemical Solution	**Concentration %**
Tap water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

(5) Laboratory Testing – Long-Term Reduction in Physical Properties: Long-term creep data in accordance with ASTM D2990 shall be submitted by each manufacturer and/or CIPP product. Duration of creep testing shall be a minimum of 10,000 hours. As an option, documentation for a minimum of 10,000 hours of pipe long term modulus evaluation by an outside test lab may be provided.

(6) Laboratory Testing – Fiber Reinforcement: If glass fiber reinforcement is used, CIPP strain-corrosion testing in accordance with D3681 must be submitted.

C. ACCEPTANCE CRITERIA. Field acceptance of the liner shall be based on the Owner or Engineer's evaluation of the installation including inspection videos and a review of certified test data for the installed pipe samples.

Groundwater infiltration of the liner shall be zero. All service connections shall be open and clear. There shall be no evidence of splits, cracks, breaks, lifts, kinks, delaminations or crazing in the liner.

If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the Owner.

Repair methods shall be submitted to the Owner or Engineer for approval. Any liner failure that requires excavation work to repair shall be initiated within two (2) hours of failure observation.

705.11 LINE OBSTRUCTIONS.

Refer to Section 701-Cleaning and closed Circuit Television (CCTV) Inspection for specifications on cleaning of sewer lines.

705.12 MAINTENANCE OF FLOW / BYPASS SEWAGE

Refer to Section 708-Bypass Pumping for specifications on by-pass pumping.

705.13 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work.

Payment for work will not be considered until post-construction CCTV videos are received, reviewed, and accepted by the Owner. The Owner reserves the right to re-review tapes after payment for final acceptance. The post video shall include full mainline surveillance as well as the viewing of all laterals for adequate cutting of openings.

Pre-CCTV inspections shall be paid as incidental to the CIPP liner and/or CIPP spot repair short liner installation.

Post-CCTV inspections shall be paid for as set forth in Section 701-Cleaning and closed Circuit Television (CCTV) Inspection. All by-pass pumping shall be paid for as set forth in Section 708-Bypass Pumping. .

A. CIPP SANITARY SEWER MAIN (SIZE, TYPE). CIPP liners for the sanitary sewer main shall be measured by the actual number of linear feet of CIPP installed, measured in place along the centerline of the pipe, from wall to wall of the manholes, of the various types (felt or glass reinforced plastic) and sizes indicated. Measurement shall be to the nearest tenth of a foot. CIPP for the sewer main shall be paid for by the respective quantities, at the type and sizes defined, as determined in the Contract unit bid price. This price and payment will be full compensation for furnishing all materials, labor, tools, equipment and appurtenances required or otherwise necessary to satisfactorily complete the Work, stopping of active leaks that would interfere with the integrity of the line to be installed, obtaining water, repairs to private property, public notification, any excavations and backfilling, sewer flow control; hydrophilic end seals; acceptance testing, sampling and testing, pre-CCTV video, care and protection of property; and all costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other Items.

B. CIPP SPOT REPAIR SHORT LINER (SIZE, TYPE). CIPP spot repair short liners for the sanitary sewer main shall be measured by the actual number of linear feet of CIPP installed, measured in place along the centerline of the pipe, for length needed for a spot repair, of the various types and sizes indicated. Measurement shall be to the nearest tenth of a foot. CIPP spot repair short liners shall be paid for by the respective quantities, at the sizes defined, as determined in the Contract unit bid price. This price and payment will be full compensation for furnishing all materials, labor, tools, equipment and appurtenances required or otherwise necessary to satisfactorily complete the Work, stopping of active leaks that would interfere with the integrity of the line to be installed, obtaining water, repairs to private property, public notification, any excavations and backfilling, sewer flow control; hydrophilic end seals; acceptance testing, sampling and testing, pre-CCTV video, care and protection of property; and all costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other Items.

C. PRE-LINER/REINFORCED PRE-LINER (SIZE). Pre-liner/reinforced pre-liner for the sewer main shall be measured by the actual number of linear feet of pre-liner/reinforced pre-liner installed, measured in place along the centerline of the pipe, from wall to wall of the manholes, of the sizes indicated. Measurement shall be to the nearest tenth of a foot.

D. SERVICE LINE REINSTATEMENT AFTER CIPP OF MAIN (SIZE). Reinstatement of active service lines shall be measured by the actual number of service lines reconnected as determined by the Owner or Engineer. Reinstatement of active service lines shall be paid for each service line reconnected as determined above at the Contract unit price bid.

Payment will be made under:

Pay Item	Pay Unit
CIPP Sanitary Sewer Main (Size, Type)	LF
CIPP Spot Repair Short Line (Size, Type)	LF
Pre-Liner/Reinforced Pre-Liner (Size)	LF
Service Lateral Reinstatement After CIPP of Main (Size)	EA

SECTION 706
EXISTING SEWER STRUCTURES

706.01 SCOPE OF WORK

This work shall consist of furnishing all labor, materials, tools, equipment, incidentals, testing and construction methods or processes required to rehabilitate existing manholes including eliminating infiltration and exfiltration; providing corrosion protection; cleaning of existing manholes; repairing of voids and restoration of the structural integrity off the existing manholes by applying monolithic fiber-reinforced structural/structurally enhanced cementitious liner to the wall and bench surfaces; installing fiberglass manholes; removing existing chimneys and replacing with new chimneys; identifying correct sizes of and installing new frames and covers; repair or rebuild invert channels, sealing pipe connections and stopping active infiltration with chemical sealant in manholes.

Work performed under this Specification shall be done in accordance with Municipal, State, and Federal standards. Traffic control and safety shall be in accordance with Section 120.

All materials shall conform to the standards referenced. All lubricants, adhesives and other incidental materials shall conform to the pipes manufacturer's recommendations.

706.02 QUALIFICATIONS AND SUBMITTALS

Contractor and manufacturer of the selected manhole monolithic lining system shall furnish engineering data covering the design and installation. Submittals shall include:

(1) Manufacturers' product data, including physical properties, surface preparation, repair, application, curing, and field control procedures.

(2) Material Safety data sheets (MSDS) for any material brought on-site including all resurfacing system materials, solvents, and abrasive blast media. Supplement MSDS information with manufacturer's application and safety procedures for all coating system materials.

(3) Manufacturer and applicator qualifications as specified.

(4) Type of lining system for each manhole.

(5) Diameter, depth (rim to invert), and material for each manhole.

(6) All design calculations shall be stamped by a Registered Professional Engineer of the State of Arkansas.

(7) Method of rebuilding bench and invert and sealing pipe at manholes.

(8) Sewer flow control plug and/or bypass plan.

(9) Written instructions and drawing details for treatment of lining materials at terminations in the structures to be lined including pipe penetrations, metal embedments, metal frames, and other terminations to be determined from the Drawings. This information should include detailed treatment for corrosion resistant lining systems at all joints in the concrete.

Per Section 105, the Contractor shall submit to the Owner or Engineer, within 10 days of the Effective Date of the Agreement, the name of the supplier (manufacturer), name of the installer, and a list of materials to be furnished before work may commence.

The Contractors shall submit a step-by-step description of methods, practices, intervals, etc. to be used in all rehabilitation systems to meet requirements of this specification Section.

Prior to each shipment of materials, the Contractor shall submit certified test reports that the materials for this Contract were manufactured and tested in accordance with the ASTM Standards specified herein.

Refer to Section 708 for by-pass pumping requirements. Refer to Section 709 for GIS and Data Delivery requirements.

A database or spreadsheet must be delivered by the Contractor describing the work performed and the structure asset attributes involved (cover, frame, depth, lining type, internal diameter). The digital data will be delivered in a format as required by the Owner. Prior to beginning work the Owner shall provide template databases or spreadsheets to be used by the Contractor to document structure rehabilitation work and structure attributes.

The Contractor or Subcontractor performing the manhole rehabilitation shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner. The Contractor shall submit the following information to the Owner or Engineer for review and approval before any work is performed:

(1) Be certified by manufacturer to install monolithic lining systems or fiberglass manholes.

(2) Have a minimum of 5 years' experience or 500 manholes in performing this type of specialized work. This may be waived by the Owner through their product approval process with documentation demonstration projects.

(3) Name of the manufacturer and supplier for this work and previous work listed below. The Contractor shall be an approved installer as certified and licensed by the manufacturer.

(4) A list of municipal clients that the Contractor has performed this type of work over the past 5 years.

(a) The list shall contain names and telephone numbers of persons who can be called to verify previous satisfactory performance.

(b) Installation dates and a description of the actual work performed.

(c) The manufacturer shall provide an installation list of his product used for similar sewer manhole rehabilitation projects. The list shall provide the same information as required in paragraphs 3.a. and 3.b. above.

(5) All manhole monolithic lining systems shall be from a single manufacturer. The supplier shall be responsible for the provisions for all test requirements specified in the referenced ASTM Standards as described herein as applicable for manhole monolithic lining. Inspections of any materials required for manhole monolithic lining may be made by the Owner or Engineer. All materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample materials may have been approved. Any materials rejected after delivery shall be marked for identification and shall be removed from the job site.

706.03 MATERIALS

A. JOINT SEALING MATERIAL. Sealing material for sealing exterior joints in precast manhole sections, concrete adjusting collars, cast iron adjusting rings, and cast iron frames shall be Wrapidseal manufactured by Canusa, Infi-Shield manufactured by Sealing Systems, Inc. or an approved equal.

B. MANHOLE PATCHING MATERIAL. Manhole patching material for filling voids and repairing walls and inverts of concrete, brick, or other masonry structures shall be a rapid-setting (10-15 minutes), fiber-reinforced, high-early strength, corrosion-resistant, hand-mixed, hand-applied, calcium aluminate based cementitious material conforming to Strong-Seal QSR as manufactured by Strong Company, Octocrete as manufactured by IPA Systems, Inc., or approved equal. The patching material shall have a minimum compressive strength of 1,400 psi at 6 hours and shall be factory blended requiring only the addition of water at the job site.

C. MANHOLE LEAK-STOP MATERIAL. Manhole Leak-Stop material shall be used where the infiltration flow rate through the manhole wall or pipe connection is greater than can be controlled with manhole patching material. Manhole Leak-Stop material shall be specifically formulated for leak control, rapid-setting (60 seconds), fiber-reinforced, high-early strength, corrosion-resistant, hand-mixed, hand-applied, calcium aluminate based cementitious material conforming to Strong-Plug as manufactured by Strong Company or approved equal. The leak stop material shall have a minimum compressive strength of 1,000 psi at 24 hours and shall be factory blended requiring only the addition of water at the jobsite.

D. CONCRETE CAP. Concrete caps shall be constructed around manhole frames and covers and shall match the surface elevation and slope of the manhole frame and the surrounding pavement. Concrete caps shall have dimensions of 6 feet by 6 feet, shall be a minimum of 8 inches thick or match existing pavement thickness, whichever is greater, and shall be constructed of Class "AAA" (4,000 psi) concrete as specified in Section 401 "Concrete General." The concrete cap shall be centered over the manhole frame and reinforced with fiber mesh. In concrete pavement areas, expansion joint material complying with Section 401 "Concrete General" shall be placed between the concrete pavement and the concrete cap.

E. MANHOLE ADJUSTING RINGS. Manhole adjusting rings shall be cast iron conforming to ASTM A48 or ductile iron conforming to ASTM A536. Adjusting rings shall be R-1979 series manufactured by Neenah Enterprises, Inc., or approved equal. The maximum height of stacked rings shall not exceed 24 inches. The Contractor shall determine all dimensions and shall ensure correct sizing of the adjusting rings.

F. ADJUSTING COLLARS. Adjusting collars, used for setting the cast iron frame and covers to the required elevation, shall be made of concrete or shall be Cretex Pro-Ring, or approved equal. Concrete adjusting collars shall have a minimum wall thickness of 6 inches. All adjusting collars shall have an inside diameter the same as the existing inside diameter of the top of the manhole.

G. FIBERGLASS MANHOLES. Fiberglass manholes shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. The resin system shall be suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with wastewater collection systems. The manhole liner shall be a one piece unit manufactured to meet or exceed all specifications of ASTM D-3753, latest edition, and HS-20 load requirements, as manufactured by L.F. Manufacturing, Inc. or approved equal.

H. CEMENTITIOUS MANHOLE MONOLITHIC LINING SYSTEM (CMML): Cementitious lining system shall provide a minimum service life of 25 years. The system shall be:

(1) Type 1: Portland-based Cementitious Liner [no sulfide conditions (substrate surface of pH 4.0 or higher)].

(a) Acceptable Manufacturers and Products are Strong-Seal; MS-2A; MS-2C; Quadex QM-1s Restore; Standard Cement Re-liner MSP; Permacast MS-10,000; Mainstay ML-72; Dinjer CMS 10K; or approved equal.

(b) Portland-based cementitious liner product shall be used to form a structural monolithic liner covering interior substrate surfaces and have following minimum requirements:

Table 4. Minimum Requirements for Portland-Based Cementitious Liners

Property	**Specification**	**Timeframe**	**Pressure**
Compressive Strength	ASTM C 109	28 days	>9,000 psi
Tensile Strength	ASTM C 496	28 days	>800 psi
Flexural Strength	ASTM C 293	28 days	>1,200 psi
Shrinkage @90% R.H.	ASTM C 596	28 days	0%
Bond	ASTM C 882	28 days	>2,000 psi
Density, When Applied			134 ± 5lbs/ft3
Freeze/Thaw	ASTM C 666	N/A	300 cycles no visible damage

(c) Portland-based liner shall be made with Type I Portland Cement and shall be used according to manufacturer's recommendations in applications where there are no sulfide conditions (substrate surface of pH 4.0 or higher). Material shall meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C 94 procedure. Potable water need not be tested.

(2) Type 2: Calcium Aluminate Cementitious Liner [mild sulfide conditions (substrate surface of pH 2.0 or higher)].

(a) Acceptable Manufacturers and Products are Strong MS-2C; Quadex Aluminaliner; Standard Cement Maximum CA; Permacast CR-9,000; Mainstay ML-CA; SewperCoat; or approved equal.

(b) Calcium aluminate cementitious liner product shall be used to form a structural monolithic liner covering interior substrate surfaces and shall have the following minimum requirements:

Table 5. Minimum Requirements for Calcium Aluminate Cementitious Liners

Property	**Specification**	**Timeframe**	**Pressure**
Compressive Strength	ASTM C 109	28 days	>9,000 psi
Tensile Strength	ASTM C 496	28 days	>800 psi
Flexural Strength	ASTM C 293	28 days	>1,200 psi
Shrinkage @90% R.H.	ASTM C 596	28 days	0%
Bond	ASTM C 882	28 days	>2,000 psi
Density, When Applied			134 ± 5lbs/ft3

Freeze/Thaw	ASTM C 666	N/A	300 cycles no visible damage

(c) Calcium aluminate cementitious liner shall be made with calcium aluminate cement and shall be used according to manufacturer's recommendations in applications where there are mild sulfide conditions (substrate surface of pH 2.0 or higher). Liner product shall be reinforced with alkaline resistant fiberglass rods or other similar fibers not less than 1/2 inch in length. Material should meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C 94 procedure. Potable water need not be tested.

I. CURED-IN-PLACE MANHOLE LINER (CIPM): The cured-in place lining system shall provide a minimum service life of 25 years. CIPM system shall be Poly-Triplex Liner System, Terre-Hill, or pre-approved equal.
Liner design and selection of materials shall be suitable for specified design conditions and shall meet minimum requirements outlined in the table below. Thicker liners may be required based on design conditions. Liner shall be custom designed to fit each manhole and basis of design shall be submitted to Owner or Engineer. It is Contractor's responsibility to supply a CIPM liner that is most suitable for existing conditions and that meets requirements of this specification. Contractor shall assume groundwater at grade for all sites for purposes of liner thickness design unless otherwise instructed by Owner or Engineer.

Manhole Depth (Grade to Invert)	**Minimum Liner Thickness * (inch)**	**Minimum Pre-Saturated Fabric Weight (ounces)**	**Minimum Flexural Modulus of Elasticity (psi)**	**Minimum Compressive Strength (psi)**	**Chemical Resistance Testing**
	ASTM D5813		ASTM D790	ASTM D695	ASTM F1216 Appendix X2
0 to 10 ft	0.117	56	1,000,000	11,000	PASS
10.1 to 15 ft	0.117	56	1,000,000	11,000	PASS
15.1 to 20 ft	0.158	68	1,000,000	11,000	PASS
*Minimum liner thickness includes only the strength portion of the liner. Non-structural layers are not included in minimum thickness requirements.					

706.04 QUALITY ASSURANCE

All material shall be new and unused.

Material quantity, manufacturing process and finished sections are subject to inspection and approval by the Owner or Engineer. Inspection may be made at place of manufacture, at work

site following delivery, or both.

Materials will be examined for compliance with ASTM standards, this Section and approved manufacturer's drawings. Additional inspection criteria include: appearance, dimension(s), blisters, cracks and soundness.

Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification any rejected materials and removed from work site immediately. Rejected materials shall be replaced at no cost to the Owner.

Repair minor damage to precast concrete sections by approved methods, if repair is authorized by the Owner or Engineer.

706.05 CONSTRUCTION REQUIREMENTS

Refer to Section 711 for notification details and information.

Materials shall be stored, shipped, and handled according to their material safety data sheet and manufacturer's recommendations.

The Contractor shall accurately field measure and size each individual manhole prior to ordering materials. All field measurements shall conform to the requirements of the required manufacturer.

Refer to Section 709 for maintenance of flow and bypass pumping.

A. REMOVE AND REPLACE FRAME AND COVER. Set frames and covers in a full mortar bed. Utilize grade adjustment rings brick and mortars to assure frame and cover are set to the finished grade. Set the manhole frame and cover to finished grade prior to placement of final paving.

   See Section 703 for the specified manhole frame and cover types and proper installation.

B. REMOVE EXISTING CHIMNEY AND REPLACE WITH NEW FIBERGLASS MANHOLE. The Contractor shall remove brick or concrete chimneys as required to complete manhole rehabilitation work, including completely dismantling the existing chimney and all bricks or materials that comprise the chimney, and removal of the existing frame and cover. If the entire manhole is to be disassembled, the manhole shall be replaced using a pre-cast concrete manhole. If only the chimney is to be replaced, the chimney shall be replaced with a fiberglass manhole inserted into the host manhole, and extending to the bottom of the host manhole.

C. MANHOLE GRADE ADJUSTMENT. Existing manholes shall be adjusted to grade using manhole adjusting rings; by removal and replacement of the frame and cover; or by removal of the top portion of the structure and installation of a fiberglass manhole liner as

shown on the plans or directed by the Engineer. Any portion of the remaining manhole structure damaged due to the negligence of the Contractor shall be repaired by the Contractor without compensation. The top of the frame and cover shall conform to the general requirements as previously set forth in this Section. All brick manholes shall be removed and replaced; no grade adjustment will be performed.

Backfill and compaction shall be as specified in Section 205 of these Specifications.

At locations where the existing manhole is buried, the Fort Smith Utility Department will assist the Contractor in locating the manhole.

(1) RAISING TOP LESS THAN 4 INCHES. Where the top of the manhole is to be raised less than 4 inches, cast iron manhole adjusting rings shall be installed in the existing frame. The rings shall be firmly seated in the existing manhole frames and shall be non-rocking. Manholes in pavement areas which are to be overlaid shall be adjusted to finished grade prior to the start of the pavement overlay operation, and shall include the construction of a concrete cap around the manhole frame and cover unless otherwise directed by the Owner.

(2) RAISING TOP BETWEEN 4 AND 24 INCHES. Where the top of the manhole is to be raised between 4 and 24 inches, the existing frame and cover is to be removed. Adjusting collars and mortar shall be used as required to set the top of the frame to the correct elevation and slope. The existing frame and cover shall be reinstalled as previously set forth in this Section. New flexible plastic gaskets and joint sealing material shall be installed, and shall conform to the specifications in Section 703. Where directed by the Owner or Engineer, a new cast iron frame and cover shall be installed and the existing frame and cover delivered to the Fort Smith Utilities Department. If manhole is located within pavement areas, the top of the manhole shall be raised as set forth in this section, and shall include the construction of a concrete cap around the manhole frame and cover unless otherwise directed by the Owner.

(3) RAISING TOP OVER 24 INCHES. Where the top of the manhole is to be raised over 24 inches, a new fiberglass manhole is to be inserted into the existing manhole and extend to the bottom of the manhole. The existing cast iron frame shall be removed. The cone shaped portion of the manhole is to be removed and disposed of. All existing laterals shall be re-tapped and sealed. If manhole is located within pavement areas, the top of the manhole shall be raised as set forth in this section, and shall include the construction of a concrete cap around the manhole frame and cover unless otherwise directed by the Owner.

(4) LOWERING TOP. Where the top of the manhole is to be lowered, the existing frame and cover is to be removed. Depending on the elevation and condition of the existing manhole cone section and the depth to which the manhole needs to be lowered, the existing manhole cone and portions of the wall may also have to be removed to the required elevation as directed by the Owner or Engineer. If this is

required, a new fiberglass manhole shall be inserted into the existing manhole and extend to the bottom of the manhole. The installation of the new fiberglass manhole and the installation of the frame and cover to grade shall be as set forth in this Section. If manhole is located within pavement areas, the top of the manhole shall be lowered as set forth in this section, and shall include the construction of a concrete cap around the manhole frame and cover unless otherwise directed by the Owner.

D. REPAIR AND REBUILD EXISTING MANHOLE INVERTS. Where shown on the plans or as directed by the Owner or Engineer, broken or damaged manhole inverts shall be repaired using manhole patching material. Prior to performing any work on the manhole invert, the pipes entering the manhole shall be plugged to prevent foreign material from entering the sewer pipe and the wastewater shall be pumped around the manhole. All foreign material shall be removed from the manhole invert. Loose and protruding brick, mortar, and concrete shall be removed. All holes, cracks, and other defective areas in the manhole invert shall be filled or repaired using hand-applied manhole patching material.

A coating of manhole patching material shall be troweled uniformly onto the entire invert to a minimum thickness as specified by the Manufacturer. Extra care shall be taken to ensure complete filling of the void at the pipe connection with manhole patching material. The coating shall extend out onto the bench to the walls of the manhole or, if shown on the plans, a sufficient distance to tie into the Manhole Grout liner which will be sprayed applied. The finished coated surfaces shall be smooth and free of ridges. The mixing, handling, and application of the patching material shall be in accordance with the manufacturers written recommendations. The patching material shall be allowed to cure as specified by the Manufacturer prior to allowing wastewater to flow across it.

E. SEWER MANHOLE MONOLITHIC CEMENTITIOUS LINING. Where shown on the plans or as directed by the Owner or Engineer, monolithic manhole lining systems shall be installed to protect concrete, brick, mortar, and other manhole surfaces from corrosion. Design products to stop infiltration, root intrusion, and further deterioration in manhole. Interior surfaces to be protected shall include walls, benches, inverts, pipe junctions and chimney (corbel). The table below outlines different monolithic manhole lining systems and respective product specification for each lining system. The pH limits listed below are typical. Type of manhole lining used shall be as shown on the drawings or as directed by Owner or Engineer.

(1) Portland Based Cementitious Liner: No or very mild hydrogen sulfide conditions, pH of 4.0 or higher.

(2) Calcium Aluminate Cementitious Liner: Mild to harsh hydrogen sulfide conditions, pH of 2.0 or higher.

(3) CIPM: Harsh hydrogen sulfide conditions, pH of 1.0 or higher. This includes structures with severe infiltration, structural integrity issues, or structures with very turbulent flow, such as pump station wet wells and force main discharge structures.

Table 6. Monolithic Manhole Lining Systems

Monolithic Manhole Lining System Type	**Type**
Portland Based Cementitious Liner	1
Calcium Aluminate Cementitious Liner	2
Cured-In-Place Manhole (CIPM)	3

(1) CEMENTITIOUS MANHOLE MONOLITHIC LINING SYSTEM (CMML) – Types 1 & 2. CMML system shall be a monolithic, Portland based or calcium aluminate cementitious liner system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes. Material specifications shall conform to Section 706.03.

Minimum thickness of Portland based cementitious lining shall be 1-inch thick. Minimum thickness of calcium aluminate based cementitious lining shall be 1-inch thick.

When cured, CMML shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage.

CMML shall cover complete interior of existing sewer manhole including benches (shelves). Lining shall effectively seal interior surfaces of sewer manhole and prevent any infiltration.

Lining shall be compatible with thermal condition of existing sewer manhole surfaces. Surface temperatures will range from 40 degrees F to 100 degrees F. Provide test data on shrinkage of cementitious lining based on ASTM C 596.

Termination of and surface of lining shall be suitable for proper installation of manhole frame-chimney seal when specified.

Cured system shall be continuously bonded to all surfaces inside sewer manhole.

Chemical sealants, grouts or patching materials used to prevent infiltration, to patch cracks, to fill voids and to otherwise prepare manhole surface prior to application of system shall be fully compatible with the system.

When cured, CMML shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage.

CMML shall cover complete interior of existing sewer manhole including benches (shelves). Inverts shall not be covered. Lining shall effectively seal interior surfaces of sewer manhole and prevent penetration or leakage of groundwater infiltration.

Lining shall be compatible with thermal condition of existing sewer manhole surfaces. Surface temperatures will range from 40 degrees F to 100 degrees F. Provide test data on shrinkage of lining based on ASTM C 596.

Place covers over invert to prevent extraneous material from entering the sewer lines.

Clean sewer manhole to be surfaced and dispose of resulting material properly.

Conduct a visual inspection of manhole after it is cleaned. Infiltration shall be plugged or sealed with grout. Remove loose mortar and rubble of existing benches and inverts. Remove protruding rubber gaskets between wall seams.

Cracks and other voids shall be repaired and filled with suitable non-shrinking cements, sealants or grouts.

Surfaces shall be clean and structurally sound.

Manhole rungs/steps shall be removed, ground smooth and patched and not replaced. Step removal shall be incidental to manhole restoration costs.

(2) CURED-IN-PLACE MANHOLE LINER (CIPM) – Type 3. Manhole liner system shall be a cured-in-place system suitable for use as a monolithic surfacing in sewer manholes.

CIPM shall be installed on benches, walls, channels, and inverts of existing manholes. Cured surface shall be smooth and continuous with proper sealing connections to unsurfaced areas. CIPM shall be sealed at frame/liner interface using an epoxy per the Manufacturer's recommendation.

CIPM shall be continuously bonded to all surfaces inside sewer manhole. CIPM shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to chemicals or vapors normally found in domestic sewage. Liner shall effectively seal interior surfaces of sewer manhole and prevent any infiltration.

Finished liner shall be repairable at any time during life of structure

Prior to placing liner, Owner or Engineer will inspect and approve surface preparation work. Contractor is responsible for ensuring proper installation conditions, including temperature and moisture.

Liner tube shall be fully saturated at a site to be designated by Contractor for approval. When fully saturated with selected resin, liner shall be inserted into manhole per manufacturer's instructions.

Once properly inserted and oriented, liner shall be cured strictly according to manufacturer's instructions for that liner system. Heat cure time, cool down time, and temperatures shall be recorded in a log for Owner or Engineer's review.

F. FIBERGLASS MANHOLE LINER. Fiberglass manhole liners can be installed within existing concrete, brick or precast manholes.

Fiberglass manholes must be installed according to the manufacturer's instructions.

Prior to ordering any products, the Contractor shall confirm the inside diameter, depth, and roundness of the existing host manhole. In determining the proper insert length, provide the ring and cover casting height. Contractor shall notify owner if liner will not work in given manhole.

Prepare excavation around the existing manhole. Remove existing ring and cover, cone sections, or chimneys.

Use a non-shrinking grout to seal the area between the bottom of the liner and the existing bench area. Fill the area between the liner and the existing manhole using a concrete grout poured evenly in one foot lifts. Bottom of liner shall match existing contour of bench.

Bring the manhole to final grade as detailed in Section 706.05. Backfill according to Section 205 using sand or crushed stone.

G. REPAIR PIPE CONNECTIONS TO MANHOLE. Where shown on the plans or directed by the Engineer new or existing pipe connections shall be repaired. Prior to performing any work on the manhole invert, the pipes entering the manhole shall be plugged to prevent foreign material from entering the sewer pipe and the wastewater shall be pumped around the manhole. All foreign material shall be removed from the manhole invert using a minimum 1500 psi water spray. The concrete, brick, or mortar around the pipe connection to the manhole shall be removed to a minimum distance of 3 inches beyond the outside edge of the pipe and to a minimum depth of 5 inches from the inside edge of the manhole wall. An

Elastomeric Waterstop Gasket shall be placed around the sewer pipe, and the hole and damaged manhole invert repaired with Manhole Patching Material.

H. CONNECT SEWER MAIN PIPE TO EXISTING MANHOLE. At locations where a new sewer pipe is to join an existing manhole, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. No bypassing of sewage flows to ditches, streams, storm sewers, or the ground will be permitted. The work shall consist of making the opening in the manhole wall, inserting the new pipe and Elastomeric Waterstop Gasket to the elevation shown on the plans, constructing necessary drop connections, and remodeling manhole invert. Openings in the manhole for the pipe shall be cored; the use of hammers will not be permitted. An Elastomeric Waterstop Gasket shall be installed in the cored opening between the manhole and the pipes. The hole in the concrete wall is to repaired with Manhole Patching Material. The patching material shall extend a minimum of 1 inch beyond the inside and outside surface of the wall and a minimum of 3 inches beyond the edge of the hole. The patch material shall cure for a minimum of one hour prior to wastewater flowing across it. If the connecting pipe requires modification to the existing invert channel, the existing channel shall be removed to the extent necessary for a new invert channel to be constructed to provide a smooth flow through the manhole.

I. CONNECT SEWER SERVICE PIPE TO EXISTING MANHOLE. Connecting sewer services to existing manholes shall include the cutting of the hole in the existing manhole wall, removal of existing service pipe as required, inserting the new service pipe into the manhole, the installation of all required fittings for connecting to the existing sewer service pipe, and repairing the manhole wall with Manhole Patching Material. Openings in the manhole for the service line shall be cored; the use of hammers will not be permitted. An Elastomeric Waterstop Gasket shall be installed in the cored opening between the manhole and the pipes. The hole in the concrete wall is to repaired with Manhole Patching Material. The patching material shall extend a minimum of 1 inch beyond the inside and outside surface of the wall and a minimum of 3 inches beyond the edge of the hole. The patch material shall cure for a minimum of one hour prior to wastewater flowing across it. If the connecting pipe requires modification to the existing invert channel, the existing channel shall be removed to the extent necessary for a new invert channel to be constructed to provide a smooth flow through the manhole.

J. REMOVE EXISTING MANHOLE. Prior to the removal of an existing manhole, the frames and covers shall be removed and delivered to the Fort Smith Utility Department located at 3900 Kelley Highway. All pipes entering the manhole shall be plugged with concrete for a minimum thickness of 12 inches.

Manholes designated to be removed shall be removed in their entirety including foundation or base unless otherwise noted on the plans or directed by the Engineer. All materials removed shall be disposed of off-site and the hole backfilled with compacted borrow.

K. ABANDON EXISTING MANHOLE. Prior to abandonment of an existing manhole, the frames and covers shall be removed and delivered to the Fort Smith Utility Department

located at 3900 Kelley Highway. All pipes entering the manhole shall be plugged with concrete for a minimum thickness of 12 inches.

Manholes designated to be abandoned shall have the top portion of the manhole removed to a depth of three feet below the adjacent surface and disposed off-site. The remaining portion of the manhole shall be filled with sand compacted by means of vibratory equipment. On-site material shall be used to complete the backfilling. Flowable Fill or other special backfill material shall be used where noted on the plans or directed by the Engineer.

L. ABANDON SEWER MAIN CONNECTION TO EXISTING MANHOLE. At locations where an existing pipe is to be abandoned at an existing manhole, the end of the pipe at the manhole shall be plugged by packing the pipe with a low slump, non-shrink concrete for a minimum distance of 12 inches from the inside wall of the manhole. The manhole invert shall be re-shaped using Manhole Patching Material. Prior to performing any work on the manhole invert, the remaining pipes entering the manhole shall be plugged to prevent foreign material from entering the sewer pipe and the wastewater shall be pumped around the manhole. All foreign material shall be removed from the manhole invert using a minimum 1500 psi water spray.

The invert shall be re-shaped with Manhole Patching Material to form a new smooth channel flow through the manhole and a new bench as required. The minimum thickness of the patching material shall be ½ inches. The finished surfaces shall be smooth and free of ridges. The mixing, handling, and application of the patching material shall be in accordance with the manufacturers written recommendations. The patching material shall be allowed to cure for a minimum of 30 minutes prior to allowing wastewater to flow across it.

706.06 INSPECTION AND TESTING

A. FIELD INSPECTION. Owner or Engineer may enter manholes to inspect benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the work. Contractor shall provide forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for Owner or Engineer to enter manhole and perform inspection in complete accordance with OSHA requirements at no additional cost to Owner.

Finished manhole surface shall be continuous and as free as commercially practicable from significant defects. Defects which will affect, in foreseeable future or warranty period, the integrity or strength of manhole shall be repaired at Contractor's expense, in a manner mutually agreed upon by Owner or Engineer and Contractor.

There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in liner. If any defects are discovered after liner has been installed, it shall be repaired or replaced in a satisfactory manner within 72 hours and at no additional cost to Owner. This requirement shall apply for entire warranty period.

Active Infiltration through lining system shall be zero.

Contractor is responsible for coordinating testing times with Owner or Engineer.

Connections to be abandoned shall be determined in the field by the Owner or Engineer and shall be plugged with bricks and mortar cement prior to rehabilitating the manhole.

The Contractor shall accurately field measure and size each individual manhole. The Contractor is reminded that each existing sewer manhole designated to receive a monolithic surfacing may have a different configuration and varying field dimensions.

B. TESTING. Each lined manhole shall be vacuum tested prior to acceptance. The vacuum test shall be performed after all pipe connections have been made and prior to backfilling. Test rehabilitated manholes using vacuum test method, following manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Vacuum testing will not be required on manholes with sewer lines greater than 16-inches in diameter due to safety concerns. Any visible leakage in manhole or structure, before, during, or after test shall be repaired regardless of test results. Vacuum test shall be performed in accordance with ASTM C 1244. All pipes connected to the manhole shall be temporarily plugged using suitable sized pneumatic or mechanical plugs. All vacuum tests shall conform to the requirements specified in Section 703.09.

All manholes with grade adjustments greater than 24 inches shall be re-tested. The Contractor shall be responsible for testing the grade-adjusted manhole, and for correcting any test failures at no cost to the Owner.

Cementitious lining shall provide a continuous monolithic surfacing with uniform thickness throughout manhole interior.

For testing of uniform thickness, the Contractor shall install pins (such as masonry nail) at four quadrants around manhole spaced every 4 feet vertically. Pins shall protrude slightly less than 1 inch from wall. Lining shall be installed to cover pins. The Contractor may develop other methods to be approved by Engineer or Owner.

If thickness of lining is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to Owner.

Field acceptance of CIPM shall be based on Owner or Engineer's evaluation of proper monolithic lining of manhole. Field acceptance shall also be based on the Owner or Engineer's evaluation of appropriate installation and curing test data along with review of manhole inspections.

CIPM shall provide a continuous monolithic lining with uniform thickness throughout manhole interior. If thickness of CIPM is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to Owner.

Owner or Engineer will measure CIPM cured thickness by a suitable non-destructive type of thickness measurement, i.e., measuring pipe penetration thickness. A minimum of two thickness measurement locations in each CIPM manhole shall be taken.

There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in CIPM.

If approved by the Engineer or Owner, ultrasonic testing shall conform to ASTM D 6132.

706.07 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work.

A. REMOVE AND REPLACE MANHOLE FRAME AND COVERS. Sewer manhole frames and covers for removal of existing sewer manhole frames and covers and replacement with new sewer manhole frames and covers, shall be measured by the actual number of new sewer manhole frames and covers installed. Sewer manhole frame and covers shall be paid for the respective quantities as determined above at the Contract unit price bid. This price and payment shall be full compensation for saw-cutting of pavement and/or concrete, excavation (except for rock and boulder removal), disposal of non-regulated excavated material, support of excavation, removal and disposal of the existing manhole frame and cover; furnishing and installing the new sewer manhole frame and cover; furnishing and installing backfill materials, compaction; delivery of the existing frame and cover to the Fort Smith Utility Department and all costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other items. Surface restoration shall be paid for separately under applicable pay item

B. REMOVE AND REPLACE EXISTING CHIMNEY. Removal of existing sewer manhole chimneys shall be measured by the total number of inches of chimney removed. Removal of existing sewer manhole chimneys and replacement with new fiberglass manhole shall be paid for the respective quantities as determined above at the Contract unit price bid. This price and payment shall be full compensation for saw-cutting of pavement and concrete, excavation (except for rock and boulder removal), disposal of non-regulated excavated material, support of excavation, removal and disposal of the existing manhole chimney, furnishing and installation of new fiberglass manhole extending to the bottom of the host manhole; and all work incidental thereto for which payment is not provided under other items. Surface restoration shall be paid for separately under applicable pay item

C. MANHOLE GRADE ADJUSTMENT – ADJUSTING RINGS. Manholes adjusted to grade by the installation of manhole adjusting rings will be measured based on the

number of such manholes adjusted to grade. Such measurement shall include furnishing and installing the adjusting rings. Concrete caps shall be paid for as specified in Section 703. Surface restoration shall be paid for separately under applicable pay item

D. MANHOLE GRADE ADJUSTMENT – FRAME AND COVER. Manholes adjusted to grade by the removal and replacement of the existing frame and cover will be measured based on the size and number each of such manholes adjusted to grade. Such measurement shall include the removal of the existing frame and cover, the furnishing and installation of flexible plastic gaskets, adjusting collars, mortar, reinstalling the existing frame and cover, and installing joint sealing material. Concrete caps shall be paid for as specified in Section 703. Surface restoration shall be paid for separately under applicable pay item

E. REPAIR AND REBUILD EXISTING MANHOLE INVERTS. Repair or rebuild of existing manhole inverts shall be measured by the actual number of manhole inverts repaired or rebuilt. Repair or rebuild of existing manholes inverts shall be paid for at the Contract unit price bid. This price and payment shall be full compensation for all labor, materials, equipment, cleaning, maintenance of flow in existing sewers including bypass pumping and plugs, repair and rebuild manhole inverts as directed by the Owner or Engineer, cleaning of the existing manhole invert; the removal of loose, broken, or unsound portion of the existing invert; and the application of the manhole patching material and all incidentals thereto, for which separate payment is not provided under other items.

F. MANHOLE LINING UP TO 6 FEET DEEP. Sewer manhole monolithic lining for sealing of existing sewer manholes using monolithic surfacing system, shall be measured in place on a size and vertical foot basis from the invert of the lowest pipe of the manhole to the top of the manhole and chimney interface. Sewer manhole monolithic lining for sealing of existing manholes using monolithic lining system, shall be paid for the quantity as above determined at the Contract unit price bid. This price and payment shall be full compensation for preparatory cleaning of the manhole walls and invert; sealing pipe connections and stopping active leaks in manhole; maintenance of flow in existing sewers including bypass pumping and plugs; furnishing and installing the manhole monolithic lining system; reopening all active manhole connections; proper disposal of cleaning solvents; materials testing; environmental protection; plugging of abandoned lines; costs associated with measuring liner thickness; final acceptance testing and all else incidental thereto for which separate payment is not provided under other Items. Surface restoration shall be paid for separately under applicable pay item

G. ADDITIONAL DEPTH FOR MANHOLE LINING. Additional manhole liners for that portion of the manholes greater than 6 feet deep, as measured from the invert of the outlet pipe to the top of the frame and cover, will be based on the vertical feet and size of manhole that is over 6 feet deep. Such measurement shall include the items required to complete the work as stated above for manhole liner.

H. FIBERGLASS MANHOLE UP TO 6 FEET DEEP. Installation of fiber glass manhole liners in existing manholes up to a maximum depth of 6 feet (measured from the invert of the outlet pipe to the top of the frame and cover), will be based on the number and size each of such liners actually installed. Such measurement shall include the removal of the existing frame, cover, and manhole cone, cleaning of the manhole, repairs to the manhole walls, plugging of abandoned lines, furnishing and applying grout liner material to the manhole walls and bench, furnishing and installing of fiberglass manhole liner, adjusting collars, and mortar, reinstalling the existing frame and cover, installing joint sealing material, and connecting all existing pipes (main and service laterals). Surface restoration shall be paid for separately under applicable pay item.

I. ADDITIONAL DEPTH FOR FIBERGLASS MANHOLE. Additional fiber glass manhole liners for that portion of the manholes greater than 6 feet deep, as measured from the invert of the outlet pipe to the top of the frame and cover, will be based on the vertical feet and size of manhole that is over 6 feet deep. Such measurement shall include the items required to complete the work as stated above for fiber glass manhole liner.

J. REPAIR PIPE CONNECTIONS TO MANHOLE. Repair of a new or existing pipe connection to a manhole, at locations shown or the drawings or as directed by the Owner or Engineer, will be based on the number each of such connections actually repaired. Such measurement shall include temporarily blocking and/or diverting sewage flows, cleaning around the existing connection; the removal of loose, broken, or unsound concrete or mortar from around pipe connections to the manhole, furnishing and installing elastomeric waterstop gasket and the application of the manhole patching material.

K. CONNECT SEWER MAIN PIPE TO EXISTING MANHOLE. Measurement for the connection of a sewer pipe to an existing manhole will be based on the number each of such sewer service pipe connections installed. Such measurement shall include temporarily blocking and/or diverting sewage flows, the cutting of hole in the existing manhole wall, inserting the new pipe with Elastomeric Waterstop Gasket into the manhole, repairing the manhole wall with Manhole Patching Material, constructing necessary drop connections, and remodeling of manhole invert.

L. CONNECT SEWER SERVICE PIPE TO EXISTING MANHOLE. Measurement for the connection of a sewer service pipe to an existing manhole will be based on the number each of such sewer service pipe connections installed. Such measurement shall include the cutting of hole in the existing manhole wall, removal of existing service pipe as required, inserting the new service pipe into the manhole, the installation of all required fittings for connecting to the existing sewer service pipe, and repairing the manhole wall with Manhole Patching Material.

M. REMOVE EXISTING MANHOLE. Measurement for removal of existing manhole will be based on the number each of such manholes actually removed. Such measurement shall include the removal and delivery of the frame and cover to the Utility Department.

Measurement for removal of manholes shall include removal in its entirety including foundation and base, off-site disposal of all materials, and backfilling with compacted borrow to match existing grades. Work shall also include the use of flowable fill or other special backfill material if so noted on the plans. Surface restoration shall be paid for separately under applicable pay item

N. ABANDON EXISTING MANHOLE. Measurement for abandonment of existing manhole will be based on the number each of such manholes actually abandoned. Such measurement shall include the removal and delivery of the frame and cover to the Utility Department. Measurement for abandoned manholes shall include removal and disposal of the top portion of the manhole, the plugging of existing connection pipes with concrete, and the filling of the manhole with compacted sand. Work shall also include the use of flowable fill or other special backfill material if so noted on the plans.

O. ABANDON SEWER MAIN CONNECTION TO EXISTING MANHOLE. Measurement for the abandonment of a sewer main pipe connection to an existing manhole will be based on the number each of such abandonments made. Such measurement shall include the plugging of the existing connection pipe with concrete, cleaning existing manhole invert, and re-shaping of the invert channel with Manhole Patching Material.

Payment will be made under:

Pay Item	Pay Unit
Remove and Replace Manhole Frame and Covers (Type)	EA
Remove and Replace Existing Chimney	INCH
Manhole Grade Adjustment - Adjusting Rings (Size)	EA
Manhole Grade Adjustment - Frame and Cover (Size)	EA
Repair and Rebuild Existing Manhole Inverts	EA
Manhole Lining Up to 6 Feet Deep (Size & Type)	VF
Additional Depth for Manhole Liner (Size & Type)	VF
Fiberglass Manhole Up to 6 Feet Deep (Size)	EA
Additional Depth for Fiberglass Manhole (Size)	VF
Repair Pipe Connections to Manholes	EA
Connect Sewer Main Pipe to Existing Manhole	EA

Connect Sewer Service Pipe to Existing Manhole	EA
Remove Existing Manhole	EA
Abandon Existing Manhole	EA
Abandon Sewer Main Connection to Existing Manhole	EA

SECTION 707
PIPE BURSTING

707.01 SCOPE OF WORK

This work shall consist of furnishing all labor, materials, tools, equipment, incidentals, testing and construction methods or processes required to install and test high density polyethylene (HDPE) or C900 PVC restraint joint sewer pipe and appurtenances using pipe bursting/crushing/reaming systems including services necessary for traffic control, bypass pumping and/or diversion of sewage flows, connecting the new pipe to existing manholes, modifying existing manhole bases as needed, reinstatement of service lateral connections, quality control, testing of the pipe burst lines, and warranty of all work.

The term pipe bursting that is used throughout the construction plans is intended to include other similar pipe enlargement systems such as pipe crushing, pipe reaming, etc.

The pipe bursting system is defined as the reconstruction of gravity sewer pipe by installing an approved pipe material. The process involves the use of a static, hydraulic or pneumatic hammer "moling" device, suitably sized to break out the old pipe or using modified boring "knife" with a flared plug that implodes and crushes the existing sewer pipe. Forward progress of the "mole' or the "knife" may be aided by the use of the hydraulic equipment or other apparatus, as specified in the approved methods. The replacement pipe is either pulled or pushed into the bore. The method allows for replacement of pipe sizes from 8-inch through 36-inch and/or upsizing in varying increments up to 48-inch.

707.02 QUALIFICATIONS AND SUBMITTALS

Submit to the Owner or Engineer in accordance with the contract documents shop drawings, product data, materials of construction, design calculations, and details of installation. The Contractor shall provide this information without delay or claim to any confidentiality. Submittals shall include but are not limited to the following:

(1) Shop drawings and product data to demonstrate compliance with these specifications and identify materials of construction.

(2) Design data and specification data sheets listing all parameters used in the pipe design and thickness calculations based on HDPE or PVC. Additional calculations shall include the anticipated pulling forces, equipment pull capability, and maximum pulling forces that can be applied to the pipe, and stresses and strains at manhole connections. All pipe design calculations shall be sealed and signed by an Engineer licenses in the State of Arkansas.

(3) Detailed construction method procedures for installing the pipe including a detail for the proposed pipe-to-manhole connection method.

(4) Drawing and layout plans showing the size and location for all proposed pits and excavations required to complete the work. All access pits shall be within the easement limits defined on the Drawings. It is assumed the excavations will occur primarily at or near existing manhole locations.

(5) A written plan and working drawings showing sewage flow bypass and maintaining sewage service flows, in accordance with Section 709-Bypass Pumping.

(6) Qualifications for personnel trained in using butt-fusion equipment and their training in the proper methods for handling and installing the HDPE or PVC pipe. The Contractor or subcontractor shall have a minimum of one (1) year of experience in the installation of sewer pipe by the pipe reaming method. Those with less than one (1) year of experience shall request preapproval from the Owner.

(7) Project specific Contingency Plan that accounts for obstructions, heave and/or settlement, damage to laterals and other utilities, loss of line and grade, and loss of bursting head.

(8) A list of all service laterals that were abandoned or reconnected as part of the work as further defined herein.

(9) Pre-rehabilitation and post-rehabilitation closed-circuit television (CCTV) inspection data. See Section 701-CCTV Inspection.

a. Provide results from all testing requirements specified herein to Owner and Engineer.

(10) Type of planned pipe bursting, pipe crushing, pipe reaming, and/or pipe boring equipment to be used on this project.

707.03 CONSTRUCTION SCHEDULING AND COORDINATION

Construction scheduling and coordination shall conform to Section 702.03.

707.04 MATERIALS

All substituted materials must be submitted and approved in accordance to the process laid out in Section 105.15 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT.

All materials shall conform to the standards referenced. All gasket and joint materials, lubricants, adhesives and other incidental materials shall conform to the pipe manufacturer's recommendations.

A. POLYETHYLENE PIPING. Replacement pipe shall be manufactured from a high density, high molecular weight polyethylene resin which conforms to ASTM D1248 and meets the requirements for Type III, Class B, Grade P34, Category 5, and has a PPI rating of PE 3408, when compounded. The pipe produced from this resin shall have a minimum cell classification of 345434D or E (inner wall shall be light in color) under ASTM D3350.

The inside pipe diameter shall be as shown on the construction plans and specifications. Pipe dimensions shall be for Standard Pipe Sizes and shall be measured in accordance with ASTM D2122. Unless otherwise noted, the minimum Standard Dimension Ratio (SDR) of the HDPE pipe shall meet the following requirements:

HDPE Pipe Minimum SDR	Maximum Depth (feet)
17	20
11	Over 20

Pipe couplings and/or fittings shall be ASTM D3261 HDPE.

Use round pipe with a smooth, even outer surface, which has joints that allow for easy connections between pipes. Pipe ends shall be designed so the bursting loads are evenly distributed around the entire pipe joint, and so point loads will not occur when the pipe is installed. Pipe used for pipe bursting shall be able to withstand all forces that will be imposed by the installation process and the final in-place loading conditions.

The pipe bursting equipment may include a bentonite or polymer slurry lubrication system in accordance with the pipe bursting equipment manufacturer's recommendations to reduce friction developed on the replacement pipe surface during insertion.

Electrofusion couplings shall be manufactured by Central, Frialen, Friatec, or approved equal.

B. C900/RJ RESTRAINED JOINT PIPE. The pipe couplings shall be made from unplasticized PVC compounds having a minimum cell classification of the 12454-B, as defined in ASTM D1784. The compound shall qualify Hydrostatic Design Basis (HDB) of 4,000 psi for water at 73.4 degrees Fahrenheit, in accordance with ASTM D2837.

Nominal outside diameters and wall thicknesses shall conform to the requirements of AWWA C900. Thrust-restrained pipe shall be furnished in sizes 4-inch, 6-inch, and 8-inch, Class 150 and 200, and 10-inch and 12-inch, Class 150. Pipe shall be furnished in standard lengths of 20 feet.

Pipes shall be joined using non-metallic couplings, which, together, have been designed as an integral system for maximum reliability and interchangeability, high-strength flexible thermoplastic splines shall be inserted into mating precision-machined grooves in the pipe and coupling to provide full 360 degree restraint with evenly distributed loading.

No external pipe-to-pipe restraining devices which clamp onto or otherwise damage the surface as a result of point-loading shall be permitted.

Couplings shall be designed for use at the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage requirements of ASTM D3139.

Every pipe and machined coupling shall pass AWWA C900 hydrostatic proof test requirements (4X rated pressure for 5 seconds).

Pipe shall be legibly and permanently marked with the manufacturer/trade name, nominal size, DR rating/pressure class, hydrostatic proof pressure, [NSF-61], manufacturing data code and the mark of the certifying agency(s) which have tested and approved the product for use in the fire protection applications.

Restrained Joint PVC Pipe shall be the CertainTeed Certa-Lok C900/RJ system or approved equal.

C. SERVICE LATERALS. Connections to the existing service lateral pipe shall be made using reinforced flexible couplings that conform to ASTM C425, such as Fernco Inc. or approved equal. Joint deflection limits and lateral connections shall meet the maximums indicated in ASTM C12 and C425.

Connection of the new service lateral to the sewer main shall be accomplished by use of a watertight, compression-fit service connection. The service connection shall be specifically designed for connection to the HDPE or PVC sewer main being installed, and shall be an INSERTA TEE as manufactured by the Inserta Fittings or approved equal.

D. TRACER WIRE. Tracer wire shall be Trace-Safe type RT1803W or Utility Department approved equal.

E. TRACER WIRE BOX. Tracer wire shall be terminated in magnetized tracer box, Model CD14*TP as manufactured by Copperhead Industries, LLC. The tracer box cover will be color coded in accordance with APWA uniform color code. The tracer wire shall not be terminated in any other location.

F. TESTING. The pipe manufacturer shall provide certification that samples of the production product meets these specifications. The certification will state that production product has been tested in accordance with ASTM D2837, and validated in accordance with the latest version of PPI TR 3.

The pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. Certification shall include a stress life curve per ASTM D2837 and testing shall have been performed in accordance with ASTM D2837.

Polyethylene plastic or restrained joint PVC pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

707.05 QUALITY ASSURANCE

Contractors shall be certified as a licensed installer by the selected pipe reaming trenchless system manufacturer.

Polyethylene pipe jointing shall be performed by personnel trained in the use of thermal butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by a qualified representative.

The manufacturer shall furnish a certified statement that all pipe materials have been manufactured and tested in accordance with the referenced standards.

No pipe bursting restoration shall be accepted that has created a sag in the restored line greater than ¼ of the installed pipe diameter or not previously inherent to the existing line. The Contractor shall be responsible for correcting any sags in the line that are created by his operations.

707.06 GENERAL

The pipe bursting method shall be determined by the Contractor and coordinated with the pipe bursting equipment suppliers.

All materials shall conform to the standards referenced. All gasket and joint materials, lubricants, adhesives and other incidental materials shall conform to the pipe manufacturer's recommendations.

A. MAINTAINING FLOW. The Contractor shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer main during the execution of the work. All by-pass pumping operations shall be in accord with Section 708-Bypass Pumping.

B. FIELD MEASUREMENTS. Field measurement shall be taken at the site to verify or supplement indicated dimensions and to ensure proper coordination of all other construction items.

   If the pipe configuration in the field is different than shown, or if a new asset is found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures. Contractor shall provide updated information to Owner and Engineer.

C. DELIVERY, STORAGE, AND HANDLING. Delivery, storage, and handling of pipe and materials shall conform to section 702.06.

707.07 PREPARATION FOR PIPE BURSTING OPERATIONS

A. SERVICE CONNECTION AND OTHER EXISTING UTILITIES. The Contractor shall conduct a pre-rehabilitation CCTV inspection for all sewers to be replaced by pipe bursting methods. The inspection shall be to identify pipe defects, to document all service lateral connection locations, and to confirm additional needed point repair locations other than those indicated on the Drawings. The Owner or Engineer will review pre-rehabilitation inspection videos to confirm point repair locations to be performed by the Contractor. The Contractor may not proceed with pipe bursting until the Owner or Engineer has reviewed and approved the Owner or Engineer has reviewed and approved the Contractor's pre-rehabilitation CCTV inspection data. All CCTV work shall conform to Section 701.

If the data is available, the Owner will provide the Contractor information on the location of known active laterals and cleanouts; however, this list may not be interpreted as all-inclusive. The Contractor shall be responsible for verifying active customer service connection prior to rehabilitation. The Contractor shall compare the service connections from the CCTV video with above ground measurements at the approximate location of center of each house or building. Any discrepancies between the CCTV data and above ground measurements of laterals shall be brought to the attention of the Owner or Engineer for a determination of lateral reinstatements. If the Contractor discovers an error or addition to the list provided, the Contractor shall immediately notify the Owner or Engineer for additional investigation. Upon completion of the rehabilitation work, a list of all service laterals abandoned or reconnected as part of the work shall be submitted to the Owner. The compiled list shall include the following information:

(1) Location of each service lateral based on the CCTV inspection logs. Location shall include both accurate distance measured from the centerline of the starting manhole as well as a notation (by clock-reference) of where on the circumference of the pipe, the service lateral connects.

(2) Status (Active or Inactive)

(3) The address of each customer and associated active lateral location.

Prior to pipe bursting, locate, excavate, expose, and completely disconnect all active service connections. Exercise due diligence when excavating to sufficiently allow the existing pipe to uniformly circumferentially expand through the service connection pit.

The Contractor shall be responsible for all costs resulting from damage to utilities during pipe bursting operations.

B. EXISTING MANHOLES. See Section 703-New Sewer Structures for specifications on existing manholes and structures.

C. ACCESS PIT LOCATIONS. The size, location, and number for pits shall be determined to facilitate the pipe bursting insertion, minimize excavation and traffic disruption, and shall be submitted prior to construction. All access pits and excavation shall be within the limits defined on the Drawings. Provide the minimum number of pits necessary to satisfactorily complete the work. Pits shall be a sufficient size to allow equipment access and new pipeline installation. Pits shall be centered over the existing sewer, and are generally anticipated to occur at each existing manhole location, at manhole construction points, at service connections, or at points where spot repairs need to be performed.

Submit any pit relocations and reasons for pit relocation for review. Include any appropriate sketches deemed necessary by the Owner or Engineer. The Contractor shall be responsible for obtaining all necessary permits as they relate to the relocation should they be approved by the Owner or Engineer.

D. CLEANING & TELEVISION INSPECTION. Perform the cleaning prior to televising. Cleaning activities shall conform to Section 701-CCTV Inspection.

E. LINE OBSTRUCTIONS. Line obstructions and cleaning activities shall conform to Section 701-CCTV Inspection.

F. SAGS IN LINE. Sags in the line being inspected shall be repaired per Section 701-CCTV Inspection.

707.08 PIPE BURSTING OPERATIONS

A. GENERAL. Though the installation process may be licensed or proprietary in nature, no change to any material, thickness, design, values, or procedural matters stated in the submittals shall be allowed without the Owner or Engineer's prior knowledge and approval.

Pipe bursting operations, including instances where pipe upsizing is required, shall not cause excessive disruption or heaving to the above ground terrain or improvements.

Upon commencing the bursting process, pipe insertion shall be continuous and without interruption from one entry point to another, except as approved by the Owner or Engineer.

If pipe spans between manholes are fused ahead of bursting operations, transport of the pipe to the site by using rollers and/or other means that will not damage the pipe's exterior. Contractor shall not drag the pipe to the insertion pit locations.

Protect the pipe and joints driving ends from damage by installing pulleys, rollers, bumpers, alignment control devices, and any other equipment required to protect existing manholes and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

B. PIPE BURSTING MACHINE & REPLACEMENT PIPE. The specific type of replacement pipe material described above for HDPE or PVC shall be installed in the locations as shown on the drawings and detailed per these specifications.

All sharp edges shall be removed from the exposed pipe opening.

The bursting head shall be sized so the maximum diameter of the temporary void created by the bursting operation shall not exceed the replacement pipe's maximum outside diameter by greater than 20 percent. The new sewer shall be installed straight along the existing pipeline centerline following the same line and grade.

The Contractor shall be responsible for replacing any existing utilities, streets, curb and gutter, storm drains, sidewalks, or structures that are damaged as a result of the pipe bursting activity. This replacement shall be in-kind, and at no cost to the City.

If the pipe reaches the rejection point (seizes in place) and it is elected to construct a recovery access pit, the Contractor shall obtain Owner or Engineer's approval and then coordinate property access, traffic control measures, and utility adjustments as necessary prior to commencing work. Excavations within delineated wetlands shall be avoided when possible.

If a pipe section is damaged during the bursting operation or joint failure occurs as evidenced by inspection, visible groundwater infiltration or other observations, the Contractor shall submit methods for repairing or replacing the pipe to the Owner or Engineer for approval. Repairing pipe sections damaged during bursting operations shall be made at no additional cost to Owner.

Allow the new HDPE or PVC pipe to return to its original length and shape in the unstressed state, and then trim the excess pipe in the manholes. The replacement pipe manufacturer's recommendations shall be followed regarding relieving and normalizing stress and strain due to temporary stretching and elongation after pulling operations have been completed. Time allowed for stress and strain relief shall not be less than 24 hours.

C. WORK IN EXISTING MANHOLES. After the pipe has been inserted into the entire sewer section length, anchor the pipe at existing manholes. The pipe shall protrude in manholes for enough distance to allow sealing and trimming.

After the pipe has been inserted into the entire sewer section length, install new precast manholes as needed or as directed by Owner or Engineer, and as shown on the Drawings.

If a new manhole is not shown on the Drawings, restore manhole bottom and invert, and repair damage caused by the insertion process. If the Owner or Engineer deems the damage caused by insertion process not repairable, replace the manhole at no cost to Owner.

When the replacement pipe passes through or terminates at an existing manhole, the channel and portion of the base shall be removed as the Contractor deems necessary for the bursting tool to be able to maintain a constant line and grade upstream and downstream of the manhole. The pipe within the existing manhole shall be neatly and completely saw-cut off and not broken or sheared off, to protrude at least 4 inches away from the manhole walls. The channel in the manhole shall be rebuilt with new concrete and mortar, shall be a smooth continuation of the pipe(s), and shall be merged with other lines or channels, if any. Channel cross section shall be U-shaped with a minimum height to the pipe's crown. The channel sides shall be built up with mortar/concrete to provide benches at a 1 in 12 pitch maximum towards the channel.

All cutting and sealing for the new pipe at manhole connections shall provide watertight pipe and manhole trough seals. Connections to manholes shall not be made any earlier than 24 hours following the bursting operations. This 24-hour "relaxation period" is intended to allow the pipe temperature to reach equilibrium with the surrounding soil and for the pipe to release stresses imparted during bursting operations. The time period shall be adjusted based on manufacturer's and/or supplier's recommendations, or as directed by the Engineer, if required.

To seal the pipe at the manhole, provide a flexible gasket connector in the manhole wall at the pipe's end, centered in the existing manhole wall. Grout the flexible connector in the manhole wall filling all voids for the full thickness.

The replacement pipe in the manhole shall be locked down and sealed as specified above before proceeding to the next pipe bursting section. All manholes shall be individually inspected by the Owner or Engineer for replacement pipe cutoffs, benches, and sealing works prior to any additional manhole rehabilitation activities.

D. SERVICE CONNECTIONS. After the replacement pipe has been completely installed and tested, all existing active service laterals shall be reconnected after the replacement pipe has been pulled in place, but not permanently before the pipe has been allowed to relax for 24 hours minimum. The time period shall be adjusted based on manufacturer's and/or supplier's recommendations, or as directed by the Engineer, if required.

The Contractor shall abandon inactive laterals without further action and shall burst through the abandoned laterals. No payment will be made for abandoning laterals. No bursting through abandoned laterals shall be performed without prior approval from the Owner or Engineer.

Prepare and submit to the Owner or Engineer a list of active and abandoned laterals. This list shall include GPS Coordinates as specified in Section 702.13.

Materials and construction procedures for the replacement (as necessary) of service lines are found in Sections 702.04 and 702.09.

If shown on the plans or directed by the Owner or Engineer, sewer laterals from the connection shall be replaced by excavation to the easement or property line if in rights-of-way with a cleanout installed. For reconstructed laterals, a minimum 2 percent slope is required.

E. POST-CCTV INSPECTION. Following the pipe bursting operations, including work associated with manhole and service connections, conduct post rehabilitation CCTV inspection for the completed work. Post-CCTV shall be done in accordance with Section 701 – Cleaning And Closed Circuit Television (CCTV) Inspection.

707.09 INPSECTION AND TESTING

Field acceptance of the new pipeline shall be based on the Owner or Engineer's evaluation of the installation, including post-bursting CCTV videos, and all pipe and manhole testing results. The Contractor shall be responsible for conducting the final or post-bursting CCTV as part of the contract work. See Section 701 for CCTV requirements.

Groundwater infiltration into the new pipe shall be zero. The replacement pipe shall be free from visual defects, including varying wall thicknesses, deformities, ridges, discoloration, and other damage. Replacement pipe with physical damage larger/deeper than 10% of the wall thickness shall be removed and replaced. The termination of the replacement pipe within a manhole shall be carefully cut and manhole connection sealed in a manner approved by the Engineer. The invert and benches shall be smoothed to allow flow.

All service connections shall be open, clear and watertight.

707.10 CLEANING AND RESTORATION

A. CLEANING OF NEW SEWER MAIN LINE. If the Owner or Engineer determine, based on the evaluation of the installation, including CCTV videotapes, that the new sewer mainline needs to be cleaned, the Contractor shall re-clean the line at no additional cost to the Owner. Cleaning operations shall conform to Section 701.

B. DISTURBED AREAS. Upon completion of the trenchless pipe replacement operation, the Contractor shall restore all areas disturbed by these operations, including streets, cross country easements, and wetland areas. Yards and acreage maintained by property owners shall be replaced with sod.

707.11 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work.

A. PIPE BURSTING (SIZE). Replacement of existing pipe with HDPE or PVC pipe via

pipe bursting of the size of the line installed, shall be measured in place on a linear foot basis which is satisfactorily installed and accepted by the Owner or Engineer. Measurements shall be from the center-to-center of the manholes for each line along the centerline of the pipe. Payment for replacement of existing pipe with HDPE or PVC pipe via pipe bursting shall be for the quantity as above determined at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for furnishing all labor, materials and equipment required for pipe bursting, including:

- Cleaning of the existing sewers
- Pre-CCTV inspection of existing sewers
- Disposal of debris removed
- Locating all live and abandoned service taps
- Sewer preparation and pre-construction inspection
- Locating and protecting all utilities with test pits
- Furnishing pre-splitting equipment and lubrication as necessary to fracture existing pipe;
- Rehabilitation of existing sewer pipe using pipe bursting
- Bypass pumping of wastewater flows
- Connections to existing sewer main and existing manholes
- Disconnecting service lateral connections (if applicable)
- Bypass of service lateral flows
- Excavation of any existing concrete encasement
- Recovery of equipment that reaches a rejection point
- Repair of existing pipe sags
- Modifications to manholes necessary to accept new pipe
- Specified testing
- Clean-up and complete restoration of areas disturbed by operations
- Any item incidental thereto for which separate payment is not provided under other items.
- Repair of manhole
- GPS and data delivery requirements

Payment for above work shall be incidental to sewer rehabilitation by the pipe bursting system, since the payment is made from center line to center line of manhole(s).

No additional compensation will be made if additional work is required because the existing line was not sufficiently cleaned.

B. SERVICE LATERAL REINSTATEMENT AFTER PIPE BURST OF MAIN (SIZE). Reconnection of active service laterals shall be measured by the actual number of laterals of the size of the line installed and reconnected as determined by the Owner or Engineer. Payment shall be full compensation for furnishing and installing compression-fit service connection, couplings, risers, plugs, connections, excavation, trenching, gravel bedding, backfilling and related work. Connection of sewer service lines to existing manholes shall be paid for under Section 706, Existing Sewer Structures. Surface restoration shall

be paid for separately under applicable pay item. Reconnection of active service laterals shall be paid for each building lateral reconnected as determined above at the Contract unit price bid.

Payment will be made under:

Pay Item	Pay Unit
Pipe Bursting (Size & Type)	LF
Service Lateral Reinstatement After Pipe Burst of Main (Size)	EA

SECTION 708
SERVICE LATERAL CONNECTION LINING (MLCIPL) PROCESS

708.01 SCOPE OF WORK

This work shall consist of furnishing all labor, materials, tools, equipment, incidentals, testing, and construction methods or processes required to rehabilitate lateral to main connections using the Main and Lateral Cured In-Place Lining (MLCIPL) process; stopping active leaks that might interfere with the integrity of the liner to be installed; complete and accepted, in accordance with the Contract Documents. Work shall conform to the latest Standard ASTM F2561 – Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner, with the exception that the hydrophilic seals may be replaced with a field applied hydrophilic paste, and the address of the service line is not required. A 10 year warranty shall be provided for the MLCIPL installation from leaks, following expansion of the hydrophilic gaskets/paste.

708.02 SUBMITTALS

Contractor is required to submit the following:

(1) Work Schedule

(2) MLCIPL Manufacturer Installation Instructions

(3) MLCIPL Manufacturer Design Calculations

(4) MLCIPL Manufacturer Material Data,

(5) MLCIPL Compatibility and Test Results

(6) MLCIPL Curing Schedule

(7) MLCIPL Installation Logs

(8) Resin Manufacturers Data, Including Resin Spectral Graph, Statement of Compatibility, Curing Schedule

(9) MLCIPL Contractor Experience Record

(10) Name and Experience of Person Performing MLCIPL Installation

(11) List of Subcontractors, with Experience

(12) Bypass Pumping Plan

(13) Testing Laboratory Information

(14) Physical Samples

(15) Temperature and Cook Logs

(16) Sample Notification

708.03 QUALITY ASSURANCE

The purpose of the main and lateral cured in-place lining (MLCIPL) is to provide for a permanent seal of the annular space of the sewer to provide a seal of the service lateral. If the sewer main is lined, MLCIPL shall be installed after the service lateral is re-instated in the sanitary sewer main. MLCIPL shall be installed per ASTM F2561.

The Contractor performing the work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner.

Full-time, on-site superintendent/foreman that will supervise MLCIPL lining installation shall have successfully installed a minimum of 300 (total) MLCIPL liners within the last three (3) years as documented by verifiable references.

MLCIPL felt and resin manufacturer(s) shall have successfully supplied a minimum of 3,000 liners as documented by verifiable references.

The MLCIPL product used on this project shall be provided by a single manufacturer. The Contractor shall be responsible for the provision of all test requirements specified herein.

Service line connection MLCIPL shall be compatible with the pipe or CIPP liner used in the sanitary sewer main pipe in which the service line is connected.

Any installation not meeting specified strengths shall have the defective service connection MLCIPL removed and replaced with a product acceptable to the Owner at the expense of the Contractor.

The Testing Laboratory selected for testing services shall be fully qualified, experienced and equipped to complete testing of MLCIPL samples as provided for in the contract documents. Submit the following information for review and approval:

(1) The name and contact information of the Testing Laboratory.

(2) The applicable certifications held by the Testing Laboratory.

(3) Information that the Testing Laboratory has performed the type of required testing for a minimum of three years.

708.04 NOTIFICATION

Refer to Section 711 - Notification for notification details and information.

708.05 HANDLING AND STORAGE

Care shall be taken in shipping, handling and storage to avoid damaging the MLCIPL service connections. Any service connection damaged in shipment shall be replaced as directed by the Engineer.

Any MLCIPL service connection showing a split or tear, or which has received a blow that may have caused damage, even though damage may not be visible, shall be marked as rejected and removed at once from the job site.

The MLCIPL service connection shall be maintained as required by the manufacturer. Any MLCIPL service line connection showing evidence of premature curing will be rejected for use and will be removed from the site immediately.

708.06 FIELD MEASUREMENTS

All service line connections will be indicated in the contract documents. Contractor shall verify the number of service line connections, the diameter of the sanitary sewer main pipe, and the size and location of the service line connections in the field prior to ordering any MLCIPL materials.

708.07 GENERAL

Work performed under this Specification shall be done in accordance with Municipal, State, and Federal standards. Traffic control and safety are the responsibility of the Contractor. All traffic control must be in accordance with Section 120 – Maintenance of Traffic and Traffic Control. All signage for work on state highway rights-of-way shall conform to the Arkansas State Highway Department requirements.

All water used during rehab processes shall be collected and transported to a proper disposal facility or, upon approval, at the City of Fort Smith Waste Water treatment facility.

The Contractor shall provide whatever measures are required to prevent the movement or discharge of gases, liquids, or solids associated with the rehabilitation materials and processes into any adjacent buildings upstream or downstream of the sewers being rehabilitated. The Contractor shall be responsible and liable for any damages or violations associated with such actions. The Contractor shall also be responsible for monitoring and protecting the discharge of any byproducts caused by the installation of any rehabilitation materials or processes. Immediately prior to installing the MLCIPL liner, the service line shall be CCTV inspected and cleaned. This is to verify that the condition of the service line has not changed since the pre-inspection work. This CCTV inspection video is not to be submitted to the Engineer, except, any discrepancies found shall be recorded and reported to the Engineer.

If not currently installed, clean-outs are to be installed in the service lines, per Section 702 – New Sanitary Sewer Lines, prior to the MLCIPL service liner being installed.

If the pre-CCTV inspection of the existing service line indicates that it is not in a condition that would allow a liner to be successfully installed, the service line shall be replaced, per Section 702 – New Sanitary Sewer Lines, from the sanitary sewer main to the clean-out prior to the MLCIPL service liner being installed. In this case, the MLCIPL shall extend into the new service line three feet.

If the pre-CCTV inspection of the existing service line indicates that the service line is in good condition, the MLCIPL shall extend into the new service line three feet.

Provide necessary bypass pumping of sewage flows where and when required, per Section 708 – Bypass Pumping.

Noise related to CIPP and MLCIPL activities shall be attenuated to not exceed the limits discussed in City of Fort Smith Ordinance, Chapter 16, Article II – Noise.

Manholes are considered as a confined space area. Proper procedures are to be followed when accessing manholes.

Scheduling and coordination shall conform to Section 701 – New Sanitary Sewer Lines.

708.08 COORDINATION

Work that requires excavation must be completed and approved before any trenchless rehabilitation work begins unless otherwise directed by the Owner or Engineer. See Section 702 – New Sanitary Sewer Lines.

708.09 MAIN AND LATERAL CURED IN-PLACE LINING (MLCIPL)

A. GENERAL. All service line connections shall be a seamless one-piece product at the junction between the sanitary sewer main and the service line. The junction between the collar and the service line sleeve must be watertight and will consist of a sanitary sewer main portion and a service line portion. The sanitary sewer main portion shall be a full circle of the main pipe and shall be 16-inches long. The service line portion shall extend into the service line to the property line or to the cleanout, as indicated in the project documents. Service line connection shall be LMK T-Liner, Perma-Liner Innerseal, BLD, or approved equal. The Contractor shall provide a 10 year warranty for the MLCIPL installation from leaks, following expansion of the hydrophilic gaskets/paste.

   The service connection material shall be capable of conforming to offset joints, bells, and disfigured pipe sections. A corrosion resistant resin compatible with the installation process shall be used.

B. MATERIALS. All materials shall conform to the most recent ASTM standards. The table below indicates the applicable governing standards.

Material	Standard
Polyester Felt Tube	ASTM D790, ASTM F1216
Resin System	ASTM D5813 or ASTM F1216

C. CLEANING AND INSPECTION. Cleaning and CCTV inspection shall be done in accordance with Section 701 – Cleaning and Closed Circuit Television (CCTV) Inspection.

D. LINE PREPARATION. Line preparation shall be done in accordance with the Manufacturer's recommendations.

E. INSTALLATION. Installation shall be done in accordance with the Manufacturer's recommendations.

708.10 INSPECTION AND TESTING

A. GENERAL. Samples shall be taken from each installed MLCIPL liner. The Contractor shall submit one (1) in every five (5) MLCIPL liners, with a minimum of one (1) sample per day per MLCIPL liner per crew for laboratory testing. The Engineer may request that a sample taken from a particular MLCIPL liner be substituted for one of the samples identified for laboratory testing. The samples not selected for laboratory testing shall be provided to the Engineer.

The MLCIPL samples selected for laboratory testing shall be tested in accordance with ASTM Test Method D790.

A post-CCTV inspection shall be made following installation of the MLCIPL service liner to document all work performed and copies shall be submitted to the Owner and Engineer, as specified in Section 701-Cleaning and closed Circuit Television (CCTV) Inspection. Visual inspection of the MLCIPL shall be made in accordance with Section 701-Cleaning and closed Circuit Television (CCTV) Inspection.

If the MLCIPL service liner fails to meet the laboratory test criteria, it will be repaired as necessary by the Contractor, and retested, at no additional expense to the Owner. The service liner will not be considered acceptable until it successfully passes the requirements of this test.

The Contractor shall be responsible for all costs, and delays incurred due to efforts to locate and repair any leaks in any MLCIPL service liner which fails the test, regardless of whether the failure is due to workmanship, material failure, or the result of improperly installed liner.

B. FIELD INSPECTION. Field acceptance of the MLCIPL service line connection shall be based on the Engineer or Owner's, or the Engineer or Owner's designated representative, evaluation of the installation including on-site CCTV inspection video recordings.

Groundwater infiltration of the MLCIPL liner shall be zero, following expansion of the hydrophilic gaskets/paste.

The finished service line connection shall be free of dry spots, lifts, delamination and excess resin. There shall be no evidence of splits, cracks, breaks, lifts, kinks or crazing.

If any defective service line connection is discovered after it has been installed, it shall be removed and replaced at no additional cost to the Owner. Repair methods shall be submitted to the Owner or Engineer for approval.

C. LABORTORY TESTING. The Contractor shall collect all samples. Samples that are selected for testing shall be sent by the Contractor, at the Contractor's expense, to an independent testing laboratory. The Contractor will pay for all initial tests and retests described herein. The laboratory shall provide the results of the tests directly to the Engineer.

Samples removed for testing will be individually labeled and logged to record the following:

(1) Owner's project number and title

(2) Name of Contractor

(3) Segment number of line and location of connection point

(4) Date and time of sample

(5) Sample number

(6) Person taking sample

(7) Results of the test

The samples shall be numbered as follows:

(1) Sample #/A: Resin Sample

(2) Sample #/B: Flat Plate Sample

(3) Sample #/C: Thickness Test

Test samples shall be prepared by securing a flat plate mold using the MLCIPL tube material and resin system provided for this project. The pressure applied to the plate sample will be equal to the highest sustained pressure exerted on the MLCIPL liner during the cure process at any location. The minimum length of the sample must be able to produce at least five specimens for testing in accordance with Test Method ASTM D790.

Laboratory testing shall include the following:

(1) Short-Term Flexural Properties – The flexural strength and flexural modulus of the MLCIPL shall be determined in accordance with Test Method ASTM D790. The values shall meet the minimum requirements listed below or the values used in design, whichever are higher.

		Minimum Value	
Property	ASTM Test	psi	(MPa)
Flexural Strength	D790	4500	(31)
Flexural Modulus	D790	250,000	(1724)

(2) MLCIPL Wall Thickness – The average wall thickness for the service line portion and the average wall thickness for the sanitary sewer main portion shall meet the thickness determined by the design. The average thickness shall be determined in accordance with ASTM D5813. The minimum wall thickness at any one point, as determined in accordance with ASTM D5813, shall not be less than 87.5% of the thickness required by the design.

708.10 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the contract unit prices listed in the proposal for the items of work. Payment at the contract unit price for each item shall be considered full compensation for furnishing all materials, labor, equipment, tools, supplies and incidentals necessary to complete each item of work. Data collection shall be considered incidental to construction.

All cleaning and pre-CCTV inspection for service connections shall be paid for in this Section of the Specifications.

All post-CCTV inspection for service connections shall be paid for in Section 701 – Cleaning and Closed Circuit Television (CCTV) Inspection.

Installation of clean-outs shall be paid for in Section 702 – New Sanitary Sewer Lines.

Installation of sewer service lines, that are required to be installed as they are not in a condition to receive a MLCIPL liner, shall be paid for in Section 702 – New Sanitary Sewer Lines.

A. MLCIPL UP TO 3 FEET (SIZE). Measurement for installation of MLCIPL up to 3 feet of the size of the service line installed, as measured from point of connection to the

sanitary sewer main. Service lateral connection shall be paid for under the respective quantities as determined at the Contract unit prices bid. This price and payment shall be full compensation for project notices; coordination with property owners and the Owner; furnishing written logs; ensure service connection point is prepared as needed to accept MLCIPL; pre-CCTV inspection; stopping active infiltration; furnishing and installing the service lateral connection liners; bypass pumping, materials testing; and all else incidental thereto for which separate payment is not provided under other Items.

B. ADDITIONAL LENGTH FOR MLCIPL (SIZE). Measurement for installation of additional length of MLCIPL of the size of the line installed, as measured from the initial 3 feet of MLCIPL, will be based on the actual length of MLCIPL installed. Such measurement shall include the items required to complete the work as stated above for MLCIPL UP TO 3 FEET.

Payment will be made under:

Pay Item	Pay Unit
MLCIPL Up to 3 Feet (Size)	EA
Additional Length for MLCIPL (Size)	LF

SECTION 709
BYPASS PUMPING

709.01 SCOPE OF WORK

This work in this Section shall consist of furnishing all labor, materials, tools equipment, incidentals, testing and construction methods or processes required for Bypass Pumping; complete and accepted, in accordance with the Contract Documents.

709.02 SUBMITTALS

A. Prior to or at the preconstruction conference, the Contractor shall submit a work plan, diversion plan, and work schedule related to bypass pumping, to the Owner and Engineer for review and approval.

B. Owner or Engineer reserves the right to approve or disapprove the work plan.

709.03 GENERAL

A. Work performed under this Specification shall be done in accordance with Municipal, State, and Federal standards. Traffic control and safety are the responsibility of the Contractor. All traffic control must be in accordance with Section 120 MAINTENANCE OF TRAFFIC AND TRAFFIC CONTROL. All signage for work on state highway rights-of-way shall conform to the Arkansas State Highway Department requirements. Access to driveways shall be maintained during by-pass pumping operations.

B. Provide necessary Bypass Pumping of sewage flows where and when required.

C. Noise related to Bypass Pumping activities shall be attenuated to not exceed the limits discussed in City of Fort Smith Ordinance, Chapter 16, Article II – Noise.

D. Provide full-time monitoring of Bypass Pumping operations. A backup pump shall be readily available. If a release occurs, the Contractor must notify the Owner immediately. Clean-up of overflows shall be responsibility of contractor at no charge to owner. Fines for release will be $1,250.00 or as provided in the Consent Decree between The United States of America and the City of Fort Smith, Arkansas (Date of Lodging 01/02/2015) paragraph 108, 109, and 110, whichever is higher.

709.04 MAINTENANCE OF FLOW / BYPASS SEWAGE

A. It will be the Contractor's responsibility to dewater the sewer and maintain existing sewage flows at all times. A plan for diversion must be submitted to the Owner or Engineer for review and approval prior to commencement of any work.

B. The Contractor shall be responsible to maintain the existing flows at all times in an acceptable manner so as not to create a nuisance or in any way endanger the adjoining properties, utilities or environment.

C. By-passing to storm sewers or other watercourses shall not be allowed at any time.

D. The Owner does not assume any liability to the Contractor for any delay, cancellation, loss or expense to which he may become subject, directly or indirectly, due to the normal or heavy flows in the existing sewer.

709.05 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be considered incidental to all work performed.

SECTION 710
GIS DATABASE UPDATES

710.01 SCOPE OF WORK

The work in this Section shall consist of furnishing all labor and competent certified technicians to collect and deliver data updates to the Owner's geographic information system (GIS) dataset (geodatabase).

710.02 SUBMITTALS

Where exceptions to the requirements are identified, the Contractor must make note of the exceptions using the appropriate COMMENT database field for the GIS feature type in question.

All data submittals shall include a standard Owner data transmittal form filled out in its entirety and included on a USB-compatible external storage device acceptable to the City with the submittal. A hard copy attached to the hard drive shall also be submitted to the Engineer.

For each submittal, the Contractor must deliver a single, updated copy with edits to the sewer system assets that correspond to the Contractor's assigned geographic area. The following items will be required with this updated copy:

(1) GIS databases submitted must be cumulative and include all previously delivered final edits.

(2) All GIS data must be relatable to all inspection records and the as-builts. The content (features) of the GIS database submittals must match those of the other data submittals and the as-builts. Each of the structures inspected or modified as part of other specification work must be contained within the geodatabase delivery made on the same date.

(3) Submittals must include a list of new unique identification codes (IDs) for all new structures located as a table inserted into the geodatabase data delivery. The table should be named "New Structures".

(4) Deliveries must be made on the same schedule as the other work being performed that result in changes to the GIS database. All inspection records must be submitted with the same schedule as a GIS dataset which includes the surveyed location of any record submitted as inspected.

(5) The name of the delivered geodatabase filename will use the following format (or other Owner-approved naming conventions) using upper case letters:

18-09_XYZ_BR02_YYYYMMDD.GDB

Where:

18-09 = Project Number (CIP Number);
XYZ=3-Character Contractor ID assigned by City's GIS Administrator
BR02= Sub-Basin ID
YYYYMMDD = 8 digit date.

(6) For projects that do not encompass an entire sub-basin, Contractor to contact Owner's GIS Administrator to obtain a "Sub_Basin_ID" for file naming.

710.03 DATA QUALITY CONTROL REVIEW

Contractor will utilize the Owner-approved standards to perform quality control and review of all data collected during the project. Quality control and continuity checks will include but not be limited to the following:

(1) Flow and connectivity checks to verify that the updated water and wastewater network data set (in GIS format) contains proper pipe flow directions and that all network features are connected or coincident spatially in order to provide an accurate and connected electronic network representing the physical network installed.

(2) All inspection records must link to the GIS features using the unique feature identifiers as specified in each of the detailed technical specifications documents for each type of work to be performed as part of the work.

(3) All inspection records must be submitted with the same schedule as a GIS dataset which includes the surveyed location of any record submitted as inspected.

(4) Data collected during the field inspection work must be checked against standard engineering practices such that pipe and structure invert elevations do not result in adverse slopes or are in conflict (unless field confirmed). Pipe materials and diameters should be consistent throughout contract or linear areas and should increase in diameter towards downstream areas of the system, unless a pipe diameter change is confirmed in the field.

(5) All database field values entered should be consistent and match valid codes provided by the CITY or as defined in the specifications.

(6) Notations or free-form comments within the database should follow guidance provided in the specifications and be consistent such that the same comment should be used to reference similar notes or observations.

Owner will review all submittals provided by Contractor and notify Contractor of any deficiencies found for correction and resubmittal.

Contractor to conduct a quality check on all submittals received following a Quality Control Plan

submitted to and approved by the Owner. Contractor to submit separate detailed Quality Control Plan to Owner for approval for internal review before sending submittals to Contractor for review.

Contractor must utilize the Esri ArcGIS or similar software sufficient to update the Owner's GIS database stored in Esri file geodatabase format.

710.04 GEODATABASE AND INSPECTION DATABASE PREPARATION AND DELIVERY REQUIREMENTS

Upon request from the Contractor, at the start of a contract, the Owner will provide each Contractor with a copy of the Owner's official ArcGIS geodatabase to be used as the basis for all deliverables. The delivered geodatabase must contain the same network, feature classes, tables, etc. as the original geodatabase provided by the Owner, and must be cumulative (containing data from all previous deliveries). There should be no changes to the structures of any of the contents of the geodatabase (feature classes, tables, etc.).

As part of this process the Contractor will identify and correct any data gaps or missing/inconsistent data values. Contractor will provide GIS data layers identifying the location of each issue and will provide an updated, complete GIS dataset to the Owner on the same monthly schedule as all inspection data so that all inspection records can be related to a GIS record.

The features in each of the inspection databases must correspond to features in the geodatabase. Therefore, all features present in the inspection databases must also exist in the geodatabase and contain matching asset ID values. For cases in which structures could not be found in the field, were not accessible, or could otherwise not be inspected, documentation should be provided in the appropriate field in the database.

GIS Data Delivery Format shall be Esri ArcGIS file geodatabase as provided by the Owner. Spatial Reference is the Arkansas State Plane Coordinate System, NAD 1983 North, FIPS 0301, US Feet. NAVD88.

710.05 GEOMETRIC NETWORK

The sewer network provided by the Owner is an Esri geometric network consisting of features in a water or sewer system dataset. All network datasets, rules and configurations present in the original geometric network must be preserved in deliverables provided by the Contractor.

710.06 NETWORK FEATURES – SPATIAL REQUIREMENTS

A. COMPLETENESS. All pipes and point assets in the project area should be present in the GIS network database.

B. NEW STRUCTURES. Any new structures added to the network must be properly integrated into the geometric network following the rules described in this document in

order to maintain the integrity of the network. When adding new structures, the appropriate pipes must be split and the pipe IDs must be modified to reflect the IDs of the new structure. The new structures must be assigned proper IDs as detailed in 709.09.-

C. DUPLICATE FEATURES. Duplicate features are not allowed. This refers to features that have the same geometry (spatially coincident), as well as features that may not have exactly the same geometry but represent the same feature.
Invalid Geometry – There should be no features containing invalid geometry (null geometries, zero-length pipes, etc.).

D. MULTIPART LINES. Multipart features (cases in which multiple lines are represented as a single line) are not allowed.

E. SPATIAL ACCURACY. As GPS coordinates are obtained for a feature, the GIS feature must be updated with these coordinates. Further checks are described below by the checking of field XY coordinates vs GIS coordinates.

F. SNAPPING. All features must be snapped to the appropriate corresponding feature (for example, manholes must be snapped to their corresponding pipes). The most accurate feature should be used as the snapping target. For example, if feature locations are updated with GPS coordinates, the locations of any connected features must be adjusted to snap to the more accurate feature.

710.07 NETWORK FEATURES – CONNECTIVITY REQUIREMENTS

A. CONNECTIVITY. The network provided by the Owner is a geometric network. The network delivered by the Contractor must be a valid geometric network, and must retain the rules and configurations (feature class names, field names, etc.) of the original network.

All features in the network must be connected. There should be no gaps or "floating" features (orphans). Pipe endpoints should be snapped to other pipes, and manholes should be snapped to the appropriate pipe. As stated in 709.04, geodatabase table must be provided with each deliverable which contains a list of IDs of all new structures.

B. CONNECTIONS TO APPROPRIATE FEATURE TYPE. Features must connect to appropriate features. For example:

(1) The downstream end of a storm sewer pipe connects to outfall
(2) A storm sewer cannot connect to a sanitary sewer
(3) A sanitary sewer can connect to a treatment plant but not to a storm sewer or water bodies

C. DIGITIZED DIRECTION. Pipes must be digitized in the direction of flow.

710.08 NETWORK FEATURES – ATTRIBUTION REQUIREMENTS

A. DIRECTION OF FLOW. The GIS network will indirectly support modeling operations. Therefore, it is important that network links flow in the correct direction. Invert elevations should decrease while diameters should increase in the downstream direction with some exceptions such as multi-line siphons, etc.

B. FIELDS. The feature classes in the geodatabase delivered by the Contractor must contain only those fields present in the original geodatabase provided by the Owner. Fields must retain their original definitions (type, length).

C. REQUIRED FIELDS. Required fields must be populated. These are identified in the field description table in Section 709.09

D. COMMENTS FIELD. Use the comments field ("COMMENT") to describe feature-related problems or questions.

E. UNITS. Measured values must use correct units, based on the Imperial System of Measurement.

F. ASSET NAMING. Asset name must follow the naming convention as described in the asset naming guidelines provided by the Owner and as outlined in Specifications 02731 and 02770.

G. ASSET DOMAINS. Some pipe attributes have predefined domain values which standardize the appropriate codes for those fields. These may be coded value domains or range domains, and are defined in the geodatabase provided by the Owner. Asset attributes must match the defined domain values. Contractor must notify the Owner if attribute values are found during work that do not appear in the domain list.

H. ASSET OWNERSHIP. Some assets found during inspection may not be owned or operated by the Owner. If assets included in the Owner's GIS geodatabase are found to be owned by an entity other than the Owner, field work should stop in this area of the scope of work and the Contractor should coordinate with the Owner on how to proceed. At minimum the Owner's GIS geodatabase shall be updated as necessary to designate a different owner other than the Owner within the OWNEDBY field of each respective feature class.

I. MIDDLE PIPE ATTRIBUTES. Comparison of attributes of pipes upstream and downstream of the pipe being checked (the "middle" pipe). If the material, diameter and pipe shape attributes of the upstream and downstream pipes are the same, then the attribute values of the "middle" pipe should also match. Discrepancies should be checked carefully, as field inspection errors may trigger these cases.

J. PIPE SHAPE AND MATERIALS. Some combinations of pipe material and pipe shape are not valid. For each pipe, the combination of material and shape attribute values must

be checked to ensure that it is a valid combination. Valid material and shape combinations are as follows:

(1) Clay, PVC, HDPE, concrete (all types unless box section) and ductile iron pipes must be circular in shape
(2) Brick and steel pipes may have different cross sectional shapes

K. DEAD END JUNCTIONS. Each manhole should have at least one pipe flowing out. Check for "dead end" manholes which do not have any pipes flowing out.

L. JUCTION WITH MULTIPLE EXITS. Each manhole should only have one pipe flowing out, except for summit manholes. Check for manholes which have more than one pipe flowing out.

M. COMPARISON OF FIELD SURVEYED (GPS) XY COORDINATES WITH GIS XY COORDINATES. The locations of features in the geodatabase must be updated with values obtained by GPS whenever applicable. The XY coordinate fields in the attribute table for these features must also be updated. Coordinates should be in international feet as stated in Section 3.01C.

N. FORCE MAIN CONNECTED TO PUMP STATION. All force mains must connect to pump stations through other force mains and not gravity pipelines.

O. PIPE LENGTHS. It is unlikely that pipes will be less than 3.5 feet in length. Pipe lengths should be checked, and any pipes less than 3.5 feet long should be verified.

P. NON-CIRCULAR PIPES. A non-circular pipe must have different values for its diameter and width. The diameter and width must be checked to ensure that they are not equal.

Q. MANHOLE CONDITION TABLE DEPTH. Manhole depth should be greater than or equal to structure rim to invert distance noted in the MACP manhole CONDITION table for the same manhole.

R. BASIN CODES. Basin codes should match the codes in the basin GIS feature class.

S. PIPE SLOPES. The value of the slope attribute must be between +/- 10% of the slope as calculated in the GIS ((Upstream Invert Elevation – Downstream Invert Elevation) / Length). Pipes with negative slopes, zero slopes, and slopes greater than 3% should be identified and flagged within the COMMENT database field for the pipeline features. In general, pipes with extreme slope should be short segments of pipeline and not long lengths of pipe greater than 3% slope. The CITY shall be notified immediately upon finding of any pipes identified to have flat, less than minimum slopes, or negative slopes.

T. UPSTREAM VS. DOWNSTREAM INVERT ELEVATIONS. Invert elevations should decrease as flows move downstream. Therefore, the downstream invert elevation of upstream pipe must be greater than upstream invert elevation of the downstream pipe.

U. UPSTREAM PIPE INVERT ELEVATIONS VS. DOWNSTREAM PIPE INVERT ELEVATIONS. A pipe's upstream and downstream invert elevations must be less than those of the upstream pipe.

V. TO AND FROM INVERT ELEVATIONS. The upstream invert elevation must be greater than downstream invert elevation for each pipe.

W. STRUCTURE INVERT ELEVATION VS. PIPE INVET ELEVATION. The pipe invert elevation must be greater than the structure invert elevation.

X. COMPARISON OF INVERTS TO GROUND HEIGHTS. Sum of pipe diameter and pipe invert bottom elevation should be less than the rim elevation of manhole. Optionally, this should also be below a specified distance below surface.

710.09 INSPECTIONS TABLE

The tables on the following pages list the required database fields to be updated in the CITY's geodatabase.

Table 7. GIS Feature Class – Sanitary Sewer Manhole

Field Name	Data Type	Field Size	Field Description	Additional Formatting Notes
MHASSETID	Text	25	Unique asset ID	To be used within GIS and all inspection databases delivered as the primary linkage field
INVERT	Double	8	Depth of the manhole feature to the lowest point as measured from the rim of the manhole	Should match the *Rim_to_Invert* field as described in the *MH_Inspections* table of the submitted MACP Database
INVERTELEV	Double	8	Elevation of the manhole invert	Calculated field: RIMELEV minus INVERT
RIMELEV	Double	8	Elevation of the manhole cover (rim)	Should match the *Elevation* field as described in the *MH_Inspections* table of the submitted MACP Database
CVTYPE	Text	20	Cover type of the manhole – tied to *piManholeCoverType* Domain	Should match the *Cover_Type* as described in the *MH_Inspection*s table of the submitted MACP Database (Solid, Vented, Gasketed, etc.)
WALLMAT	Text	25	Wall material of the manhole – tied to *piPipeMaterial* Domain	Should match the *Wall_Material* field as described in the *MH_Inspections* table of the submitted MACP Database
MHTYPE	Text	20	Manhole type – tied to *piManholeType* Domain	Type of manhole should be described as either *Standard, Inside Drop, Outside Drop or Unknown*
RIMTOGRADE	Double	8	Depth between the rim of the manhole and the grade level	Should match the *Rim_to_Grade* field as described in the *MH_Inspections* table of the submitted MACP Database

LINED	Text	3	Describes if the manhole is lined	Calculated field (Yes/No)
LIFECYCLESTATUS	Text	25	Status of the manhole – tied to *LifeCycleStatus* Domain	Status of the manhole should be described as either *Active, Inactive, Abandoned or Removed.*
OWNEDBY	Short Interger		Owner of the manhole – tied to *AssetOwner* Domain	Calculated field per *AssetOwner* Domain
LOCATION	Text	250	Location description of the manhole	Should match the *Street* field as described in the *MH_Inspections* table of the submitted MACP Database
COMMENTS	Text	250	Comments regarding the manhole data collection	
GPSDATE	Date & Time		Date that the manhole was surveyed using traditional or GPS methods by the CONTRACTOR	Only required if asset was surveyed as part of the work
DATASOURCE	Text	25	Primary source of the data collected – tied to *DataSource* Domain	Calculated field per *DataSource* Domain
LASTUPDATE	Date & Time		Last edit date	
LASTEDITOR	Text	50	Last editor of the asset	3 Character Contractor ID assigned by the CITY's GIS Administrator
ENABLED	Short Interger		Field used in conjunction with a Geometric Network to describe if feature is Enabled/Disabled and can/cannot be traced through – tied to *EnabledDomain* Domain	Boolean Field (0 = False, 1 = True)

Table 8. GIS Feature Class – Sanitary Sewer Pipe

Field Name	Data Type	Field Size	Field Description	Additional Formatting Notes
PIPEASSETID	Text	25	Unique asset ID	To be used within GIS and all inspection databases delivered as the primary linkage field
MATERIAL	Text	20	Material of the pipe – tied to *piPipeMaterial* Domain	Should match the *Material* field as described in the *Inspections* table of the submitted PACP Database
DIAMETER	Double	8	Diameter of a circular pipe or height of a non-circular – tied to *piPipeDiameter* Domain	Should match the *Height* field as described in the *Inspections* table of the submitted PACP Database
MAINSHAPE	Text	50	Cross sectional shape of the pipe – tied to *piPipeShape* Domain	Should match the *Shape* field as described in the *Inspections* table of the submitted PACP Database
WIDTH	Double	8	Width of a non-circular pipe	Should match the *Width* field as described in the *Inspections* table of the submitted PACP Database (only used if pipe is non-circular)
HEIGHT	Double	8	Height of a non-circular pipe	Should match the *Height* field as described in the *Inspections* table of the submitted PACP Database (only used if pipe is non-circular)
LINERMAT	Text	20	Material of the pipe liner	
FROMMH	Text	11	Upstream manhole (structure) asset ID	*MHASSETID* of the upstream manhole or Asset ID of the upstream structure (Clean Out)
TOMH	Text	11	Downstream manhole (structure) asset ID	*MHASSETID* of the downstream manhole or Asset ID of the downstream structure (Pump Station)

DSDEPTHFROMRIM	Double	8	Depth from structure access rim to pipe lower lip of the pipe at the downstream end	Should match the *Down_Rim_to_Invert* field as described in the *Inspections* table of the submitted PACP Database
DOWNELEV	Double	8	Elevation of the lower lip of the pipe at the downstream end (Downstream Invert Elevation)	Calculated field: Downstream Manhole Rim Elevation (*RIMELEV*) minus *DSDEPTHFROMRIM*
USDEPTHFROMRIM	Double	8	Depth from structure access rim to pipe lower lip of the pipe at the upstream end	Should match the *Up_Rim_to_Invert* field as described in the *Inspections* table of the submitted PACP Database
UPELEV	Double	8	Elevation of the lower lip of the pipe at the upstream end (Upstream Invert Elevation)	Calculated field: Upstream Manhole Rim Elevation (*RIMELEV*) minus *USDEPTHFROMRIM*
SLOPE	Double	8	Slope of the pipe from upstream end to downstream end	Calculated field: (*UPELEV* minus *DOWNELEV*) Divided by *SHAPE_Length*
LIFECYCLESTATUS	Text	25	Status of the pipe – tied to *LifeCycleStatus* Domain	Status of the pipe should be described as either *Active, Inactive, Abandoned or Removed.*
OWNEDBY	Short Interger		Owner of the manhole – tied to *AssetOwner* Domain	Calculated field per *AssetOwner* Domain
LOCATION	Text	250	Location description of the pipe	Should match the *Street* field as described in the *Inspections* table of the submitted PACP Database
COMMENTS	Text	250	Comments regarding the pipe's data collection	
DATASOURCE	Text	25	Primary source of the data collected – tied to *DataSource* Domain	Calculated field per *DataSource* Domain
LASTUPDATE	Date & Time		Last edit date	

LASTEDITOR	Text	50	Last editor of the asset	3 Character Contractor ID assigned by the CITY's GIS Administrator
PRECLEANINGTYPE	Text	10	Type Of Preparatory Cleaning Conducted Prior To Survey	
CCTVDATE	Date & Time		Date and time of the CCTV performed on the pipe by the CONTRACTOR	
CCTV_ID	Text	8	Inspection identification code for the CCTV performed on the pipe by the CONTRACTOR	Should match the *InspectionID* field as described in the *Inspections* table of the submitted PACP Database

Table 9. GIS Feature Class – Sanitary Sewer Basin Boundary

Field Name	Data Type	Field Size	Field Description	Additional Formatting Notes
BASIN	Text	2	Basin name – tied to *ssBasins* Domain	
SUBBASINID	Text	10	Sub-basin ID	e.g. RF01, M003, etc.
LASTUPDATE	Date & Time		Last edit date	
LASTEDITOR	Text	50	Last editor of the asset	3 Character Contractor ID assigned by the CITY's's GIS Administrator
Shape	Esri Shape		Basin boundary limit location	GIS polygon feature modified if required to adjust boundary based on information gathered in the field

710.10 MEASUREMENT AND PAYMENT

All equipment, materials, and labor related to GIS Data collection and delivery shall be considered incidental to all work performed.

SECTION 711
NOTIFICATION

711.01 SCOPE OF WORK

This work shall consist of notification of property owners and business establishments, in accordance with the Contract Documents.

A. All property owners shall receive notification that their sewage service will be interrupted as a result of any work performed on sewer pipe or structures. The Contractor shall distribute all written notices to each affected property owner at the following times:

   1. Forty Eight (48) hours prior to work activities.

   2. Within one (1) hour after completion of work activities.

B. The Owner will provide a sample of all public notifications for distribution by the Contractor.

C. Each notice shall include the date, start time, and estimated time when service will be completely restored. The notice shall include the name of the Contractor and a 24-hour telephone number for contacting the Contractor or his designated representative and the Utility Department 24 hour emergency phone number, 479-784-2342. Sewer service shall not be disrupted prior to 8:00 a.m. All services must be reestablished by 6:00 p.m. unless otherwise approved by the Engineer and the Owner.

D. The Contractor shall contact and notify any home or business that cannot be reestablished within the time stated in the written notice. Contractor shall also contact and notify Engineer and Owner of the delay.

E. The maximum amount of time any home or business shall be without sanitary sewer service is eight (8) hours. Any home or business that is without sanitary service for longer than (8) hours will be bypassed to the sanitary sewer at no additional cost to the Owner.

F. Contractor's schedule is subject to approval based on critical stakeholders and at no additional cost to the Owner.

711.02 MEASUREMENT AND PAYMENT

All equipment, materials, and labor related to Notification shall be considered incidental to all work performed.

DIVISION 800 - TRAFFIC CONTROL FACILITIES

SECTION 801
ACTUATED CONTROLLER

801.01 DESCRIPTION

This item shall consist of furnishing and installing multi-phase actuated, digital timed, solid state controllers in accordance with these specifications and at the locations shown on the plans, or as directed.

801.02 MATERIALS

Design Requirements - General and Specific

A. CONSISTENCY OF INTERVALS. The length of any interval, position, period, or unit-extension shall not change by more than five percent of its value if the voltage of the power supply varies between the limits of 10 percent above and 10 percent below normal, 115 volts, 6Q-cycle power supply. Similarly, variations of more than five percent shall not occur, due to any change in outside temperature between the limits of 120 degrees F above and 35 degrees F below zero, preferably without the necessity of heater elements.

B. POWER. The controller and associated equipment shall be designed for use in 120 volts, 6Q-cycle alternating current.

C. MECHANISM. The timing circuits shall consist entirely of solid state electronic circuitry. No vacuum or gaseous tubes shall be used in any timing circuits.

Switching functions shall be accomplished through the use of solid state electronic circuitry. No electro-mechanical devices such as camshafts, rotary, stepping or line switches shall be used for switching functions.

Solid state signal control assemblies shall be used for opening and closing signal light circuits. The assemblies shall be external to the controller and shall be jack-mounted. Each circuit shall have the capacity to switch 1000 watts of tungsten-Lamp load at 120 to 125 volts, 6Q-cycle.

Functional operating circuits and their associated components shall be grouped in plug-in, printed-circuit assemblies. Similar assemblies shall be interchangeable between controllers. Each grouping of components as a printed-circuit assembly shall have a mean time to failure of three years.

Printed circuits shall be of epoxy glass with extra-heavy (2 ounces or better) copper tack.

All extender cards necessary to perform normal maintenance and troubleshooting of controller internal circuits shall be furnished.

The components shall be amply derated with regard to heat-dissipating capacity and rated voltage so that, with maximum ambient temperature and maximum applied voltage, material shortening or life or shift in values shall not occur. The design life of all components under 24 hours per day operating conditions in their circuit application shall be not less than five years.

Indicator lights shall be provided for at least the following functions, but not limited thereto:

(1) Vehicle call.
(2) Vehicle initial and extension.
(3) Vehicle yellow.
(4) All red interval.
(5) Walk.
(6) Pedestrian Clearance.
(7) Pedestrian Call.
(8) Phase Recall.
(9) Maximum I.
(10) Maximum II.
(11) Pedestrian Recall.
(12) Phase On.
(13) Phase Next.

D. CABINET. The controller shall be furnished completely in an aluminum alloy cabinet. The cabinet shall be of clean-cut design and appearance. The size of the cabinet shall be such as to provide ample space for housing the controller and associated electrical devices herein specified. A hinged door shall be provided, permitting complete access to the interior of the cabinet. When closed, the door shall fit closely to gasketing materials, making the cabinet weather-resisting and dust-tight. The door shall be provided with a strong lock and key. The door hinges and pins shall be of non-corroding material.

The cabinet shall contain a strong mounting table, sliding ways, or other suitable support for the controller.

Each cabinet shall be provided with louvered vents and a permanent, washable, removable, electrostatic filter with an aluminum frame, mounted in the front door. The filter shall meet the "American Society of Heating, Refrigeration, and Air Conditioning Engineers" (ASHRAE) testing requirements as follows:

Arrestance	90%
Dust Holding Capacity	85 grams at 0.5 water gauge

The cabinet shall also be equipped with an electric fan assembly with a minimum capacity of 100 cubic feet per minute (2.8 cubic meters per minute).

The fan shall be mounted in the top of the cabinet in a manner to prevent rain from entering the cabinet. The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 90°F (32°C) and 150°F (66°C). The opening and all others shall be insect proof.

In addition to the main cabinet door, an auxiliary door shall be provided with a conventional police lock and two keys.

On a panel behind the auxiliary door, there shall be a signal-flash switch, a manual-control switch and cord, and a signals on-off switch. In addition, a momentary push button for each vehicular and pedestrian phase shall be provided to allow maintenance personnel to enter a call to the controller. All switches shall be properly wired to the controller.

Electrical connections from the controller to the out-going and incoming circuits shall be made by inserting a multi-terminal plug (Type MS) into the plug receptacle incorporated in the controller. The controller shall be replaceable with a similar unit without the necessity of disconnecting and reconnecting the individual wires leading therefrom.

Provisions for field mounting of the cabinet shall be as specified or as shown in the plans.

E. WIRING. Panel wiring shall be neat and firm and the panel shall mount at least:

(1) Terminal with fuse receptacle and fuse for power supply line.
(2) Terminal, unfused, for neutral side of power supply line.

(3) Terminals for conductors or signal light cable; one for each signal circuit and one or more terminals for the common conductors.
(4) Terminals for detector cables.

The controller equipment and terminals shall be so arranged within the cabinet that they will not upset the entrance, training and connection of the incoming conductors.

All detector cables shall be wired for delay operation of detectors.

The field terminals shall be suitably identified.

The outgoing traffic control signal circuits shall be of the same polarity as the line side of the power supply. The common return of the signal circuits shall be of the same polarity as the ground side of the power supply.

The grounded side of the power supply shall be grounded to the controller cabinet in an approved manner.

F. INTERVAL SEQUENCE. The controller shall provide and be set up for the proper intervals and interval sequence as provided elsewhere in these specifications or the plans.

G. INTERVAL SETTING AND ADJUSTMENT. The controller shall provide for the setting up of each interval or period by means of adjustment to a keyboard panel with all keys accessible. There shall be the following keys for each of the separate traffic movements.

(1) Minimum green.
(2) Unit green extension.
(3) Maximum green.
(4) Amber.
(5) Red.
(6) Maximum I.
(7) Maximum II.
(8) Walk.
(9) Pedestrian Clearance.
(10) Added Initial Per Actuation.
(11) Time to Reduce Gap.
(12) Time Before Gap Reduction.
(13) Minimum Gap.

The keys shall allow settings in seconds and shall give a clear visual indication of the length of each interval or period. The timing keys shall be on the front of the controller, easily identifiable, and it shall not be necessary to remove or change wires or contact or to use any tools in making interval adjustments.

H. AUXILIARY EQUIPMENT. Controllers shall be equipped with a Alpha FXM1100 continuous power unit, or approved equal. This unit shall provide 400 watts of continuous power for a minimum of 8 hours. This unit shall also include batteries, a cabinet separate from the controller, wiring, and pad.

The surge protectors to be supplied for traffic signals shall be Innovative Technology, Inc., surge protectors, Model No. HS-P-SP-120A-60A-RJ or approved equal.

Each loop detector input circuit (at cabinet entry point) shall be provided with a series hybrid type surge protector capable of protecting the detector against differential surges between the loop leads and common mode surges between leads and grounds.

Each solid state load switch shall be provided with a series hybrid type surge protector capable of protecting the load switch against common mode surges.

Means shall be provided to permit the substitution of flashing-signal indications for the normal - cycle. Unless otherwise noted, the flasher shall be wired to flash red on the main street and red on the cross street. The flashing indications shall be at the rate of not less than 50 nor more than 60 flashes per minute with approximately 50% on and 50% off

periods. Controllers shall be equipped with yellow-red flash terminals for possible future field changes. (See definition No. 47, ITE Technical Report No.3).

Controllers shall have a self-contained monitoring device provided. The monitoring device shall meet NEMA Standards TS-2 2003. In addition the monitor shall display four (4) indications per channel, one for each "red", "yellow", "green" and "walk" input per channel.

I. SIGNAL SHUTDOWN SWITCH. Each intersection controller shall be provided with a switch for shutting down the signals only at the intersection, without affecting the power supply to other parts of the controller.

J. UNINTERRUPTED TIMING. Normal traffic-actuated operation shall be resumed automatically after flashing manual or other special form of operation has been utilized.

K. FEATURES OF OPERATION. The controller and associated equipment shall be designed to include the following operating characteristics:

(1) Right-of-way shall not be given to any street without actuation thereon, and in the complete absence of traffic at the intersection, the right-of-way shall be capable of resting on either of the major phases. Recall switches shall be provided for the major phases, which may be turned on to either phase despite the absence of traffic thereon.

(2) The actuation of a detector on any street now having the right-of-way shall, after proper yellow interval on the street which is losing the right-of-way, cause right-of-way to be transferred to the street from which actuation was received, subject to the provision of other paragraphs in this section referring to the transfer of right-of-way.

(3) The transfer of right-of-way from any street as specified can take place only after the green signal has remained on that street for at least a predetermined minimum period consisting either of one initial interval and one vehicle interval or of one minimum green interval.

(4) The transfer of right-of-way from any street shall take place immediately (subject to other limitations) after the expiration of one vehicle of minimum green interval on the traffic phase having the right-of-way during which time there was no actuation.

(5) Each vehicle crossing a detector in approaching the intersection on a green signal after the initial or minimum green interval, shall so actuate the controller as to retain the green signal for one vehicle or passage-time interval from the instant of its actuation, except that successive actuations cannot continue to hold the right-of-way from an opposing street from which a demand for right-of-way has been registered by vehicle actuations or by closure of the recall switch beyond a maximum period which shall be provided for each phase.

(6) The timing of any extension limit (Maximum period) shall: a) commence with an actuation or registration of traffic demand for right-of-way on any traffic phase not having the right-of-way after the initial portion has expired, or b) commence immediately upon actuation or registration of traffic demand for right-of-way.

(7) If the right-of-way is taken from a vehicle at the expiration of the maximum period before that vehicle has been allowed its normal time (one full vehicle or passage-time interval) to pass from the detector into the intersection, the controller shall cause the right-of-way to return without further actuation by the vehicle so stopped.

(8) Opportunity for assignment of right-of-way to each of the traffic phases shall be in accord with the phase sequence shown on the plans. In the absence of actuations on the phase, the controller shall be capable of resting on a major phase.

(9) A vehicle crossing a detector in approaching the intersection on a red interval or on a yellow interval shall so affect the controller that the right-of-way shall be subsequently transferred to it without the necessity of further actuation.

(10) The controller shall be so designed that loop, sonic video, and radar vehicle detectors, and pedestrian push buttons may be connected to permit actuations by the vehicles and pedestrians, if so specified. It shall not be necessary to orient the controller manually after power failure.

801.03 CONSTRUCTION METHODS

The controller shall be mounted as shown on the plans or as directed and shall in no case be located less than three feet from the pavement edge.

The Contractor shall furnish and properly install each cabinet and controller with accessory equipment and perform the necessary splicing and connections, testing of circuits, adjustments and such other operations as may be necessary in order that each complete traffic signal installation, with all of its components, be completely integrated and tested as a unit in order that the desired control of the intersection is attained, complete and in the best of working order. to the satisfaction of the Engineer. The Contractor shall also be responsible for securing from the manufacturer of the controller a trained representative to meet with the Engineer and provide him with instructions on the adjustment of the controller and consultation of stocking replacement parts.

801.04 METHOD OF MEASUREMENT

Work completed and accepted under this item will be measured by the Multi-Phase Actuated Controller assembly.

801.05 BASIS OF PAYMENT

Work completed and accepted under this item and measured as provided above, will be paid for at the contract unit price bid each for Multi-Phase Actuated Controller. which price shall be full compensation for mounting the controller cabinet, installing wiring and testing the controller; for excavation and backfilling; and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Actuated Controller ( ) Phase	EA

SECTION 802
COORDINATED CONTROLLER

802.01 DESCRIPTION

This item shall consist of furnishing and installing multi-phase actuated, coordinated, digital timed, solid-state controllers in accordance with these specifications and at the location shown on the plans, or as directed.

802.02 MATERIALS

A. GENERAL. The controller, cabinet and all accessories in the cabinet shall be supplied to the Contractor by one supplier. All controllers on a project must be made by one manufacturer. The supplier must test the controller and all accessories in the cabinet as a unit before shipping to the Contractor.

B. CONTROLLER DESIGN REQUIREMENTS

(1) Functional Requirements. The controller shall be designed to operate as an actuated isolated intersection controller, an isolated pretimed controller, or an interconnected multidial controller.

The controller shall be capable of providing a minimum of 3 different cycle, 3 offsets per cycle, 4 splits per cycle, 8 permissive period per split, 1 pedestrian permissive per permissive period, and 8 force-offs per split. These functions shall be accomplished through the use of a microprocessor to implement the control logic and modular construction with keyboard entry of operating data.

The controller shall have an internal clock to provide for time base coordination. The internal clock shall provide time of day, day of year, week of year, and daylight savings time programming through the keyboard.

(2) Cycle Lengths. The controller shall be capable of operating on a minimum of 3 manually or remotely selectable dials, each programmable to a maximum length of 255 seconds in 1 second increments. The duration of each cycle shall be entered into the controller memory by a front panel control.

Dial transfer from one dial to another shall occur at the end of the timing interval in effect at the time of request for transfer. Intervals may be programmed to inhibit transfer. Dial transfer shall cause no irregular interval timing or out of step operation of the controller.

(3) Offsets. Each dial shall be capable of being programmed with up to 3 offsets. Each offset shall be remotely or manually selectable.

Offsets shall be programmable from 0 to 255 seconds in 1 second increments. An offset shall be the time from the receipt of a synchronization pulse to the beginning of the dwell interval. Offsets timing may be in terms of percent of cycle as well as seconds. It shall be possible to program the maximum time duration of the dwell per dial. The maximum time duration is set independently for each dial.

(4) Interval Timing. The controller shall allow signal sequences to be programmed up to 24 intervals. Each interval can be 0.0 to 12.7 seconds in length in 0.1 second steps or 0 to 127 seconds in 1 second steps. Interval times are entered through the front panel. Interval timing may be in percent of cycle or in seconds.

Interval times may be entered for up to 24 intervals for each of the cycle lengths. No intervals shall be required to be set to zero time as the signal sequence can be programmed to the exact number of timing intervals without the necessity of establishing dummy intervals. Intervals programmed to zero time shall be skipped.

(5) Interval Control. The controller shall provide and be set up for the proper intervals and interval sequence as provided elsewhere in these specifications or the plans.

(6) Front Panel Displays and Features. The front panel display shall be either an LED or LCD Decimal Digital Display that will display intervals, interval durations, cycles, offsets and dwell maximum duration.

Ranges	
Cycle	0-255 seconds
Offset	0-255 seconds
Interval	1-24
Interval time	0-127 seconds
Dwell	0-99.9 seconds

The indicators on the front panel shall be as follows:

(a) Clock. A timing indicator shall be provided on the front panel of the controller. This timing indicator shall pulse each second as long as the controller is timing. Pulsing shall be inhibited when the controller is dwelling, in manual synchronization, and/or in manual operation.

(b) Stop-Timing. An indicator on the front panel shall show that the unit is in the stop timing mode.

(c) Cycle, Offset, Split, and Current Pattern.

(7) Remote Operations. The controller shall be capable of remote operation from a master controller of the same design which allows for 3 cycles, 3 offset per cycle operation.

The unit can be installed in a standard multidial, 3 cycle, 3 offset system which utilizes a solid state master controller and 120 VAC interconnection or other type of interconnection which outputs Dial 2, Dial 3, Offset 1, Offset 2, Offset 3, and Flash.

The controller shall work in systems when a momentary (0.5 to 2.0 second) absence of offset input is identified as a synchronization pulse.

The controller shall operate in interconnected systems with centrally located offset interruptions.

(a) Cabinet. The cabinet shall meet the requirements of subsection 801.02.D "Materials."

(b) Cabinet Auxiliary Equipment. The Cabinet Auxiliary Equipment shall meet the requirements of subsection 801.02.H "Materials."

(c) Certification. The supplier shall provide a certification of compliance with the above requirements and that the controller and conflict monitor meet the latest NEMA specifications. This certification shall be transferred to the

Engineer.

802.03 CONSTRUCTION REQUIREMENTS

The solid state controller shall be mounted as shown on the plans or as directed by the Engineer and shall in no case be located less than 3 feet from the pavement edge.

The Contractor shall furnish and properly install each cabinet and controller with accessory equipment and perform any and all necessary splicing and connections, testing of circuits, adjustments and such other operations as may be necessary in order that each complete traffic signal installation, with all of its components be completely integrated and tested as a unit so that the desired control of the intersection is attained, complete and in proper working order and to the satisfaction of the Engineer. The Contractor shall provide instructions on the adjustments of the controller and consultation for replacement parts stocking.

802.04 METHOD OF MEASUREMENT

Coordinated Controllers (Local. Local/Master) will be measured by the unit.

802.05 BASIS OF PAYMENT

Work completed and accepted and measured as provided above. will be paid for at the contract unit price bid each for Coordinated Controller (Local, Local/Master), which price shall be full compensation for furnishing the cabinet and controller; for mounting the controller cabinet; for installing, wiring and testing the controller; for excavation and backfilling; and for all materials, equipment, labor, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Coordinated Controller (Local, Local/Master)	EA

SECTION 805
TRAFFIC SIGNAL HEADS

This item shall consist of furnishing and installing traffic signal heads of the type and size called for in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer.

805.02 MATERIALS

A. GENERAL. Each signal face shall consist of an assembly of signal sections in sufficient quantity to provide the required number of indications. The sections shall be joined together in a manner that provides both mechanical integrity and a weatherproof unit.

Each signal section of a signal face shall consist of a housing, door and optical assembly. The housing, door and lens, together with necessary gaskets, shall constitute a weatherproof unit. The lens and the remainder of the optical assembly, together with necessary gaskets shall constitute a dust-tight assembly. Each signal section shall be provided with a visor.

Each signal section and its associated optical system shall be capable of operating satisfactorily with the section's axis either vertical or horizontal.

Each signal section shall be provided with opening in the top or bottom for mounting purposes. Each opening shall be round to accommodate 1½ inch pipe. Each unused opening shall be v closed with a gasketed plug.

Each signal face shall be capable of being rotated 360 degrees about its axis and shall be capable of being locked at 5 degree intervals. Locking shall be accomplished by the engagement of serrations in the end signal sections with similar serrations in the mounting bracket assembly.

Signal indications shall be assembled in accordance with the latest revisions of the Manual on Uniform Traffic Control Devices for Streets and Highways.

B. OPTICAL UNIT. Each traffic signal shall be equipped with a LED (light emitting diode) with 2000 MCD per LED, plus other components as required, and shall conform to the ITE Vehicle Traffic Control Signal Heads (VTCSH) Standard. The optical assembly together with the necessary gaskets shall constitute a dust-tight assembly which shall be designed to give clear visible signal indications within an angle of at least 45 degrees and from 10 feet to 300 feet under all light and atmospheric conditions. The optical assembly shall be designed to minimize the return through the lens of outside light entering the lens at low sun angles to prevent the effect termed “Sun Phantom.”

Lenses shall be of the color indicated, circular in shape and made of UV stabilized polycarbonate material. The lenses shall be uniformly colored throughout the body of the material true to a size and form and free from any streaks, wrinkles, chips, or bubbles that in any way detract from their efficiency or use. Each lens shall be so designed and manufactured that when installed in a standard traffic signal, it will satisfy the minimum requirements for candlepower distribution and intensity and chromaticity as specified in the latest Specification of the Institute of Traffic Engineers. When mounted, the lens shall have a visible diameter of not less than 11½ inches as shown on the plans. Lens shall be marked to indicate top.

C. HOUSING. The signal head housing shall consist of an assembly of separate sections substantially secured together in a water-tight manner to form a unit of pleasing appearance. Each section shall house an individual optical unit. Each housing shall be equipped with suitable fittings required for mounting, and shall include a backplate.

The sections shall be interchangeable and so constructed that each section can be removed or added. Each section shall be assembled with 2-plated washers and 3-plated bolts. Each cap shall be drilled for slip fit of a standard 1½ inch pipe nipple. The area around this opening shall be reinforced and serrated so that serrated fittings may be used to secure the housing. A terminal block of an approved type shall be mounted at the back and inside of the housing. All mounting brackets and fittings shall be assembled water-tight. Brackets shall be 1½ inch standard pipe or rigid conduit of sufficient strength to withstand the vertical and horizontal loads specified by I.T.E.

All brackets shall provide a wireway free of sharp edges and protrusions that might damage conductor insulation and of sufficient size to carry at least 10 #14 A.W.G. conductors with 45 mil thickness insulation.

Each housing shall be molded (injection, rotational, or blow molded) from an engineering structural plastic. Plastic shall be ultraviolet and heat stabilized and flame resistant. Plastic housings may be either molded in one piece or may be fabricated from two or three pieces joined into a single piece using thermal, chemical, or ultrasonic bonding.

Each door shall be made of the same material as the housing. The lens opening in the doors shall provide a visible diameter of not less than 11 inches nor more than 11½ inches for a nominal 12 inch round lens.

All exterior metal parts, except as noted and including hinge pins, shall be made from stainless steel.

Visors and backplates for signal faces shall be either formed from sheet plastic or assembled from one or more injection, rotational or blow molded plastic sections.

Each visor shall be a minimum of 9½ inches in length for nominal 12 inch round or rectangular lenses and 7 inches in length for nominal 8 inch round lenses and not less than 0.05 inches in thickness, with a minimum downward tilt of 3½ degrees.

Visors shall mount to the door by use of four stainless steel screws.

Gasketing shall be made from neoprene, silicone rubber, or an equivalent material that is resistant to heat, permanent deformation and the weather and that is compatible with the materials of the door, housing and lens.

The door of each signal section shall be a one piece door hinged to the housing so as to permit access to the section of relamping. The optical systems shall be so mounted on the door that the various parts may be swung open for ready accessibility and removal. The door shall be secured with simple devised and a noncorrosive door locking device to provide for opening and closing the door without the use of special tools.

All exterior parts of the signal head except the lens and mounting brackets shall be finished with two coats of the best quality synthetic resin enamel of the color specified herein. Non-metallic materials shall have the color impregnated in the resin material. Unless plans specify, colors shall be as listed below.

Housing - Black
Door Assembly - Black
Visor - Flat Black

805.03 CONSTRUCTION METHODS

Signal heads shall be installed to maintain an 18'-0" maximum and 17'-0" minimum vertical clearance directly under the signal head.

805.04 METHOD OF MEASUREMENT

Work under this item shall be measured by the Traffic Signal Head, of the type and size specified.

805.05 BASIS OF PAYMENT

Work completed and accepted under this item and measured as provided above, will be paid for at the contract unit price bid per each for Traffic Signal Heads, of the type and size specified, which price will be full compensation for furnishing materials, fittings, brackets, clamps, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Traffic Signal Heads ( )	EA

SECTION 806
PEDESTRIAN SIGNAL HEAD

This item shall consist of furnishing and installing pedestrian signal heads and accessories in accordance with these specifications and at the location shown on the plans or as directed.

806.02 MATERIALS

The pedestrian signals shall be 1-section, dual indication, LED countdown type with "UPRAISED HAND" and "WALKING PERSON" symbol messages, as manufactured by GE Gelcore, Dialight, Duralight, or approved equal.

Message configuration shall consist of the "UPRAISED HAND" symbol and "WALKING PERSON" symbol overlaid upon each other on the left half of the message bearing surface and countdown numbers on the right half of the message bearing surface. The "UPRAISED HAND" symbol and the countdown numbers shall be illuminated with Portland orange LED color sources, and the "WALKING PERSON" symbol shall be illuminated with a white LED color source. When not illuminated, the "WALKING PERSON" and "UPRAISED HAND" symbols shall not be readily visible to pedestrians at the far end of the crosswalk that the pedestrian signal head indications control.

The "UPRAISED HAND" and "WALKING PERSON" LED symbols shall each be a minimum of 11 inches in height and 7 inches in width. The countdown numbers shall be a minimum of 9 inches in height and 7 inches in width. Message configuration, color and size shall be Class 3 as defined by I.T.E. Equipment Standard "Pedestrian Traffic Control Signal Indications" dated March 19, 2004. Only filled or full LED symbols shall be used. Outlined LED symbols shall not be allowed.

The maximum overall dimension of the signal shall be 18.5 inches W x 18.75 inches H x 9.2 inches D, including the sun visor and hinges. Each signal shall be equipped with a crate type visor designed to eliminate sun phantom.

Case shall be supplied with side pole clamshell type mounting hardware.

Pedestrian-actuated signals shall have a ADA compliant 2 inch mushroom plunger type pushbutton mounted 3 ½ to 4 feet above the surface of the sidewalk at each end of the crosswalks where actuation is required. The pushbutton detector shall be located on a traffic signal pole or a pedestrian signal pedestal pole.

The standard pedestrian-actuated signal sign (MUTCD R10-3e) shall be mounted just above the pushbutton. The sign shall comply with the requirements of Section 860 of these specifications.

806.03 CONSTRUCTION REQUIREMENTS

Pedestrian signals shall be mounted with the bottom of the signal not less than 8 feet nor more than 10 feet above the sidewalk level and so that there is a signal in the line of vision of pedestrians crossing in any direction. The pedestrian signal head shall be so positioned and adjusted as to provide maximum visibility at the start of the controlled crosswalk. The signal shall be wired to operate upon actuation from the pedestrian push-button when the controller is the traffic actuated type.

806.04 METHOD OF MEASUREMENT

Pedestrian signal heads will be measured by the unit.

806.05 BASIS OF PAYMENT

Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per each for Pedestrian Signal Heads, which price shall be full compensation for furnishing all materials, signs, equipment, labor, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Pedestrian Signal Head	EA

SECTION 807
TRAFFIC SIGNAL CABLE

807.01 DESCRIPTION

This item shall consist of furnishing and installing traffic signal cable containing the number and size of conductors indicated on the plans, in accordance with these specifications and at the locations shown on the plans, or as directed.

807.02 MATERIALS

The cable shall be #14 A.W.G. with the number of conductors as shown on the plans and shall conform to the International Municipal Signal Association Specification 20-1 or 20-3 for 600 volt polyethylene insulated and jacketed signal cable.

The Contractor shall furnish and install approved bands, ties and other supports for the cable in poles and control boxes in accordance with the best modern practice.

Cables shall be marked for phase identification in accordance with the manufacturer's standards.

807.03 CONSTRUCTION METHODS

Connections to signal heads shall be made with polyethlene jacketed, stranded or solid wire cable. The Contractor will be allowed to make connections to the signal heads by the "line tapping" method.

All underground signal cable wiring shall be a continuous run from pole base terminal facility to the signal controller cabinet assembly without any splices.

807.04 METHOD OF MEASUREMENT

The quantity of cable will be the actual number of linear feet of cable installed, complete and accepted in place.

807.05 BASIS OF PAYMENT

Work completed and accepted under this item and measured as provided above, will be paid for at the contract price bid per linear foot for Traffic Signal Cable, which price shall be full compensation for materials, splicing and connections; and for all tools, equipment, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Traffic Signal Cable ( )	LF

SECTION 808
CONDUIT

808.01 DESCRIPTION

This item shall consist of furnishing and installing conduit and appurtenances in accordance with these specifications and at the locations shown on the plans, or as directed.

808.02 MATERIALS

A. GALVANIZED STEEL CONDUIT. All conduit, expansion joints and fittings shall be hot dipped galvanized, inside and outside in accordance with ASTM A 123. Conduit shall be free of all imperfections which might injure the cable. Conduit fittings and accessories shall be suitable for underground, encased and exposed applications in accordance with Underwriters Laboratories and the latest National Electric Code. The conduit shall withstand an 8 dip Preece Test in accordance with ASTM A 239. Conduit straps shall be galvanized stock, sized according to size conduit shown on plans. Nuts on conduit strap anchor studs shall be galvanized and shall be of a locking type.

Where flexible conduit connection is required, all metal flexible galvanized steel tubing with a liquid tight neoprene jacket extruded over the flexible metal core shall be used. The fittings required for connection between the flexible conduit and rigid conduit or connection boxes shall be liquid tight and as recommended by the manufacturer of the flexible conduit. Factory fabricated flexible conduit assemblies having liquid tight characteristics are acceptable. Non- watertight conduit is not acceptable. A flexible conduit connection is required at all locations of bridge expansion joints.

B. PVC CONDUIT. Conduit, fittings and accessories shall be polyvinyl chloride suitable for underground, encased and exposed applications as approved by Underwriters Laboratories in Article 347 of the 1965 National Electric Code. Conduit shall be Type 40, heavy wall, rigid PVC.

808.03 CONSTRUCTION REQUIREMENTS

Conduit shall be installed in trenches not less than 18 inches below final grade except where otherwise indicated on the plans or directed.

Conduit installed under existing roadways shall be installed by boring or jacking under the roadway. If the Engineer determines that conditions are such that boring or jacking of conduit is not possible, the Contractor shall cut a trench in the pavement prior to the overlay.

Conduit installed by the boring or jacking method shall be installed a minimum of 18 inches below the final grade of the roadway surface. The roadway surface shall not be disturbed by the jacking or boring. Excavation at the ends of the conduit run shall be filled and the area shall be returned to its original condition to the satisfaction of the Engineer.

Upon completion of each conduit run, and in the presence of the inspector, a mandrel with a diameter of at least 85% of the nominal diameter of the conduit shall be pulled through the conduit run. If the mandrel does not pull through, the cause of the obstruction shall be determined and corrected. A #10 drag wire shall be pulled through each conduit and left for later use if conduit is to be left empty.

Standard bends should be used wherever possible, but when the bend is formed, the longest possible bending radius shall be used and shall never be less than six times the nominal diameter of the conduit.

Excavation, backfill, compaction and disposal of surplus materials shall be performed to the satisfaction of the Engineer.

808.04 MEASUREMENT AND PAYMENT

Signal conduit will be measured and paid for as casing under Section 205 “Trench and Structure Excavation & Backfill.”

SECTION 809
CONCRETE PULL BOX

809.01 DESCRIPTION

This item shall consist of furnishing and installing precast concrete pull boxes with covers in accordance with these specifications and at the locations shown on the plans, or as directed.

809.02 MATERIALS

The pull boxes shall be constructed of polymer concrete reinforced with heavyweave fiberglass and shall be Quazite® brand as manufactured by Hubbell Power Systems, Inc., or approved equal. The inside dimensions shall not be less than 10 inches by 17 inches and the depth of the pull box shall not be less than 12 inches.

No fiberglass shall be exposed. All exposed portions of the pull box shall be non-electrically conductive.

A bolt down cover shall be provided for each pull box. The pull box and cover shall be constructed in such a manner that the assembly will support light vehicular traffic loads when installed in accordance with these specifications.

Pull box with cover in place shall comply with the National Electric Code for exposed boxes rated at voltages up to 480 VAC.

809.03 CONSTRUCTION METHODS

The pull boxes shall be installed at the location shown on the plans. The excavation for the pull box shall be to a depth that will result in the top of the cover being flush with the ground.

The pull box shall include a 12 inches concrete apron on all sides when installed outside of paved area.

The pull box shall be set on a gravel or crushed stone bedding that will serve as a sump. Bedding shall extend 18" to 24" below the bottom of the box.

809.04 METHOD OF MEASUREMENT

Work completed and accepted under this item will be measured by the Concrete Pull Box completed, in place with steel cover.

809.05 BASIS OF PAYMENT

Work completed and accepted under this item and measured as provided above, shall be paid for at the contract unit price bid per each for Concrete Pull Box, which price shall be full compensation for furnishing and installing the pull box and concrete collar, complete and in place, in accordance with the plans and these specifications, and shall include all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Concrete Pull Box	EA

SECTION 812
TRAFFIC SIGNAL MAST ARM AND POLE WITH FOUNDATION

812.01 DESCRIPTION

This item shall consist of furnishing and erecting steel traffic signal mast arms and poles, ground rods, grounding wire and connections, galvanized anchor rods and nuts, foundations, service head fittings where required, galvanized pole cap and miscellaneous fittings complete and in place at the locations and to the dimensions and details shown on the plans, or as directed.

812.02 MATERIALS

The following material requirements shall apply to mast arms, poles, and foundations.

A. Poles and mast arms shall be ASTM A 1011, SS, Grade 50, AASHTO M 270, Grade 50, ASTM A 595 Grade A or ASTM A 572, Grade 50 or Grade 65. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

B. Anchor bolts shall comply with AASHTO M 314, Grade 55, including Supplementary Requirement S1. All exposed portions of bolts shall be galvanized according to AASHTO M 232 or ASTM B 695, Class 40 or 50.

C. Anchor Base Plates shall be AASHTO M 270 Grade 36. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

D. Cast Anchor Base Plates shall be AASHTO M 103/M 103M Grade 65-35. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100, or ASTM B 695, Class 40 or 50.

E. Hex nuts shall comply with AASHTO M 292 Grade 2H or AASHTO M 291 Grade DH or DH3 (Grade 10S or 10S3). The thread series shall correspond with that of the bolt furnished. Washers shall comply with AASHTO M 293. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50. Nuts shall be galvanized by the same process as that of the bolts.

F. Clamp Plates shall be AASHTO M 270 Grade 36. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

G. Flange and Gusset Plates shall be AASHTO M 270 Grade 36. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

H. Clamp and Flange Bolts shall be AASHTO 164M. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50.

I. Concrete and reinforcement shall comply with the requirements of Section 401 “Concrete General” for Class AAA (4,000 psi) concrete.

J. Ground rods shall be 5/8” diameter or larger Copperweld with ground wire and connections.

K. Vibratory Mitigation Devices shall be anti-galloping panels consisting of 60”x16”x0.125” sign blanks.

812.03 FABRICATION

The pole shall be constructed to the dimensions shown on the plans. The pole shaft shall have a continuous taper with only one vertical seam electrically welded and rolled smooth. A handhole of sufficient size to allow for internal wiring shall be provided near the pole base. A reinforcing frame for the handhole tapped for a grounding bolt shall be welded into the shaft a short distance from the base. A J-hook wire support shall be welded inside the shaft near the top of the pole.

A cast steel or plate anchor base of the size and shape shown on the plans shall be electrically welded to the bottom of the pole. The anchor base and welding thereto shall develop the full strength of the adjacent shaft.

The arm may be connected to the pole using clamp and gusset plates or flange and gusset plates. When using clamp plates, one rounded plate conforming to the curvature of the pole shall be welded to the mast arm and reinforced with gusset plates as required to develop sufficient strength. The back clamp plate shall be connected to the mast arm clamp plate with 4 bolts of sufficient size to develop adequate strength in the connection.

When using flange and gusset plates to connect the arm to the pole, adequate size plates shall be welded to the pole in the proper position. Another flange plate of suitable design and strength shall be welded to the end of the arm. The arm will then be connected to the pole by 4 bolts of sufficient size to develop adequate strength in the connection.

Four anchor bolts with hex leveling nuts shall be provided with each pole. The anchor bolts shall be of the length shown on the plans and have an L-bend on the bottom and shall be threaded at the top.

In lieu of designing the structure to resist periodic galloping, a vibratory mitigation device may be provided by the pole manufacturer.

Before installation, the Contractor shall furnish to the Engineer design details regarding this item. These details shall specify materials and shall include a certification prepared and/or approved by a Professional Engineer who is registered in any of the United States:

- That the design complies with the plans and specifications and meets or exceeds the standards found in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 4th Edition (2001)* with 2003 and 2006 interims.
- That the materials specified in the design meet or exceed the requirements of Subsection 812.02.

The Contractor shall also furnish a certification from the manufacturer or supplier that the traffic signal mast arm and pole were fabricated in compliance with the certified design and that the materials furnished comply with the specifications.

812.04 CONSTRUCTION REQUIREMENTS

The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Excavation, backfill, compaction, and disposal of surplus materials shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to the original condition.

Foundations for the traffic signal mast arm and pole shall be constructed in firm earth to the minimum size and depth shown on the plans. The location of foundations shall be as shown on the plans or as directed by the Engineer. Foundations shall be placed monolithically and have a 1" chamfer at the top.

Conduit, anchor bolts, and ground rods shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Concrete shall be constructed in accordance with Section 401 "Concrete General." Forms shall not be removed less than 24 hours after the concrete has been placed. The exposed portion of the foundation shall be given a Class 2, rubbed finish. The area between the top of the foundation and the pole base shall be neatly grouted after the pole has been raked and secured in place. The pole shall not be erected upon the foundation for a minimum of 72 hours after placement of concrete.

Mast arm support poles shall be securely bolted to the foundation in a raked position employing galvanized leveling nuts.

Mast arm support poles shall be effectively grounded by means of a ground rod. The grounding wire shall be attached to the pole using a solderless steel bolt.

Subsequent to erection, any damaged galvanized coating or paint shall be repaired by a method approved by the Engineer.

All holes in traffic signal mast arms and poles required for traffic signal cable, controller mountings, etc., shall be machine drilled.

Vibratory Mitigation Devices shall be mounted near the end of the mast arm with the long axis of the panel collinear with the long axis of the mast arm. The panel shall be mounted at such a height as to provide at least 6" clearance from the top of any signal assembly or sign panel located on the mast arm within the length of the vibratory mitigation device.

812.05 MEASUREMENT AND PAYMENT

Work completed and accepted under this item will be measured by the Traffic Signal Mast Arm and Pole with Foundation, complete and in place. Payment will be made at the contract unit price bid per each for Traffic Signal Mast Arm and Pole with Foundation of the arm length specified, which price shall be full compensation for furnishing and installing the pole and arm; for excavation, backfill, compaction, and removal of surplus material; for furnishing and placing reinforcing steel and concrete; for furnishing and installing vibratory mitigation device; and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Traffic Signal Mast Arm and Pole With Foundation (Mast Arm up to 34')	EA
Traffic Signal Mast Arm and Pole With Foundation (Mast Arm 35' to 50')	EA
Traffic Signal Mast Arm and Pole With Foundation (Mast Arm 51' or greater)	EA
Traffic Signal Mast Arm and Pole With Foundation (Twin Mast Arms-all sizes)	EA

SECTION 813
TRAFFIC SIGNAL PEDESTAL POLE WITH FOUNDATION

813.01 DESCRIPTION

This item shall consist of furnishing and erecting steel traffic signal pedestal poles with foundations according to these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

813.02 MATERIALS

The following material requirements shall apply to mast arms, poles, and foundations.

A. The poles shall be constructed of 4" standard steel pipe shaft complying with ASTM A 501 or A 53 Grade B. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

B. Anchor bolts shall comply with AASHTO M 314, Grade 55, including Supplementary Requirement S1. All exposed portions of bolts shall be galvanized according to AASHTO M 232 or ASTM B 695, Class 40 or 50.

C. Anchor Base Plates shall be AASHTO M 270 Grade 36. Galvanizing shall comply with AASHTO M 111, Thickness Grade 100.

D. Cast Anchor Base Plates shall be AASHTO M 103 Grade 65-35. Galvanizing shall comply with AASHTO M 232.

E. Hex nuts shall comply with AASHTO M 292 Grade 2H or AASHTO M 291 Grade DH or DH3 (Grade 10S or 10S3). The thread series shall correspond with that of the bolt furnished. Washers shall comply with AASHTO M 293. Galvanizing shall comply with AASHTO M 232 or ASTM B 695, Class 40 or 50. Nuts shall be galvanized by the same process as that of the bolts.

F. Concrete and reinforcement shall comply with the requirements of Section 401 "Concrete General" for Class AAA (4,000 psi) concrete.

G. Ground rods shall be 5/8" diameter or greater Copperweld with ground wire and connections.

813.03 FABRICATION

The pole shall be constructed to the dimensions shown on the plans. A handhole of sufficient size to allow for internal wiring shall be provided near the pole base. A reinforcing frame for the

handhole tapped for a grounding bolt shall be welded into the shaft a short distance from the base.

A cast steel or plate anchor base of the size and shape shown on the plans shall be electrically welded to the bottom of the pole. The anchor base and welding thereto shall develop the full strength of the adjacent shaft.

Four anchor bolts with hex nuts shall be provided with each pole. The anchor bolts shall be of the length shown on the plans and have an L-bend on the bottom and shall be threaded at the top.

Before installation, the Contractor shall furnish to the Engineer design details regarding this item. These details shall specify materials and shall include a certification prepared and/or approved by a Professional Engineer who is registered in any of the United States:

- That the design complies with the plans and specifications and meets or exceeds the standards found in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 4th Edition (2001)* with 2003 and 2006 interims.
- That the materials specified in the design meet or exceed the requirements of Subsection 813.02.

The Contractor shall also furnish a certification from the manufacturer or supplier that the traffic signal pedestal pole was fabricated in compliance with the certified design and that the materials furnished comply with the specifications.

813.04 CONSTRUCTION REQUIREMENTS

The Contractor shall contact the local utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

Excavation, backfill, compaction, and disposal of surplus materials shall be performed to the satisfaction of the Engineer. Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill. Disturbed surfaces shall be returned to the original condition.

Foundations for the traffic signal pedestal pole shall be constructed in firm earth to the minimum size and depth shown on the plans. The location of foundations shall be as shown on the plans or as directed by the Engineer. Foundations shall be placed monolithically and have a 1" chamfer at the top.

Conduit, anchor bolts, and ground rods shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Concrete shall be constructed in accordance with Section 401 "Concrete General." Forms shall not be removed less than 24 hours after the concrete has been placed. The exposed portion of the foundation shall be given a Class 2, rubbed finish.

The area between the top of the foundation and the pole base shall be neatly grouted after installation. The pole shall not be erected upon the foundation for a minimum of 72 hours after placement of concrete.

The pedestal pole shall be securely bolted to the foundation in a perpendicular position, employing galvanized shims if necessary.

Poles shall be effectively grounded by means of a ground rod. The grounding wire shall be attached to the pole using a solderless steel bolt.

Subsequent to erection, any damaged galvanized coating or paint shall be repaired by a method approved by the Engineer.

All holes in traffic signal pedestal poles required for traffic signal cable, controller mountings, etc., shall be machine drilled.

813.05 MEASUREMENT AND PAYMENT

Work completed and accepted under this item will be measured by the Traffic Signal Pedestal Pole with Foundation, complete and in place. Payment will be made at the contract unit price bid per each for Traffic Signal Pedestal Pole with Foundation, which price shall be full compensation for furnishing and installing the pole; for excavation, backfill, compaction, and removal of surplus material; for furnishing and placing reinforcing steel and concrete; and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Traffic Signal Pedestal Pole With Foundation	EA

SECTION 814
TRAFFIC SIGNAL EQUIPMENT PERFORMANCE TEST

814.01 DESCRIPTION

This item shall consist of providing a two (2) year guarantee and proving the soundness of all traffic signal equipment and related electrical components installed at each location in accordance with these specifications and at locations shown on the plans or as directed.

The Contractor shall obtain and assign to the City transferrable manufacturer's warranties or guarantees on all electrical and mechanical equipment, consistent with those provided as customary practice. The Contractor shall guarantee satisfactory in-service operation of the mechanical and electrical equipment and related components for a period of two years following project acceptance, at no additional cost.

The Contractor shall conduct a performance test which shall consist of a continuous 30 day period of operation without a major malfunction. Such malfunctions are considered to be any occurrence which renders the installation inoperative either momentarily or for a longer period. Lamp burn outs are not considered a major malfunction unless two or more bulbs in the same socket burn out within the 30 day period.

Defective equipment or accessories shall be repaired or replaced in accordance with applicable specifications and to the satisfaction of the Engineer within a reasonable period of time during the 30 day performance test and the two year guarantee period.

814.02 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Work completed and accepted under this item will not be paid for directly but will be considered subsidiary to the traffic signal equipment involved at each installation. Payment of the final estimate for the items involved will be withheld until satisfactory completion of the 30 day Traffic Signal Equipment Performance Test.

SECTION 815
REMOVAL OF TRAFFIC SIGNAL EQUIPMENT

815.01 DESCRIPTION

Under this item, the Contractor shall remove traffic signal heads, traffic signal poles, traffic signal pole foundations, span-wire assemblies, traffic controllers and all other existing signal equipment at locations shown on the plans or as ordered by the Engineer.

815.02 MATERIAL

The Contractor shall provide all equipment and tools necessary to remove the signal equipment at locations shown on the plans or as designated by the Engineer.

815.03 CONSTRUCTION METHODS

The Contractor shall maintain the existing traffic signal operation during construction until the completion of the traffic signal work contemplated in the contract.

The Contractor shall disconnect and remove all traffic signal heads, span wire assemblies, traffic controllers, traffic signal poles, traffic signal pole foundations and all other existing signal equipment at locations shown on the plans or as ordered by the Engineer.

The Contractor shall remove the traffic signal pole foundations and all appurtenances such as reinforcing steel, conduit, anchor bolts and cable to a depth of 12 inches below grade. The concrete foundations shall be broken up and the material disposed of outside of the limits of the project by the Contractor. The Contractor shall fill with earth all holes where concrete foundations or wooden span-wire poles have been removed under this item. The earth in the hole shall be thoroughly compacted until it is as firm and unyielding as the surrounding material.

All removed equipment not to be used in new installations shall be delivered to the Traffic Control Division of the City's Streets and Traffic Control Department, located at 3900 Kelley Highway.

815.04 BASIS OF PAYMENT

All work completed and accepted under this item shall be paid for at the contract lump sum price bid for "Removal of Traffic Signal Equipment", which price shall be full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work as described herein and for transporting removed equipment to the Traffic Control Division at 3900 Kelley Highway.

When removal of traffic signal equipment is not listed as a separate pay item, this work shall be considered incidental to other work specified in the project.

SECTION 820
EMERGENCY PREEMPTION SYSTEM

820.01 DESCRIPTION

This item shall consist of a priority control for emergency vehicles in conjunction with a traffic signal system. The preemption system shall be furnished and installed complete except that the optical emitter assembly will be installed by the Owner.

820.02 SUBMITTALS

Prior to the start of work, Contractor shall submit to Engineer for review and approval 5 copies of the following:

A. Product data sheets for each component listed in section 820.03
B. Certification of Compliance per section 820.07
C. Warranty per section 820.06

820.03 MATERIALS

A. GENERAL DESCRIPTION. This system employs optical communication to identify the presence of designated priority vehicles and causes the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available. The matched set of components which make up the system will cause the existing traffic controller to be manipulated upon recognition of the signal from the vehicle. This communication is effective to the optical detectors at or near the intersection over a line-of-sight path of up to 1,800 feet. The system requires no attention of the vehicle operator other than a simple emitter "ON" switch located in the vehicle which is to remain "ON" until the end of the emergency run. The system shall operate on a first-come, first-served basis. The system is capable of overriding lower priority systems of similar nature while yielding priority to activity such as railroad, drawbridge, etc. The system shall interface with existing traffic signal controllers without compromising normal operation or existing safety provisions. The priority control system shall consist of optical emitter assemblies, optical detectors, optical detector cable and phase selectors.

The system shall be comprised of four basis matched components. To insure system integrity, operation and compatibility, the four basic components (optical emitter, optical detectors, detector cable, phase selector) shall be from the same manufacturer.

The system shall be capable of writing a log record in non-volatile memory consisting of the following information:

Vehicle subgroup	Final greens at end of call
Vehicle ID number	Duration of final greens
Signal Band	Time call ended in real time
Direction	Near or far vehicle approach
Call duration	

B. OPTICAL EMITTER ASSEMBLY. A lightweight, weatherproof, light "emitter" with internal, regulated power supply. A crystal controlled "emitter switch" including all hardware and wiring to connect to the vehicle battery system to produce precisely timed pulses of high intensity optical energy.

C. OPTICAL DETECTOR. A lightweight, weatherproof, adjustable, bi-directional optical detector assembly. Internal circuitry transforms optical energy from the optical emitter

assembly into electrical signals for delivery (up to 1,000 feet) via optical detector cable to the phase selection equipment.

D. OPTICAL DETECTOR CABLE. A durable, shielded, 3-conductor cable (with drain wire) with necessary electrical characteristics to carry power to the optical detector from the phase selector and deliver the necessary high quality signal to the phase selector.

E. PHASE SELECTOR. This equipment shall interface between the optical detector and the controller unit and provide the following functions while not compromising the existing fail-safe provisions.

(1) Deliver sufficient power to all optical detectors required for the intersection.
(2) Control sensitivity to the optical detector signal via adjustable range settings.
(3) Distinguish the flash rate of the electrical signals from the optical detector caused by the optical emitter.
(4) Assign control on first-come, first-served basis.
(5) Deliver signals to the controller to cause selection of the desired phase green display for the approaching vehicle.
(6) The phase selector shall take advantage of the phase delivery capability of the traffic controller.

820.04 SYSTEM OPERATION

A. Dual priority phase selection shall be activated by an optically transmitted signal upon the actuation of a test switch located on the unit.

B. The system shall provide power for up to 3 optical detectors for each priority channel. The system shall maintain continuous communication between the optical emitter equipped vehicle and the traffic controller.

C. The system shall cause the controller to deliver the desired traffic signal display even if the optical energy signals are interrupted before the desired display is obtained.

D. The system shall allow the traffic signal controller to resume normal timing operation after the optical signals cease for an appropriate period.

820.05 RELIABILITY

A. All equipment supplied as part of the optical priority remote traffic control system intended for use in the controller cabinet shall meet the electrical and environmental specifications spelled out in the NEMA standards publication TS2 2003, Part 2: v02.06:

(1) Line voltage variations per NEMA TS2 2003, Paragraph 2.1.2.
(2) Power source frequency per NEMA TS2 2003, Paragraph 2.1.3.
(3) Power source noise transients per NEMA TS2 2003, Paragraph 2.1.6.
(4) Non-destructive transient immunity per NEMA TS2 2003, Paragraph 2.1.8.
(5) Input-Output terminals per NEMA TS2 2003, Paragraph 2.1.7.
(6) Temperature range per NEMA TS2 2003, Paragraph 2.1.5.
(7) Humidity per NEMA TS2 2003, Paragraph 2.1.5.
(8) Shock test per NEMA TS2 2003, Paragraph 2.2.9.
(9) Vibration per TS2 2003, Paragraph 2.2.8.

B. All equipment supplied as part of the optical priority traffic control system intended for use in or on emergency vehicles shall operate property under any combination of the following environmental conditions:

(1) Temperature range: -30 degrees F (-34 degrees C) to 140 degrees F (+60 degrees C).
(2) Relative humidity: 0 to 95%.
(3) Vehicle battery voltage: 10 to 18 volts.

820.06 WARRANTY

Manufacturer shall warrant that, provided the complete matched component system has been properly installed, operated and maintained, system component parts (except emitter lamps) that prove to be defective in workmanship and/or material during the first five (5) years from the date of shipment from the manufacturer will be repaired at no charge.

Emitter lamp warranty shall be two (2) years from the date of shipment or 3,000 hours of operation, whichever occurs first.

This warranty shall further assure operational reliability and interface compatibility of this equipment with future emergency response management system components produced by the equipment manufacturer for ten (10) years from the date of shipment of this order.

Any warranty service required shall be promptly performed at the manufacturer's facility or the manufacturer's authorized service agency. The purchasers will pay transportation costs to such service point, and the manufacturer will pay those costs to return the unit by normal surface transportation means.

820.07 CERTIFICATION OF COMPLIANCE

The manufacturer of the priority control system shall certify that all component products are designed, manufactured and tested as a system of matched components and will meet or exceed the requirements of this specification.

820.08 EQUIPMENT REQUIREMENTS

A. OPTICAL EMITTER ASSEMBLY.

(1) The assembly shall include an optical energy emitting unit for mounting to the exterior of the vehicle, an emitter control switch for mounting to the interior dash or instrument panel, and all necessary wiring and hardware for typical installation.

(2) The optical emitter assembly shall operate over an ambient temperature range of -30 degrees F (-34 degrees C) to up to 140 degrees F (+60 degrees C).

(3) The optical energy emitting unit shall contain an internal regulated power supply to convert 12VDC (positive or negative ground) vehicle battery power to high voltage required for the flashtube and meet the following electrical requirements:
   (a) Operational at 10 volts DC to 15 volts DC.
   (b) Have internal protection for a sustained input voltage of up to 25 volts DC.
   (c) Deliver insufficient optical energy to activate the optical detector from a distance of 1800 feet.
   (d) Consume no more than 40 watts.

(4) The optical energy emitting unit shall weigh not more than 4.5 pounds.

(5) The optical energy emitting unit shall not exceed the following physical dimensions:

Length	5.25 inches
Width	7.0 inches

Height 6.63 inches

(6) The optical energy emitting unit shall be capable of producing precisely timed pulses of high intensity light in response to a low voltage trigger signal from the crystal controlled emitter controller switch.

(7) The optical energy emitting unit shall be controlled by a single ON/OFF switch which requires no warm-up, setting, or adjustments by the vehicle operator. An indicator located adjacent to the ON/OFF switch shall identify that the crystal controlled circuitry is energized.

(8) The emitter control switch shall produce crystal controlled low voltage trigger pulses to the optical energy emitting unit. For high priority/Class II applications, the frequency of the trigger pulses shall be 14.035 ± 0.255 HZ. For low priority/Class I applications, the frequency of the trigger pulses shall be 9.639 ± 0.119 HZ.

B. OPTICAL DETECTOR.

(1) The optical detector shall be a lightweight, weatherproof device capable of sensing and transforming pulsed optical energy into electrical signals for use by the phase selection equipment.

(2) The unit shall be high impact polycarbonate construction with stainless steel and/or brass hardware.

(3) The unit shall be designed for each mounting at or near an intersection on a mast arm, pedestal, pipe, or span wire.

(4) The unit shall accept optical signals from one or two directions and provide a single electrical output signal.

(5) The unit shall include a design feature to allow aiming of the two optical sensing inputs for skewed approaches or slight curves.

(6) The unit shall have a built-in terminal strip to simplify wiring connections.

(7) The unit shall receive power from the phase selector and have internal voltage regulations to be operational from 16 to 40 volts.

(8) The unit must be responsive to the optical emitter at a distance of 1800 feet.

(9) The unit must deliver the necessary electrical signal to the phase selector via cable up to 1000 feet.

C. OPTICAL DETECTOR CABLE.

(1) The cable must guarantee delivery of the necessary quality signal from the optical detector to the phase selector over a non-spliced distance of 1000 feet.

(2) The cable must guarantee sufficient power to the optical detector over a non-spliced distance of 1000 feet.

(3) The cable must be of durable construction to satisfy the following installation methods:
Direct burial.
Conduit and mast arm pull.

Exposed overhead (supported by messenger wire).

(4) The weight shall not exceed .04 lbs./ft.

(5) The outside diameter shall not exceed 0.3 inches.

(6) The insulation rating shall be 600 volts minimum.

(7) The temperature rating shall be 80 degrees C minimum.

(8) The cable shall have 3 conductors of AWG #20 (7x28) stranded, individually tinned copper, color coded insulation as follows:
Orange for delivery of 8 optical detector power (+).
Blue for optical detector power return (-).
Yellow for optical detector signal.

(9) The conductors shall be shielded with aluminized polyester and have an AWG #20 (7x28) stranded and individually tinned drain wire to provide signal integrity and transient protection.

(10) The shield wrapping shall have a 20% overlap to ensure integrity following conduit and mast arm pulls.

D. PHASE SELECTION EQUIPMENT. The high priority control system manufacturer shall offer high/low priority devices to assure interface with solid state controllers.

All phase selectors shall be digitally controlled and be capable of providing a basic high and low priority, two channel system with traffic controllers operating up to eight phases.

The systems shall be easily expanded to four channel operation by inserting an additional phase selector. Each phase selector shall contain a power supply to support optical detectors and circuitry to recognize electrical signals from the optical detectors caused by emitter equipped vehicles.

(1) Phase selector for use with NEMA traffic controllers and solid state equipment:

(a) Shall be plug-in, two channel, dual priority device intended to be installed directly into card rack wired to controllers.

(b) Shall be powered from 115 volt, 60HZ mains and contain an internal, regulated power supply to support optical detectors.

(c) Shall be capable of recognizing the following pulse rates as delivered by the optical detectors:
9.639HZ ± .119HZ as low priority (Class I).
14.035 HZ ± .255HZ as high priority (Class II).

(d) Primary optical detector inputs and power outputs shall be on the card edge. Two additional detector inputs, per channel, shall be provided via a front panel connector.

(e) One opto-isolated NPN output per channel shall be delivered to the appropriate channel pin on the card edge connector as follows:
6.25 ± .02HZ 50% on/duty square wave in response to a Class I call.
A “Steady ON” in response to a Class II call.

(f) Shall utilize crystal control timing and optical pulse rate recognition circuitry to assure:
Accurate optical signal recognition for dual priority.
Synchronous logic.
Precise output pulse. Accurate call
dropout time.

(g) Shall have six recessed range controls per channel, three for low priority and three for high priority to adjust optical sensitivity (emitter range).

(h) Shall have a solid state "Power ON" indicator.

(i) Shall have a "Class I" and Class II" solid state indicator for each channel which performs as follows:
Flash during call validation
Be steady-on during valid call and test switch operations.

(j) Shall have a test switch for each channel to deliver Class I or Class II signal pulse rates to verify proper function at both optical emitter flash rates, first-time, first- served operation and Class II override capability.

(k) Shall have a selectable call dropout time of 5 seconds (10 seconds optional) -0 to +2.5%.

(l) Shall properly identify a high priority (Class II) demand with any combination of up to 10 high and low priority emitter signals being received simultaneously on either channel.

(m) Shall not exceed the following physical dimensions:
Length (including handle) 7.91 inches.
Width 1.11 inches.
Height 4.50
inches.

820.09 CONSTRUCTION REQUIREMENTS

Contractor shall furnish and install preemption system and perform any and all necessary terminations, connections, testing of circuits, adjustments and such other operations as may be necessary in order that each complete traffic signal installation, with all of its components, be completely integrated and tested as a unit so that the desired control of the intersection is attained, complete and in proper working order and to the satisfaction of the Engineer.

820.10 MEASUREMENT AND PAYMENT

Work completed and accepted will be measured and paid for as follows:

Optical emitters furnished complete with control switch, wiring and hardware will be measured and paid for by the unit.

Work completed and accepted under "Emergency Preemption System" will be measured by the unit for each intersection.

Work measured and accepted as above will be paid for at the contract unit price bid for "Emergency Preemption System"; which price shall be full compensation for providing all

components needed, including furnishing and installing all optical detectors, optical detector cable, and phase selectors complete with all hardware and accessories; installing the system on temporary and permanent signals; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Pay Item	Unit
Emergency Preemption System Optical Emitter	EA
Emergency Preemption System	EA

SECTION 821
VIDEO VEHICLE DETECTION SYSTEM

821.01 DESCRIPTION

This work shall consist of furnishing and installing a video vehicle detection system at locations shown on the plans for the purpose of providing actuation to a traffic signal controller and for incident detection and tracking. In addition, live video display shall be available to a remote location through Ethernet connection.

The video vehicle detection system supplied shall consist of video detection cameras, processors, cables and all other associated equipment, hardware and software required for a complete installation.

821.02 MATERIALS

Video vehicle detection system shall be Autoscope by Econolite Control Products, Inc., Flir Traficon, or an approved equal. For single camera systems, Autoscope shall be used, or an approved equal. System components shall also meet the following requirements:

A. VIDEO CAMERAS. Cameras shall be high-resolution, color or black and white image sensors with mechanically operated zoom and focus (unless Flir thermal cameras are provided), in an environmentally sealed enclosure with faceplate heater and weather shield. All cable, wiring harness, mounting brackets for both pole and mast arm mounting, and other accessories shall be provided. Cameras shall be mounted on the mast arms utilizing band mount brackets with the cameras at a height of 5' above the mast arms (unless Flir thermal cameras are provided). Mounting height for Flir thermal cameras shall be 1’ above the mast arms.

B. VIDEO PROCESSOR. The system shall allow detection zones to be programmed as standard vehicle detectors or as incident detectors. All zone types must be capable of collecting and recording the following traffic data as a minimum:

(1) Volume/counts
(2) Lane occupancy
(3) Speed
(4) Headway
(5) Density
(6) Vehicle classification/length

C. SOFTWARE. Software required for setup, programming, and real-time monitoring of the system, from both on-site and remote locations, shall be supplied. All costs of the software shall be considered incidental to the system. Software shall be Windows based and operate from a computer with Intel Pentium processor and current Windows operating system.

821.03 SUBMITTALS

The following are required to be submitted to the Engineer for approval at the Pre-Construction Conference:

A. Manufacturer’s product data on each individual component being supplied with the system.
B. List of subcontractor’s experience installing manufacturer’s system or similar systems.

821.04 CONSTRUCTION REQUIREMENTS

The Contractor shall furnish and properly install each unit with all required wiring/cabling, whether or not shown on the plans, and accessory equipment and perform necessary connections, testing of circuits, adjustments, and such other operations as may be necessary to ensure that each complete installation, with all of its components, be completely integrated and tested as a unit so that the desired control of the system is attained, complete, and in the best of working order, to the satisfaction of the Engineer.

If temporary signals are shown on the plans, at the beginning of construction, the detection cameras shall be installed on the temporary signal poles with pole-mounted brackets and the video processors installed within the existing traffic controller cabinets. When the new, permanent signal is installed and ready for activation, the cameras shall then be moved and installed onto the new signal mast arms with brackets that will elevate the cameras approximately 5 feet above the mast arms (unless Flir thermal cameras are provided).

821.05 MANUFACTURER SUPPORT

A manufacturer's representative shall provide assistance to Contractor personnel during installation and setup for both the temporary and permanent signals. If requested by the Owner, the manufacturer's representative shall be present at the time of activation of each signal, and shall provide assistance and operational instructions to Owner personnel in setup and programming of the system.

821.06 MEASUREMENT AND PAYMENT

Work completed and accepted under "Video Vehicle Detection System" will be measured by the unit for each intersection.

Work measured and accepted as above will be paid for the contract unit price bid for "Video Vehicle Detection System"; which price shall be full compensation for providing all components including all wiring or cabling needed; installing the system on temporary and permanent signals; wiring, aligning, configuring, testing, and training; and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Unit
Video Vehicle Detection System	EA

SECTION 840
TRAFFIC PAINT PAVEMENT MARKINGS

840.01 DESCRIPTION

This item shall consist of furnishing and placing traffic paint pavement markings including words, arrows and emblems, of the color and type specified and the removal of pavement markings in accordance with these specifications and in conformity with the dimensions and at the locations shown on the plans or as directed by the Engineer.

The markings are to be placed under local traffic conditions. The work shall meet the requirements of the Manual of Uniform Traffic Control Devices (MUTCD) except as modified by these specifications.

840.02 MATERIALS

A. TRAFFIC PAINT. Paint for pavement markings, including words, arrows, and emblems, shall be Hotline® Fast Dry Waterborne (Latex) Traffic Marking Paint (TT-P-1952E/F Types I and II) as manufactured by Sherwin-Williams Company, Cleveland, OH, or approved equal. Paint color for words, arrows, emblems, crosswalks, and stop bars shall be TM2152 White. Paint colors for 4" striping shall be either TM2152 White or TM2153 Lead Free Yellow dependent upon location of striping and MUTCD requirements.

B. GLASS BEADS. Glass beads for use on traffic line paint shall be clear, colorless and clean and of such character as to permit their embedment in a pigmented binder having their upper surface exposed to permit the refracting of light rays. The beads shall be of such character that when applied to a traffic line paint they shall embed to approximately their equator in the paint film.

(1) Refractive Index:

The spheres shall have an average index of refraction not less than 1.50 when tested by the liquid immersion method at 25 degrees C.

(2) Size:

U.S. Standard Sieve No.	Percent Passing by Weight
U.S. 40	90 - 100%
U.S. 80	0 - 10%

(3) Percent Spheres:

A minimum of 75% (by weight) of the spheres shall be true spheres.

(4) Flotation:

A minimum of 90% of the glass spheres shall float on eylol (aromatic solvent) or minimum of 75% of the glass spheres shall float on heptane (aliphatic solvent) when tested as follows:

A single layer of spheres shall be spread on a clean, inverted pint tin can lid. Solvent shall be slowly introduced with a syringe of dropper at the edge of the lid until it overflows. The percentage of spheres floating on the solvent surface shall be estimated visually.

(5) Color:

The glass spheres shall be colorless to the extent that they impart no objectionable day or nighttime hue to the binder when applied at concentration equal to those used on road surfaces.

840.03 CONSTRUCTION REQUIREMENTS

A. MARKING EQUIPMENT. Markings shall be applied by equipment that has been developed for application of paint or paints of the type indicated. Where drawings indicate, the machine shall be capable of applying traffic marking paint, both reflective and non-reflective, in either solid lines or skip lines, or a combination of both.

Equipment used to apply glass beads shall be so constructed that the amount of glass beads applied may be readily adjusted and operate simultaneously with the paint application, placing glass beads over the full width of applied paint. Where drawings require the use of a skip line application, the machine shall be readily equipped with a skip-line mechanism capable of applying the paint at the cycle indicated. Marking machine shall permit a sharp, clear line definition when applying the paint. Paint storage tanks of 30 gallon capacity or more shall be equipped with a mechanical agitator.

B. SURFACE RESTORATION. Any surface preparation required prior to application of paint will be performed by the Contractor. Surfaces on which markings are to be applied shall be thoroughly cleaned of scale, dirt, mud, oil, grease or other foreign material. Markings shall be applied only when surfaces are thoroughly dry and when the air and surface temperatures are a minimum of 50 degrees F and rising. No markings shall be applied when the relative humidity exceeds 85%.

Conflicting paint or thermoplastic pavement markings shall be removed by blasting with water or sand or by grinding. This blasting and grinding is considered pavement marking removal.

C. APPLICATION OF MARKINGS. All dimensions, spacings and locations of markings shall be as indicated on the drawings and in the MUTCD. The paint shall be applied at 14 to 16 mils wet film thickness. Glass beads shall be applied at approximately 6 pounds per gallon of paint. The Contractor shall use such guidelines, string lines, templates and forms as required to obtain workmanship of the highest grade throughout. The Contractor shall use appropriate and approved methods to produce straight lines on tangents and a smooth uniform line on curves. All lines shall be uniform in width and shall have clean cut edges and ends, without fuzziness. The operation of application equipment will be by qualified, skilled technicians to insure that the best standard of practice for the equipment is complied with.

840.04 MEASUREMENT AND PAYMENT

A. PAVENTMENT MARKINGS. Traffic paint pavement markings will be measured by the linear foot of material actually placed for the specified color and width of stripe. Work completed and accepted under the item of Traffic Paint Pavement Markings will be paid for at the contract price bid per linear foot in place, which price shall be full compensation for furnishing and installing markings; and for all labor, tools, equipment, surface preparation, and incidentals necessary to complete the work.

B. WORDS, ARROWS, AND EMBLEMS. Words, Arrows, Railroad Emblems, and Bicycle Sharrows will be measured by the unit. Work completed and accepted under the items

Traffic Paint Pavement Marking (Words), (Arrows), (Railroad Emblems), and (Sharrows) will be paid for at the contract price bid per each in place, which price shall be full compensation for furnishing and installing Words, Arrows, Railroad Emblems, and Bicycle Sharrows and for all labor, tools, equipment, surface preparation, and incidentals necessary to complete the work.

C. PAVEMENT MARKING REMOVAL. Pavement Marking Removal will be measured by the linear foot of marking actually removed for the width specified. Any pavement markings removed from detours or during staged construction, by milling or any other pavement removal operations, or covered over with successive pavement courses, shall not be measured for payment. Work completed and accepted under the item of Pavement Marking Removal will be paid for at the contract price bid per linear foot, which price shall be full compensation for all materials, labor, tools, equipment, and incidentals necessary to complete the work.

D. PAVEMENT MARKING REMOVAL (WORDS, ARROWS, & EMBLEMS). Pavement Marking Removal will be measured by the unit for each word, arrow, railroad emblem, or bicycle sharrow actually removed. Any words, arrows, or emblems removed from detours or during staged construction, by milling or any other pavement removal operations, or covered over with successive pavement courses, shall not be measured for payment. Work completed and accepted under the item of Pavement Marking Removal (Words, Arrows, & Emblems) will be paid for at the contract price bid per each, which price shall be full compensation for all materials, labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Traffic Paint Pavement Marking White (___")	LF
Traffic Paint Pavement Marking Yellow (___")	LF
Traffic Paint Pavement Marking (Words)	EA
Traffic Paint Pavement Marking (Arrows)	EA
Traffic Paint Pavement Marking (Railroad Emblems)	EA
Traffic Paint Pavement Marking (Sharrows)	EA
Traffic Paint Pavement Marking Removal (___")	LF
Traffic Paint Pavement Marking Removal (Words, Arrows, & Emblems)	EA

SECTION 850
RAISED PAVEMENT MARKER

850.01 DESCRIPTION

This item shall consist of furnishing and installing raised pavement markers in accordance with these specifications and at the locations shown on the plans or as directed.

850.02 MATERIALS

Pavement markers shall be of the type and color shown on the plans or specified herein.

Type I - One-Way (Color) Reflective Markers
Type II - Two-One (Color/Color) Reflective Markers

Pavement markers shall be the prismatic reflector type and shall conform to ArDOT Section 721 "Raised Pavement Marker."

Adhesives shall conform to ArDOT Section 721.

850.03 CONSTRUCTION REQUIREMENTS

The surface to which the marker is to be bonded shall be free of dirt, curing compound, grease, oil, moisture, paint and any other material which would adversely affect the bond of the adhesive. The adhesive shall be placed uniformly on the surface of the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker has been pressed into place. Surface preparation and application of adhesive shall conform to the adhesive manufacturer's recommendations. Removal of excess adhesive from the marker or pavement surface shall be accomplished utilizing a solvent which will not harm the marker or pavement.

Markers shall be accurately positioned and aligned as shown on the plans or directed by the Engineer.

850.04 MEASUREMENT AND PAYMENT

Raised pavement markers will be measured by the unit. Work completed and accepted and measured as provided will be paid for at the contract unit price bid each for Raised Pavement Markers of the type specified, which price shall be full compensation for furnishing and installing raised pavement markers; and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
Raised Pavement Marker (Type__)	EA

SECTION 860
SIGNS

860.01 DESCRIPTION

This item shall consist of furnishing and installing traffic signs, complete with posts, supports, fittings and concrete bases, where required, in accordance with these specifications and to the dimensions and details and at the locations shown on the plans or as directed.

860.02 MATERIALS

Signs shall meet the requirements of the MUTCD, and shall conform to the details in the Standard Highway Signs manual published by the FHWA, U.S. Department of Transportation.

All colors for signs shall match the colors specified in the MUTCD. The color and size of letters, symbols, borders and background on signs shall be as shown in the Standard Highway Signs unless otherwise specified on the plans.

Signs shall be made of aluminum and shall be reflectorized.

A. SIGN PANELS. Standard signs shall be fabricated without stiffeners on the back and shall be fabricated of aluminum alloy (ASTM B 209, Alloy 5052 H38) and shall consist of a single sheet of aluminum. The sign blank shall be 0.080 inch thick. Sign blanks shall be flat and straight and within commercial tolerances established by the aluminum industry.

Sign panels to which reflective sheeting is to be applied shall be degreased, etched and alodized.

All fabrication, including cutting and punching of holes, shall be completed prior to metal degreasing, etching, alodizing and the application of reflective sheeting.

Sign panels shall be free of buckles, warp, dents, burrs and defects resulting from fabrication. The surface of all sign panels shall be flat.

The Contractor shall submit a Certified Test Report to the Engineer covering sign panels.

B. REFLECTIVE SHEETING. The reflective sheeting for signs shall be 3M Diamond VIP Grade Reflective Sheeting. The reflective sheeting materials shall comply with all applicable requirements for Type II as set forth in Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, 1985 (FP-85), Section 633 and Section 718. The Contractor shall submit a Certified Test Report to the Engineer covering the reflective sheeting. Type II enclosed lens reflective sheeting shall consist of spherical lens elements embedded within a transparent plastic having a smooth, flat outer surface as exposed in use. Type II reflective sheeting shall be weather resistant and have a protected pre-coated adhesive backing.

Reflective sheeting shall be applied to properly treated sign panels with mechanical equipment in a manner specified by the sheeting manufacturer. Sign faces comprising 2 or more pieces or panels of reflective sheeting must be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance both day and night. Alternate successive width sections of either sheeting or panels must be reversed and consecutive in insure that corresponding edges of reflective sheeting lie adjacent on the sign. Non-conformance may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting which will not be acceptable.

At splices, sheeting shall be overlapped no less than 3/16 inch.

C. LEGEND. All legend which includes letters, numerals, symbols, arrows and border shall have a regular outline and be clean cut and sharp and shall have a continuous stroke and border without ragged or torn edges.

All legend on guide signs shall be of the size shown on the plans. Legend on standard signs shall meet the requirements of the latest revision of Standard Highway Signs.

(1) Silk Screen Process. The letters, numerals, arrows, symbols, border and other features shall be produced on reflective sheeting of the sign field by a silk screen process approved by the Engineer. Sign messages and borders of a color darker than the sign field shall be applied to the reflective sheeting by direct process. Sign messages and borders of a color lighter than the sign field shall be produced by the reverse process in which message and border are outlined by applying darker transparent color to the reflective sheeting of the sign field.

Transparent colors, inks and paints used in the silk screen process shall be of the type and quality recommended by the manufacturer of the reflective sheeting and shall conform to red, blue, yellow and green colors approved by the FHWA shown in the MUTCD and FHWA Standard Highway Signs.

(2) Direct Applied Legend. The legend and other features of the sign message shall be cut from Type II reflective sheeting with a pre-coated pressure sensitive adhesive backing (Class 1).

D. POSTS. Steel posts shall be U-section channel conforming to ASTM A 499, Grade 60. Posts shall weigh not less than 3.0 pounds per foot and shall be punched or drilled with 3/8 inch holes on 1 inch centers for the full length of the post. Posts shall be painted with green enamel.

Posts shall be 12 feet length unless otherwise shown on the plans.

E. FASTENERS AND BRACKETS. Fasteners, including bolts, nuts, washers, post clips and stop nuts shall be aluminum conforming to ASTM B 211 Alloy 2024-T4 or stainless steel conforming to ASTM A 193, Grade B-8. Brackets shall be cast aluminum conforming to ASTM B 26.

F. CONCRETE. Concrete shall be Class A, 3000 psi, conforming to Section 401 "Concrete."

G. OBJECT MARKERS. Object marker consist of 6 inch x 12 inch yellow reflective panel mounted vertically on a steel post. Reflective panel shall consist of Type III High Intensity Grade reflective sheeting permanently adhered to an aluminum sheet backing. Steel posts shall be a channel, or winged channel, section weighing not less than 2.0 lb/ft, hot dip galvanized, with length as required for the specified mounting height. Tamper resistant fasteners shall be used to attach panel to post.

860.03 SHOP DRAWINGS

The Contractor shall submit, for the approval of the Engineer, prints of shop drawings in duplicate showing arrangements and spacing of all letters, symbols and borders for each type of sign; the support to be used with each different type of sign panel; and the proposed method of attaching signs to the supports on signs not detailed on the plans. When the shop drawings have been approved, four prints shall be furnished to the Engineer. The contractor shall be responsible for the correctness of

the drawings, even though the drawings may have been approved by the Engineer.

860.04 CONSTRUCTION REQUIREMENTS

Signs shall be erected at the specified locations, plumb and to the specified vertical and horizontal clearances as shown on the plans or as directed by the Engineer. Signs shall be installed with the specified fasteners and brackets.

Signs shall normally be erected so that the sign face is vertical and at 93 degrees away from the center of the lane which the sign serves and away from the direction of travel. Where lanes divide, or on curves, sign faces shall be oriented so as to be most effective both day and night and to avoid the possibility of specular reflection.

Object markers shall be installed at the locations shown on the plans. The bottom of the reflective panel shall be 4' above the surface of the nearest traffic lane, unless otherwise noted on the plans.

Field drilling of holes in any part of the sign support structure shall be done only when specified in the plans or as directed by the Engineer.

After sign installation is complete, the signs will be inspected at night by the Engineer. If specular reflection is apparent on any sign, its position shall be adjusted by the Contractor to eliminate this condition.

Existing signs and posts designated to be removed and replaced, or salvaged, shall be removed by the Contractor in a manner which will avoid damaging of the signs or posts. Where salvaging is specified, all fasteners, brackets and accessories shall be included with the signs.

Concrete work shall conform to Section 401 of these specifications.

860.05 MEASUREMENT AND PAYMENT

Signs will be measured by the square foot of sign area. Measurements will consist only of the face of the sign to the nearest 0.10 square foot of area. No deduction in square footage will be made for corner radii or mounting holes.

The area of octagonal signs will be computed as the area of the circumscribing square. The area of triangular signs will be computed as the area of the triangle.

Object markers will be measured by the accepted quantity of object markers installed and paid for at the contract unit price per each, which price shall include furnishing and installing sign, post, fasteners, and related work.

Sign posts will be measured by the unit of the type, size and length erected.

Accepted quantities of signs will be paid for at the contract unit price per square foot, which price shall include furnishing and installing signs, fasteners, brackets and related work.

Accepted quantities of posts will be paid for at the contract unit price per each, complete in place.

No separate payment will be made for concrete used in sign post installation.

No separate payment will be made for removal of existing signs, posts and accessories and for replacement or salvaging unless otherwise specified.

No separate payment will be made for relocation of existing signs, posts and accessories.

Payment will be made under:

Pay Item	Pay Unit
Traffic Signs	SF
Sign Post (Type, Size, Length)	EA
Object Marker	EA

DIVISION 900 - MISCELLANEOUS CONSTRUCTION

SECTION 903
PIPE UNDERDRAINS

903.01 SCOPE OF WORK

The work included in this section of the specifications shall consist of furnishing and installing pipe underdrains.

903.02 MATERIALS

A. PIPE. Pipe shall be perforated "Heavy Duty" corrugated polyethylene tubing conforming to AASHTO M 252. Pipe fittings and appurtenances shall be of the same material and shall be designed for the tubing furnished.

B. FILTER MATERIAL. Filter material shall be a gravel or crushed stone and shall consist of hard, durable particles or fragments, free from objectionable, injurious or deleterious matter. The aggregate shall be free from an excess of flat, elongated, soft of disintegrated pieces, dirt, or other objectionable matter. The material furnished shall not contain more than ten (10) percent by weight of shale, slate and other deleterious matter. Aggregate shall be graded as follows:

NOMINAL SIZE	PERCENT PASSING
1 Inch	100%
3/4 Inch	90-100%
No. 10	3% Maximum

C. FABRIC. Fabric shall be a nonwoven polypropylene drainage filter fabric conforming to the following minimum requirements and test methods:

Nominal Weight (ASTM D 1910)	4.0 oz/sq. yd.
Grab Tensile Strength (ASTM D 1682)	120 lb.
Water Permeability, K	2 x 10 CM/SEC

Fabric shall be non-biodegradable and shall be resistant to soil acids and alkalies.

Fabric shall be similar and equal to Supac 5-P manufactured by Phillips Fibers Corporation, Mirafi 140 N manufactured by Celanese Corporation, or Typar 3401 manufactured by DuPont Company.

Fabric shall be protected from direct exposure to the sun during storage.

903.03 CONSTRUCTION METHODS

Trenches for underdrains shall be excavated to the dimensions and grades shown on the plans unless otherwise directed by the Engineer. Underdrains shall be installed and has cured sufficiently as determined by the Engineer. The Contractor shall be responsible for damage to curb and gutter and other completed work resulting from installation of the underdrains. Trench excavation shall not advance more than one hundred fifty (150) feet ahead of the completed underdrain. Where rock is encountered within the limits of the underdrain, the trench shall be excavated into the rock a minimum of six (6) inches. Following excavation of the trench, the fabric shall be placed in the trench and a bed of filter material approximately two inches thick placed in the bottom of the trench. The pipe shall then be placed to the established line and grade. Pipe shall be laid with the

perforations at the lower quarter points of the section. Jointing of pipe and closure of upstream ends shall be made with the specified couplings and end caps. The downstream end of the pipe shall be connected to the drainage structures by embedding a sleeved connector in the structure wall or by grouting the pipe. Prior to backfilling, the pipe shall be approved by the Engineer.

The trench shall be backfilled with filter material to the specified depth. Care shall be taken to avoid damage or displacement of the pipe. Fabric shall be folded into place and lapped as shown on the plans. Excess fabric shall be trimmed and removed.

Backfilling of the underdrain shall be completed by placing of soil above the fabric. Backfill material and compaction shall be as specified in other sections of these specifications.

903.04 MEASUREMENT AND PAYMENT

The measurement and payment of the work included in this section of the specifications shall be at the unit price listed in the Proposal for "Pipe Underdrains". Payment at the unit price per linear foot for "Pipe Underdrains" of the size actually furnished under this item in the Proposal shall be considered full compensation for all equipment, tools, material, labor, supplies and incidentals necessary for the completed pipe underdrains including trenching and backfilling, perforated pipe, filter material, fabric, earth backfill and other items necessary for the completed construction of the work.

Rock excavation will be considered incidental to construction of the pipe underdrains and no separate payment will be made for rock excavation.

No separate payment will be made for connection of underdrain pipe to storm drain structures, headwalls or other outlet structures.

Portland Cement Concrete Base used for Type “C” Underdrains will be considered incidental to the construction of the pipe underdrains and no separate payment will be made.

Payment will be made under:

Pay Item	Pay Unit
4” Pipe Underdrain (Type A & B)	LF
4” Pipe Underdrain (Type C)	LF

SECTION 904
RIPRAP

904.01 DESCRIPTION

This work shall consist of furnishing and placing riprap protection in accordance with these specifications and as shown on the plans or directed by the Engineer.

904.02 MATERIALS

A. STONE. Stone for riprap shall be sandstone or limestone and shall be hard, sound and durable. The stones shall consist of field stone, quarry stone or crushed stone approximately rectangular in section. Tests for weight and absorption will be determined in accordance with ASTM C 97, "Tests for Absorption and Bulk Specific Gravity of Natural Building Stone". The minimum weight shall be 140 pounds per solid cubic foot and the maximum absorption shall be 6 percent.

(1) TYPE I RIPRAP. Stones shall have an average size of 30 to 50 pounds with not more than 20 percent weighing less than 20 pounds. Maximum size of stone shall be 200 pounds.

(2) TYPE II RIPRAP. Stone size shall conform to the following gradation:

Lighter By Weight	Weight
100%	133-53 Lbs.
50%	39-27 Lbs.
15%	20- 8 Lbs.

Dirt or fines less than one-half inch shall not exceed five percent by weight.

B. FILTER FABRIC. The filter fabric shall be a woven or unwoven synthetic fiber geotextile conforming to the requirements of AASHTO M 288. Filter fabric shall be similar to Mirafi 140 N or Dupont Typar Style 3601, or approved equal.

C. CONCRETE. Concrete for grouted riprap shall be Class "B" (2,500 psi) in accordance with Section 401 "Concrete General."

904.03 CONSTRUCTION REQUIREMENTS

Prior to placing filter fabric and riprap, the areas to be protected shall be shaped as shown on the plans.

A. FILTER FABRIC. Filter fabric shall be placed directly on the prepared surface. Fabric sections may be placed vertically or horizontally on the slope. Adjacent fabric sections shall be joined by overlapping a minimum of 2 feet at the edges and pinning the overlapped strip with U-shaped wire pins or similar fasteners. Fasteners shall be inserted through both strips of overlapped fabric at increments approximately 4 feet along the overlap. Additional pins shall be installed as necessary to prevent displacement of the fabric.

Fabric shall be overlapped in the direction of water flow. The fabric shall be turned down and buried approximately 12 inches at the exterior limits.

No construction equipment will be permitted directly on the fabric.

B. RIPRAP. The riprap shall be placed in one layer of the thickness and at the location shown on the plans and as directed by the Engineer. The larger stones shall be well distributed and the finished riprap shall be free of objectionable pockets of small stones. Riprap may be placed by dumping or by machine provided proper distribution of material is achieved. Hand placing may be required, but only to the extent necessary to secure the results specified. Placing riprap by dumping into chutes or other methods likely to cause segregation will not be permitted.

Riprap stone shall not be deposited in a manner that will cause damage to the filter fabric. Any damage to fabric during placement of riprap shall be corrected by the Contractor at no cost to the Owner. Damaged fabric shall be repaired or replaced as directed by the Engineer.

C. GROUTED RIPRAP. Filter fabric and riprap shall be placed as described above in subsections 904.03 A. and B. The surfaces of the riprap shall be thoroughly wetted and cleaned of any adhering sediment or deleterious material prior to placement of concrete. Concrete shall be placed from the bottom to the top of the riprap and shall be of sufficient quantity to fill all voids between the stones. All voids shall be filled with concrete from the subgrade to the top of the stones. The surface of the riprap shall be covered with approximately one inch of concrete.

904.04 MEASUREMENT AND PAYMENT

Riprap and grouted riprap will be measured by the cubic yard or by the ton. When measured by the cubic yard, the volume to be included will be the product of the thickness multiplied by the area as shown on the plans or authorized by the Engineer. Filter fabric will be measured by the square yard; laps and turned down edges will not be measured. Concrete will not be included in the cubic yard or tonnage measurement for grouted riprap.

Payment for riprap and/or grouted riprap by the cubic yard or ton, as provided in the bid form, shall be full compensation for furnishing and placing riprap, concrete (for grouted riprap only), preparation of subgrade, and related work. No separate payment will be made for toe trenches, backfill or excess thickness of riprap.

Payment for filter fabric at the unit price per square yard shall be full compensation for furnishing and installing fabric and fasteners and for furnishing and installing fabric and fasteners and for excavation and backfill related to fabric placement.

Payment will be made under:

Pay Item	Pay Unit
Riprap Type I	CY or TN
Riprap Type II	CY or TN
Filter Fabric for Riprap	SY

SECTION 905
GUARD RAIL

905.01 DESCRIPTION

This work shall consist of furnishing and installing guard rail in accordance with these specifications and as shown on the plans or directed by the Engineer.

905.02 MATERIALS

All materials used in the construction of guard rails shall conform to the following requirements:

A. POSTS. The Contractor has the option of selecting either steel, wood, or concrete posts and spacer blocks. Whichever type of material is selected, however, must be used for the entire project except where otherwise noted on the plans or specified within these specifications.

Wood posts shall be of the dimensions shown on the plans and shall be treated Southern Pine or Douglas Fir. The wood posts and spacer blocks shall be of No.1 Dense SR and shall be free from knots or other defects which may materially impair their strength. The wood shall be pressure treated with Creosote or five (5) percent Pentachlorophenol by a standard empty cell or full cell process in accordance with AWPA practice to retain not less than eight (8) pounds per cubic foot of wood. The wood preservatives and pressure treatment processes shall conform to the applicable requirements of AASHTO M-133.

Concrete posts shall be of reinforced concrete and shall have dimensions as shown on the plans. Concrete and reinforcing steel shall conform to the requirements of Section 401 of these specifications with the concrete having the minimum strength equal to Class A concrete.

Steel posts and spacer blocks shall consist of structural shapes of the section and dimensions shown on the plans. The steel shall conform to the requirements of ASTM A36. Posts and spacer blocks shall be galvanized in accordance with ASTM A 123.

Terminal anchor posts shall consist of structural shapes as shown on the plans. Concrete for the anchor shall conform to the requirements of Section 401 “Concrete”and shall be Class A concrete.

B. GUARD RAIL. Steel guard rails shall conform to the requirements of AASHTO M180, Class A, Type I. The guard rails shall be straight sections or curve sections as shown on the plans. End sections shall be of the same class and type material used for the beams. Bolts, nuts and washers shall be galvanized and shall conform to the requirements of AASHTO M180.

905.03 CONSTRUCTION REQUIREMENTS

The alignment and location of the guard rails shall be as shown on the plans or as directed by the Engineer.

A. SETTING POSTS. The posts shall be spaced as shown on the plans, set plumb, and with the front faces at a uniform distance from the roadway edge. The posts shall be set to the depth shown on the plans or as directed by the Engineer and shall be thoroughly tamped into place. Backfill material shall be approved and placed in layers not to exceed six (6) inches in depth. The tamping shall be done in such a manner as to not shift the posts from the correct alignment. Steel posts may be driven by mechanical means. The manner of driving shall

be such as to avoid damage to the posts and any posts damaged in the driving shall be removed and replaced. Any galvanized surfaces which are damaged shall be repaired by applying two coats of an approved zinc rich paint.

B. GUARD RAIL. Guard rail beams shall be erected in a manner resulting in a smooth, continuous installation. The guard rail beams shall be connected to the posts using the specified fasteners. The fittings shall be secured to the posts in a workmanlike manner providing for a uniform alignment. All laps shall be made in the direction of traffic.

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 with two coats of an approved zinc rich paint.

905.04 MEASUREMENT AND PAYMENT

Guard rail will be measured by the linear foot from center of end posts or to center of connection to masonry or steel structures. The measurement shall be made horizontally along the face of the guard rail beam.

Terminal anchor posts will be measured by the unit.

Payment for guard rail at the unit price per linear foot shall be full compensation for furnishing and installing rail, posts, accessories and excavation, backfill and related work.

Payment for terminal anchor posts at the unit price per each shall be full compensation for furnishing and installing terminal anchor posts, accessories, concrete and related work.

No separate payment will be made for rock excavation required for setting posts or terminal anchors.

Payment will be made under:

Pay Item	Pay Unit
Guard Rail	LF
Terminal Anchor Posts	EA

SECTION 906
HANDRAIL

906.01 DESCRIPTION

This item shall include furnishing and installing handrails including anchorages and appurtenances.

906.02 MATERIALS

Steel railing materials shall be welded or seamless steel pipe conforming to the requirements of ASTM A 120, structural steel conforming to ASTM A 36, or tubular sections of hot rolled mild steel conforming to ASTM A 501. Minimum wall thickness shall be 10 gauge. All steel railings shall be galvanized in accordance with ASTM A 123.

The base metal for aluminum railing shall be ASA alloy designation 6063-T6. Pipe and tubing shall be extruded conforming to the requirements of ASTM B 429, plates and sheets shall be rolled conforming to ASTM B 209, and rods, bars or shapes shall be extruded conforming to ASTM B 221.

Welding shall conform to the requirements of the AWS Structural Welding Code for steel and to the requirements of the "Specifications for Aluminum Structures" of the Aluminum Association, for aluminum alloys. All exposed welds shall be ground flush with adjacent surfaces.

Shop drawings showing details and dimensions of railings shall be submitted for approval.

906.03 CONSTRUCTION REQUIREMENTS

Handrail of the size and type shown shall be constructed in accordance with details shown on the plans and in conformance with the requirements herein. It shall be constructed to the alignment and grade designated on the plans. Shop fabricated railing shall be of such uniformity as to insure good joints and continuous lines after erection. Any appreciable amount of cutting, bending or filling required on erection to produce a reasonable fit shall be cause for rejection of the rail. Unless otherwise shown on the plans, rail posts shall be erected plumb, with the top rails parallel to the grade indicated on the plans or to the surface of the structure on which the rail is mounted.

The method of mounting or attachment shall be in accordance with the detail shown on the plans or the approved shop drawings. At points of connection to concrete or steel, aluminum members shall be separated by a rubber pad, 1/8 inch minimum thickness, unless otherwise specified.

Galvanized handrail on which the galvanizing has become scratched or otherwise damaged shall be repaired by painting the damaged areas with zinc oxide paint.

906.04 MEASUREMENT AND PAYMENT

The various types of handrail will be measured by the linear foot from end to end along the face of the railing.

The price paid per linear foot for railing in place shall include full compensation for furnishing all labor, materials, tools and equipment and performing all work involved in constructing the handrail complete in place, as shown on the plans and specified herein.

Payment will be made under:

Pay Item	Pay Unit
Handrail – Galvanized Steel	LF
Handrail – Aluminum	LF

SECTION 907
FENCES AND GATES

907.01 DESCRIPTION

This work shall consist of furnishing and installing wire fence, chain-link fence, wood fence, and gates in accordance with the plans and these specifications and in conformity with the lines, grades and alignment shown on the plans or as directed. It shall also include any clearing required, all excavation, backfilling, concrete foundations and gate adjustments for operation to the satisfaction of the Engineer.

907.02 MATERIALS

Fence materials shall be new and shall be the product of one manufacturer.

A. CHAIN LINK FENCE

(1) Fabric. Material for chain-link fabric shall be certified to meet the requirements of AASHTO M181, Type I thru IV. Type I fabric (galvanized steel) shall be Class D (minimum coating of 2.0 oz/sf) for commercial and industrial fences and Class C (minimum 1.2 oz/sf) for residential fences. Type IV fabric shall be Class B, PVC coated, thermally fused and adhered to a primer that is thermally cured onto galvanized core wire. Color of Type IV fabric to be selected by Engineer from manufacturer's standard colors.

Commercial and industrial fence fabric shall be 9 gage, in 2-inch mesh. Residential fence fabric shall be 11 ½ gage minimum, in 2 ¼ inch mesh. For Type I, II, and III fabric, gage of wire specified is the finished wire diameter. For Type IV fabric, gage of wire specified is for the metallic-coated core wire.

Fabric less than 6 feet high shall be knuckled at both selvages. Fabric 6 feet or higher shall be knuckled at one selvage and twisted at the other, and installed at the direction of the Engineer.

Each roll of fabric shall carry a tag showing the kind of base metal, the kind of coating, the gage of wire and the name of the manufacturer.

(2) Wire. Wire fabric ties, wire ties, and tension wire for use in conjunction with a given type of fabric shall be of the same material identified with the fabric type. The tension wire shall be 7 gage for commercial, and 9 gage for residential, coiled spring wire coated similarly to the respective wire fabric being used. Wire fabric ties shall be hog rings, aluminum wire, or 12 gage galvanized steel wire or 9 gage aluminum wire. Barbed wire shall be 2-strand 12 ½ gage zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3 (AASHTO M280).

(3) Steel Posts, Rails, and Braces. Posts, rails, and braces furnished for use in conjunction with galvanized steel fabric shall be of zinc-coated steel or aluminum-coated steel pipe; those furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy; and those furnished for use in conjunction with PVC coated fabric shall be PVC coated. Posts, rails, and braces shall comply with AASHTO M181. Fence posts and rails shall consist of either galvanized steel or aluminum alloy. Galvanized steel pipes shall be standard weight Schedule 40 and shall be provided in the nominal sizes and weight per foot listed in Table 1 of ASTM F1083 and as designated on the Standard Drawings. Aluminum alloy pipes shall be alloy 6063-T6 Schedule 40, shall conform to the requirements of ASTM B 429, and shall be

provided in the nominal sizes listed on the Standard Drawings.

(4) Hardware and Fittings. Hardware and fittings shall conform to ASTM F626. Any miscellaneous hardware or fittings not listed shall be galvanized in accordance with ASTM A123 or A153 (AASHTO M111 or M232).

Barbed wire support arms installed on top of security fencing shall withstand a load of 250 pounds applied vertically to the outermost end of the arm. Supporting arms may either be attached to posts or integral with post top weather cap.

(5) Gates. Chain-link gate frames shall consist of galvanized steel pipe, aluminum-coated steel pipe, or aluminum pipe and conform to the specifications for the fence fabric and pipe furnished in conjunction with the gate. Frames may either be fastened at the corners by clamps and braces or welded. If steel is used the entire weld shall be galvanized. For double gates, gate stops shall be provided, set in concrete, and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.

B. WIRE FENCE

(1) Wire. Woven wire farm fence shall be AASHTO M279 design number 1047-6-11, Grade 60. Smooth line wire shall be 9 gage. Both woven wire and smooth line wire shall conform to ASTM A116, Class 3 galvanizing (AASHTO M279).

Barbed wire shall be 12-1/2 gage and shall conform to ASTM A121, Class 1 (AASHTO M280) galvanizing. As an alternate to the barbed wire specified, the wire may consist of two strands of high tensile wire, each having the same galvanizing and breaking strength as Class 3, 12-1/2 gage wire, and conforming to the requirements of ASTM A121 (AASHTO M280) for a four-point barb.

Gage of the high tensile barbed wire shall be as follows:

Strand wire gage	15-1/2
Barb wire gage	17

Staples used to attach the wire fencing to wood posts shall be galvanized 9 gage, 1½ inches in length. Wire ties shall be a minimum No. 11 gage galvanized wire. Wire stays shall be spiral twist-on type of minimum No. 10 gage galvanized smooth wire.

(2) Posts. Wood posts and braces shall be Southern Pine or Douglas Fir species and shall be treated by a standard empty cell or full cell process in accordance with American Wood Preservers Association (AWPA) practice using pentachlorophenol, or chromated copper arsenate and retaining a minimum of 0.4 pounds per cubic foot of wood. Posts shall be peeled, sound and straight-grained and shall be free from cracks, splits and decay. Posts shall be round and the diameter shall not be less than the diameter shown on the plans.

Steel line posts shall be studded "T" post weighing 1.33 pounds per lineal foot plus or minus five (5) percent, excluding anchor plate, and shall conform to the requirements of AASHTO M281. The steel posts shall be shop painted with a minimum of one coat of rust inhibiting primer and a finish coat of weather resistant paint except where galvanized posts are specified. Tubular steel posts shall be galvanized and shall conform to AASHTO M181.

(3) Gates. Wire fence gates shall be a commercial type five panel gate constructed of

galvanized steel or aluminum. The horizontal panels shall be welded or riveted to the vertical and diagonal sections to provide a sag proof gate. The hinges supplied shall be either a bolt or lag screw type. The latch shall be of such design that a padlock may be used for locking. Hinges and latches shall be galvanized.

C. WOOD FENCE. Wood fence shall be constructed with treated wood boards mounted on wood posts utilizing a selected grade of materials. Wood posts and braces shall be Southern Pine or Douglas Fir species and shall be treated by a standard empty cell or full cell process in accordance with American Wood Preservers Association (AWPA) practice using pentachlorophenol, or chromated copper arsenate and retaining a minimum of 0.4 pounds per cubic foot of wood for posts and 0.025 pounds per cubic foot for rails and pickets. Posts shall be peeled, sound and straight-grained and shall be free from cracks, splits and decay.

Wood pickets shall be SAS treated pine - No. 2 grade, 1 inch x 6 inches x 6 feet. Stringers shall be 2 inches x 4 inches x 8 feet, No.2 treated pine. For wood fencing installed to replace existing wood fencing, the post, picket and stringer size shall match the existing fence.

D. CONCRETE. Concrete for fence installation shall be Class "B" 2500 psi and shall conform to the requirements of Section 401 "Concrete."

E. SALVAGED MATERIALS. When reconstruction of fence is called for in the plans, materials to be used in the reconstructed fence shall be the materials salvaged from the existing installation where possible. Materials that are not in a condition to be moved or which are damaged during salvage operations shall be replaced by serviceable material of the same type and size of the material removed. All replacement material shall be equal to or better than the existing fence and shall be satisfactory to the Engineer.

907.03 SUBMITTALS

The following are required to be submitted to the Engineer for approval at the Preconstruction Conference:

A. FENCE MATERIALS. Contractor shall submit a copy of the proposed fence manufacturer's material product data for chain link and wire fences, including posts, rails, fabric, hardware, fittings, gates and miscellaneous materials.

B. CERTIFICATIONS. Contractor shall submit a copy of the manufacturer's certification that all materials supplied meets the requirements of the specifications.

907.04 CONSTRUCTION

A. GENERAL. The fence shall be constructed in accordance with the plans and specifications herein. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail.

The Contractor shall be responsible for maintaining accurate position and alignment of the fence. The Contractor shall preserve and protect all survey and right-of-way markers.

The Contractor shall schedule and arrange all work to maintain and protect livestock, pets, and children on adjoining property.

The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities shall be graded so that the fence will present a uniform appearance while conforming to the general contour of the ground. The fence line shall be cleared to a minimum width of 2

feet on each side of the centerline of the fence. This clearing shall consist of removal of all stumps, brush, rocks, trees, or other obstructions which will interfere with proper construction of the fence. Clearing shall be performed as specified in Section 202 of these specifications.

The connection or bracing of any part of the fence to trees will not be permitted. The new fence shall be permanently tied to the terminals of the existing fences whenever required by the Engineer.

During post installation, when solid rock is encountered with an overburden of loose rock or soil, the posts shall be set to the required depth for soil unless the penetration into solid rock exceeds 10 inches for line posts and 16 inches for end, corner, gate and pull posts. In such cases, the posts shall be set into the solid rock a minimum depth of 10 inches for line posts and 16 inches for end, corner, gate and pull posts. The hole in the rock shall have a minimum cross section dimension one inch greater than the post to be set. The posts shall be cut prior to setting to give the proper length above ground surface. The hole shall be filled with Class "B" concrete or a grout consisting of one part Portland cement and three parts concrete sand.

Where the new fence joins an existing fence, the two shall be attached in a satisfactory manner, with end posts being set as directed. Where the proposed fence intersects an existing fence, the end post shall be set for the proposed fence clear of the existing fence line. The existing fence shall be connected to the end post. When the point of intersection falls more than 2 feet from a post on the fence, a line post shall be set at the intersection.

B. CHAIN LINK FENCE. All posts shall be set in concrete as shown on the plans, plumb and true to line and grade. The concrete shall be thoroughly tamped around the posts. The posts shall be equally spaced in the line of fence not to exceed the spacing shown on the plans. Concrete in post footings shall be 3 days old before stretching and securing fabric to posts, bracing or hanging gates.

Top rails, when required, shall pass through post caps and shall be securely fastened to end, brace, pull and corner posts. Joints in top rail shall be made with expansion sleeve couplings, to provide a substantial connection and allow for expansion and contraction of the rail.

Before the fence fabric is placed, the tension wire shall be placed at the proper location, stretched taut, securely anchored to each end, corner or intermediate braced post and satisfactorily fastened to each line post.

The fence fabric shall be attached to the face of the post as noted on the plans or directed by the Engineer, except on curves, where fabric shall be placed on the outside of the curve. Leave approximately 2 inches between finish grade and bottom of fabric, unless otherwise indicated. The end of the fabric shall be attached to the posts by means of a stretcher bar threaded through the end loops of the fabric and secured to the posts with clamps and bolts. The fabric shall be stretched to remove all slack with approved stretching equipment. The stretched fabric shall be secured to line posts, top rail, braces and tension wire with specified fabric fasteners so that fabric remains in tension after pulling force is released. Fabric fasteners shall be placed on line posts at not greater than 14 inches centers and on top rail, braces and tension wire at not greater than 24 inches centers. Stretching operations shall be repeated at approximately every 100 feet for each run of fence. The use of trucks, tractors, and similar equipment will not be permitted in stretching operations, except as anchors.

Splicing of the fabric shall be done by interweaving a wire picket through each end loop

of each piece of fabric in a manner that will neatly and securely fasten the lengths of fabric together.

Gates of the length and type shown on the plans shall be constructed at the locations shown on the plans or as directed. Install gates, plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

C. WIRE FENCE. Line posts and pull assembles shall be spaced as shown on the plans. Wooden lines, corner, gate and pull posts may be driven in place provided the driving does not damage the post, or they may be set in dug holes and backfilled with earth thoroughly compacted as placed, or set in concrete. Metal corner, gate, end and pull posts shall be set in concrete. Wire shall not be stretched onto posts set in concrete for a minimum of 7 days. Posts shall be set plumb.

The Contractor has the option of using wooden or steel posts and braces unless otherwise specified, but shall use the same material on the entire project. The end, corner and pull posts shall be of the same material as the line posts for fences.

Wire tension braces for wood pull, end and corner assemblies shall consist of a 9-gage wire passed around the posts to form a double wire. The wire shall be fastened to each post and the ends fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Pull post assemblies shall be placed at intervals of not more than 330 feet in straight alignment on level or uniformly sloping ground and at sharp vertical angle points in the line.

Corner post assemblies shall be placed at all horizontal angle points of 15 degrees or more in the fence. When the distance from the corner post to the next corner of pull post is less than
165 feet, one approach span on the corner assembly may be omitted.

End post assemblies at fence ends, gates, bridge abutments, and on banks of streams shall be erected in the same manner as corner construction. Extra length posts shall be provided for crossing small streams, ditches, ravines or soft ground. Additional depth of set shall be secured in soft ground as directed.

The wire shall be attached to the face of the post as noted on the plans or directed by the Engineer, except on curves where the fencing shall be attached on the outside of the curve in order that the wire can be pulled tight against the posts. The wire shall be attached to wood line posts with staples driven at right angles to the grain and at a slight downward angle to attain the best anchorage. The staples shall not be driven tightly against the wire but shall leave just enough free space for adjustment in tension due to changes in temperature. Wire shall be attached to steel line posts with approved galvanized clips. All barbed wire and alternate line wires of woven fabric shall be fastened to the posts. Barbed wire and all line wire of woven fabric shall be fastened to end, corner and pull posts by wrapping the wire around the post and tying the wire back on itself with not less than 3 tightly wrapped twists. Splicing of barbed wire and woven wire shall be done in accordance with the plans.

Tension for stretching the barbed wire and woven wire shall be applied by use of standard wire stretchers manufactured for that purpose. The use of trucks or tractors, except as anchors, will not be permitted.

Gates shall be erected at the locations and in the manner shown on the plans or as directed by the Engineer. Install gates, plumb, level, and secure for full opening without interference. Adjust hardware for smooth operation and lubricate where necessary.

D. WOOD FENCE. Line posts shall be spaced 8 feet maximum on center. Posts shall be set in dug holes and backfilled with earth thoroughly compacted as placed; or set in concrete. Gates shall not be placed onto posts set in concrete until seven days after placement of concrete. Posts shall be set plumb.

Install wooden members with galvanized ringshank nails. Use minimum of 4 per picket (#16 penny) and 4 per stringers (#16 penny). Place wooden pickets on one side with a maximum 3/8" gap.

Gates shall be erected at the locations and in the manner shown on the plans or as directed by the Engineer. Install gates, plumb, level, and secure for full opening without interference. Adjust hardware for smooth operation and lubricate where necessary.

E. REMOVAL AND RECONSTRUCTION OF FENCES. Existing chain link, wire, and wood fencing shall be removed and reconstructed with new materials. The fence shall be reconstructed in a workmanlike manner to the line shown on the plans or established by the Engineer. Reconstruction of the fence shall conform to the requirements for new fence as specified above and shall provide a fence equal to or better than the original.

Removed chain link fencing may be used by the Contractor as temporary fencing.

F. TEMPORARY FENCING. Temporary fencing and gates shall be installed at locations where existing fences and gates must be removed to complete the work shown on the plans. They shall provide the same degree of security from intrusion and the same degree of protection for pets as the existing fence and gates.

Temporary fencing and gates shall be installed prior to removal of the existing fence and gates, and they shall consist of chain link of at least the same height as the existing fence. Temporary gates shall be installed in locations closely approximating the locations of existing gates. Temporary fencing and gates shall be maintained for the duration of the project, and shall only be removed after new permanent fencing and gates have been installed.

907.05 MEASUREMENT AND PAYMENT

Fence will be measured by the linear foot in place along the midpoint in height of the fence from outside to outside of the end posts. The length of gates will be excluded from this measurement. Gates will be measured by the unit.

Fences and gates completed and accepted under this item and measured as provided above will be paid for at the contract unit price bid per linear foot of the fence type and height specified and per each gate of the type and dimensions specified.

The contract unit prices mentioned above shall be full compensation for clearing, grading, setting posts, concrete, erecting fence; for excavation and backfill; for furnishing materials; and for all equipment, tools, labor and incidentals necessary to complete the work.

No separate payment will be made for rock excavation required for fence construction or for termination or connection of existing fences.

No separate payment will be made for stream or channel crossings unless otherwise specified. These structures will be included in the measurement and payment for fence as stated above.

Removal and reconstruction of fences and gates will be paid for at the contract unit price bid per linear foot of the type and height specified for fences and per each of the type and dimensions specified for gates. Measurement for payment will be made along the midpoint in height of the new fence from outside to outside of the end posts. The length of gates will be excluded from this measurement. The contract unit prices mentioned shall be full compensation for removal and disposal of existing fences and gates; for construction of new fences and gates; for clearing, grading, excavation and backfill; for furnishing materials; and for all labor, equipment, tools and incidentals necessary to complete the work. No separate payment will be made for termination or connection of existing fences.

All clearing, grading, excavation and backfill, materials, labor, equipment, tools, and incidentals necessary for the construction, maintenance, and removal and disposal of temporary fences and gates shall be incidental to the other fencing items in the contract and no separate payment shall be made.

Payment will be made under:

Pay Item	Pay Unit
_' Chain Link Fence	LF
_' PVC Coated Chain Link Fence	LF
_' Wood Fence	LF
_' Woven Wire Fence	LF
Barbed Wire Fence ( ) Strand	LF
Barbless Wire Fence ( ) Strand	LF
Gates - Chain Link ( )	EA
Gates - PVC Coated Chain Link ( )	EA
Gates - Wood ( )	EA
Gates - Galvanized Steel (or Aluminum)	EA
Remove and Reconstruct Fence (Type & Size)	LF
Remove and Reconstruct Gate (Type & Size)	EA

SECTION 908
MONUMENTS

908.01 DESCRIPTION

This work shall consist of furnishing and placing project, right-of-way, or survey monuments or markers in accordance with the specifications and as shown on the plans or directed by the Engineer.

908.02 MATERIALS

Concrete shall meet the requirements of Section 401 "Concrete" and shall be 3000 psi, air entrained. Reinforcing steel shall met the requirements specified in Section 401.

Bronze tablets shall be cast bronze. The surface of bronze tablets shall be finished smooth and shop imprinted letters shall be depressed a minimum of 1/16 inch. Special survey markers shall be of the size and type shown on the plans or specified in the Special Conditions.

908.03 CONSTRUCTION REQUIREMENTS

Concrete markers and monuments shall be reinforced concrete of the dimensions shown on the plans. Reinforcing steel, bronze tablets and templates for figures or letters imprinted in the concrete shall be accurately positioned and firmly held in place while the post is being cast.

All right angles shall be chamfered on a 1/2 inch radius. The tops of markers shall be finished smooth and shaped to drain. The exposed portion of markers shall be given a rubbed finish.

Precast monuments or markers and special survey markers shall be installed in accordance with the details shown on the plans.

Monuments and markers shall be accurately located within the Engineer's staked reference points and the true position shall be held during placing operations. Posts shall be set plumb, with the designated length of posts above ground line and shall be firmly tamped into place.

908.04 PROTECTION

Reference markers shall be protected from damage during construction operations and any markers moved or damaged by the Contractor's operations shall be replaced by the Contract at his expense.

908.05 MEASUREMENT AND PAYMENT

Monuments and markers will be measured by the unit.

The accepted quantities of reference markers will be paid for at the contract unit price per each, complete in place.

Payment will be made under:

Pay Item	Pay Unit
Project Markers	EA
Right-of-Way Markers	EA
Survey Markers	EA