





# REQUEST FOR BID FOR RALEIGH MILLINGTON SEWER IMPROVEMENTS

Bid No. 421810.71.0419

May 2, 2025



# City of Memphis, Tennessee

Black & Veatch and Overland Contracting Inc. (OCI), a subsidiary of Black & Veatch, are the Program Manager and Construction Manager respectively, for the SARP10 Program for the City of Memphis.

Overland Contracting Inc. 845 Crossover Lane, Suite 120, Memphis, TN 38117

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# 00170 - Request for Bid

#### 00170.1 Introduction

Sealed bids will be received at the Office of the City of Memphis Environmental Administration, Room 620, City Hall, 125 N. Main, Memphis, TN 38103, until **2:00 p.m. local time, June 12, 2025** furnishing the City of Memphis with the following:

FOR THE DIVISION OF: PUBLIC WORKS FOR THE CONSTRUCTION OF: SARP10 Program **Raleigh Millington Sewer Improvements** 

The Sealed Bid envelope must be labeled with the project name, bidder's name, license bidder number, license expiration date, license classification. The Sealed Bid envelope must contain one (1) hardcopy of the bid and one (1) electronic flash drive copy of the bid.

Sealed Bids sent through the mail or other such delivery service shall be sent in such a manner so as to allow the opening of the "Mailing Container" and still have intact the sealed Bid. On the Mailing Container the sender shall state the words that a "**SEALED RESPONSE IS ENCLOSED**" and the Bid number.

Subcontractors intending to bid on this project must follow the instructions for Registration as stated in the Advertisement Legal Notice Request for Bid No. **421810.71.0419** (dated May 2, 2025). Registration information must be submitted by **May 29, 2025**.

#### 00170.2 Program Overview

The Program consists of the management of the capital program needed to bring the City's wastewater and sewer system into compliance with federal and state regulations per the City of Memphis Wastewater Collection and Transmission System (WCTS) Condition Assessment and Rehabilitation Program Consent Decree signed on September 21, 2012, including the procurement of studies, design and construction services associated with the City of Memphis SARP10 Program.

#### 00170.3 Scope of Work

The scope of work for this project generally includes the installation of a new sewer pump station, ±9,300 LF of 12" force main, abandonment of existing gravity sewer manholes, erosion control, traffic control, bypass pumping, and site prep & restoration. There is a directional bore under Raleigh Millington near the Shelby County Fire Station. The bid also includes two alternates for sewer improvements on the Charles Baker Airport property. Bidding on each alternate is mandatory for this project.

## 00170.4 Bid Guarantee Requirements

Guarantee Requirements:

- a) Bidder will not withdraw bid for one hundred eighty (180) calendar days after opening of bids without Purchaser's written consent.
- b) If bid is accepted, bidder will enter into formal Subcontract with Purchaser, within five (5) calendar days after receipt of Subcontract documents for execution.
- c) If bid is accepted, bidder will execute required 100% Performance/Payment Bond in accordance with Article 00571.4 and will obtain required insurance coverage in accordance with Article 00572.21 within ten (10) calendar days after receipt of Subcontract.
- d) All bids will require a bidder's bond or certified or cashier check made payable to the Purchaser on a solvent bank in the amount of 5% of the bid. Said instrument to remain in effect and will be returned only after the Subcontract has been fully executed and secured. Additionally, the successful bidder shall execute a performance bond in an amount equal to 100% of the Subcontract sum as security for the faithful performance of the Subcontract and for the payment of labor and material furnished and incorporated into the Work. The only acceptable form of instrument for this bid bond is bound herein, Article 00672.7.



Bidder shall be liable to the Purchaser for full amount of proposal guarantee as representing damage to the Purchaser on account of default of bidder if:

- a) Bid is withdrawn within one hundred eighty (180) calendar days after receipt of bids without approval by Purchaser.
- b) Bidder fails to enter into contract with Purchaser and execute required Performance Bond and provide required insurance coverage within ten (10) calendar days subsequent to notice of award of the Subcontract.

#### Firms desiring to submit a Bid should carefully review these instructions. Compliance with all requirements will be solely the responsibility of the Respondent.

## 00170.5 Request for Bid Definitions

Terms used in this Request for Bid documents are defined and have the meanings assigned to them as follows. The term "OCI", "Purchaser" or "Program Manager" means Overland Contracting Inc. The term "Respondent", "Firm", "Company", "Subcontractor" or "Bidder" means one who submits a Response for the purpose stated in this Solicitation Request for Bid documents. The terms "BID", "Response" or "Respondent's Response" mean all submittal documents provided by the Respondent as required by this Request for Bid. The terms "Request for Bid" or "Bid Documents" mean the documents included in this Request for Bid.

Every effort has been made to use industry-accepted terminology in this Request for Bid. Any statement in this document, which uses words such as "must", "shall", "should", "provide for" or "have/provide the capability of/for", means that compliance with the intent of the statement is mandatory and that failure by the Respondent to satisfy that intent may be cause for the Response to be rejected.

## 00170.6 Minority / Women Business Enterprise (M/WBE) Requirements

This section shall set forth the respondent's M/WBE Participation Plan that must be submitted and include: (1) the level and dollar amount of participation your firm anticipates to achieve in the performance of the Subcontract resulting from this RFB; (2) the type of Work to be performed by the M/WBE firms participating; and (3) the names of the M/WBE firms the Respondent plans to utilize in the performance of the Subcontract resulting from this RFB.

SARP10 DBE Participation Goal: DBE minimum **15%** (Vendors from the City of Memphis EBO list only)

## 00170.7 Clarification of Bid

Purchaser reserves the right to obtain clarification of any point in a Response or to obtain additional information as necessary to properly evaluate a particular Response. Failure to respond to such request for additional information or clarification in a timely manner may result in rejection of the Response.

## 00170.8 Not Used

## 00170.9 Responsiveness

Respondents should respond to all requirements of the Bid to the maximum extent possible and are required to clearly identify any limitations.

## 00170.10 Examination of Request for Bid Documents

Before submitting a Response, each Respondent must:

- Study and carefully correlate the Respondent's observations and responses with the Bid Documents.
- Notify Purchaser of all conflicts, errors and discrepancies, if any; in the Bid Document submitted.
- Review the Loss Control Manual.



Respondents by and through the submission of their Response, agree that they shall be held responsible for having therefore familiarized themselves with the nature and extent of the requirements in the Bid Documents.

## 00170.11 Interpretations and Addenda

If any prospective Firm is in doubt as to the true meaning of any part of the Requirements for Preparing and Submitting Bid Submittal for the requested services, they may submit a written request (verbal requests will not be accepted) for an interpretation before the Last Date for Bidder Questions; as stated in 00170.16. The person submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addendum transmitted to each party receiving a set of such documents. Purchaser will not be responsible for any other explanations or interpretations of the proposed documents. Any requests not submitted within this time period will be deemed waived.

## SUBMIT ALL QUESTIONS BY E-MAIL TO:

Attn: Justin Avent justin.avent@greshamsmith.com Cc: Ginny Dorsey DorseyV@bv.com Cc: Jerry Caldwell CaldwellJ@bv.com (Poference: SAPP10 Program Paloigh Millington Source Improvements PID No. 421810 71 0410)

(Reference: SARP10 Program Raleigh Millington Sewer Improvements, BID No. 421810.71.0419)

All requests or questions should be clearly marked and must be received by Last Date for Bidder Questions, as stated in 00170.16. A response will be returned via addendum to all Firms along with the original question(s).

There shall be no communication between the Firm, their employees or subcontractors concerning this Bid to anyone within Black & Veatch, Overland Contracting, Allen & Hoshall, Allworld Project Management, Gresham Smith, Carter-Malone Group, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above except through Bently Green – Program Director or Jerry Caldwell – Project Manager. Failure to comply with this requirement will be grounds for disqualification.

# 00170.12 Modification or Withdrawal of Bid Submittals

Responses may be modified or withdrawn by an appropriate document duly executed (in the same manner that a Response must be executed) and delivered to the place where Responses are to be submitted at any time prior to the submission deadline. A request for withdrawal or a modification must be in writing and signed by an authorized person. Evidence of such authority must accompany the request for withdrawal or modification. Withdrawal of a Response will not prejudice the rights of a Responder to submit a new Response prior to the Response deadline. After expiration of the period for receiving Responses, only Purchaser may request clarifications or additional information.

## 00170.13 Rejection of Responses

To the extent permitted by applicable local, state and federal laws and regulations, Purchaser reserves the right to reject any and all Responses, to waive any and all informalities not involving price, time, or changes in the Work with the successful Respondent, and the right to disregard all non-conforming, non-responsive, unbalanced or conditional Responses. Also, Purchaser reserves the right to reject a Response, in its sole discretion, if the City of Memphis believes that it would not be in its best interest to make an award to that Respondent.

Purchaser reserves the right to reject any Response if the evidence submitted by the Responder or if the investigation of such Respondent fails to satisfy Purchaser that such Respondent is properly qualified to carry out the obligations and to complete the Work contemplated therein. All Responses will be rejected if there is reason to believe that collusion exists among Respondents. Responses will be considered



irregular and may be rejected if they show serious omissions, alterations in form, additions not called for, conditions or unauthorized alterations, or irregularities of any kind.

## 00170.14 Other Items

This Bid does not commit Purchaser to enter into a Subcontract, nor does it obligate Purchaser to pay for any costs incurred in the preparation and submission of Responses or in anticipation of a Subcontract. Costs of preparing the Bid in response to this request are solely the responsibility of the Respondent.

By responding to this solicitation, the respondent attests that no employee of Black & Veatch, Overland Contracting, Allen & Hoshall, Allworld Project Management, Gresham Smith, Carter-Malone Group, or City of Memphis employee or any such person's spouse, child, parent, brother, sister, dependent or person assuming a relationship being the substantially equivalent of the above, has an existing or pending, direct or indirect, financial interest in the respondent's business.

No Respondents to this solicitation shall discriminate against any employee or applicant for employment because of race, religion, color, sex, age, or national origin.

## 00170.15 Selection Process

Purchaser intends to select one Firm based on price and successful completion and approval of the OCI Registration process.

## 00170.16 Selection Schedule

The following schedule will be adhered to during the selection process. It is subject to change at the sole discretion of OCI.

Event	Completed By	
Advertising Date	May 2, 2025	
Pre-Bid Meeting	May 15, 2025	
Registration Information submitted per 421810.71.0419 Advertisement	May 29, 2025	
Last Date for Bidder Questions	May 29, 2025	
Issue Addendum for answers to questions	June 5, 2025	
Receive all Bids	June 12, 2025 by 2:00 pm local time	
Public Opening	June 12, 2025 immediately following receipt of bids	
Public Notice of Intent to Award	June 26, 2025	
Preconstruction Meeting with Subcontractor	July 3, 2025	
Tentative Notice to Proceed	July 3, 2025	

## 00170.17 Mandatory Pre-Bid Meeting

A mandatory pre-bid meeting will be held at 9:30 A.M (local time) at the Environmental Maintenance Office, 2865 Frayser Boulevard, Memphis, TN 38127 on May 15, 2025. Bidders are required to attend at their own cost.



# 00270 - Instructions to Bidders

#### 00270.1 Bidder's Compliance with Request for Bid

Provide the information requested and any supporting information necessary to permit a complete analysis of your bid. You acknowledge that preparation and submission of a bid will be at your sole cost and that you will treat this RFB and any resulting discussions as confidential. If you do not agree to treat this RFB and associated discussions as confidential, return the complete RFB to Purchaser and delete or destroy any copies you made.

#### 00270.2 General Bid Parameters

Provide the information requested in Section 00270 and Section 00370 in the appropriate fields of Section 00370. Complete each line of Section 00370 in its entirety and submit it with your bid in accordance with Section 00170. Do not alter Section 00370 forms in any way or deviate from the terminology used or the unit of measure indicated when completing Section 00370. Submit Section 00370 forms in their original core application software, with no embedded programming and no permissive encoding restricting access to the data provided.

#### 00270.2.1 Bidder's Contact Information

Include contact information for your representative in Article 00370.2.1. Your representative must have the appropriate expertise and authority to negotiate on behalf of your company.

#### 00270.2.2 Addenda to Request for Bid

In Article 00370.2.2, list all addenda received from Purchaser and indicate "Yes" to show your receipt of and incorporation of the listed addenda into the proposal.

#### 00270.3 Bid Pricing

You must include numerical values in the applicable fields of Table 00370.3.1. Non-numerical values, such as "included" or "not applicable," are not acceptable. Purchaser will evaluate fields left blank or filled with a zero as scope included in your bid at no cost.

#### 00270.3.1 Unit Pricing

Provide the unit prices to perform the Work in accordance with this RFB in Table 00370.3.1. A unit price is the total amount to be billed to Purchaser for a specific unit of work. Unit pricing includes all costs, overhead, profit and mark-up associated with delivering the complete unit.

## 00270.4 Supplemental Bid Information

#### 00270.4.1 Company Status

In Article 00370.4.1, indicate the type of your organization's legal entity and the state and country in which it is organized.

#### 00270.4.2 Contractor License

If you are not licensed to perform the Work, indicate "No" in Article 00370.4.2.

#### 00270.4.3 Not Used

#### 00270.4.4 Bid Validity Period

Indicate "Yes" in Article 00370.4.4 if your proposal is valid for one hundred eighty calendar days after the Proposal Due Date (the "<u>Proposal Validity Period</u>"). Purchaser may reject your proposal without prior notice if your proposal is not valid for the full Bid Validity Period.

#### 00270.4.5 Firm Non-Escalatable Pricing

Indicate "Yes" in Article 00370.4.5 if the proposal pricing is firm and not subject to escalation.



#### 00270.4.6 Taxes

Tax requirements are identified in Article 00571.6. Indicate "Included" in Article 00370.4.6 if your proposal includes the tax requirements.

#### 00270.4.7 Work at Jobsite

Identify the type of craft labor. If you plan to subcontract any of the Work, indicate "Yes" in the appropriate section of Article 00370.4.7 and complete Table 00370.4.7.

#### **00270.5 Schedule Compliance**

Indicate "Yes" in Article 00370.5 if you can meet the schedule dates included in Table 00370.5. If you indicate "No," submit an alternative summary level schedule with your proposal.

#### 00270.6 Compliance with Request for Bid

00270.6.1 Not Used

00270.6.2 Not Used

#### 00270.7 Bid Attachments

List any supplemental documents included in your bid in Article 00370.7.

#### 00270.8 Declarations

Indicate "Yes" in Article 00370.8 to confirm you have familiarized yourself with the conditions affecting the Work.

#### 00270.9 Nondiscrimination

All entities contracting with the Purchaser agree to abide by and to take affirmative action when necessary to ensure compliance with the nondiscrimination clauses set out below and agree to show proof of non-discrimination upon request and to post in conspicuous places available to all associate agents and their employees. In the event of non-compliance with nondiscrimination clauses, or with provisions of Executive Orders 11141 (age), 11246, 11375 (women), 12086 (Vietnam veterans), 11478 (federal employees), 11625 (minority business) 11701 (veterans), Title 41, Chapter 60 (handicapped) and specifically the handicapped affirmative action clause in Section 60-741.6.9 of OFCCP Rules, and any and all other federal laws prohibiting discrimination, contracts may be canceled, terminated, or suspended in whole or in part by the Purchaser.

The Bidder shall execute the specified Nondiscrimination Certificate (see Section 00672.3) agreeing that, if awarded the Subcontract, he/she shall not discriminate against any Sub-subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex, in accordance with the citations listed in the above paragraph; and shall require the execution of such a certificate for each Sub-subcontractor prior to award of any subcontract with the further requirement that each subcontractor shall include identical requirements in any lower tier subcontracts which might in turn be made. FAILURE TO EXECUTE AND SUBMIT SUCH CERTIFICATE WITH THE BID MAY CAUSE THE BID TO BE REJECTED AS NON-CONFORMING. The successful Bidder and all Sub-subcontractors under the general contract shall maintain copies of their payrolls and all subcontracts for each weekly payroll period for the life of the construction and for a period of **SEVEN (7) YEARS** after final release and payment is made by the Purchaser to the contractor.

## 00270.10 Equal Business Opportunity Program (EBO)

The Bidder must complete and return the Equal Business Opportunity Program Compliance Form included in Section 00672.4 of this RFB.



# 00370 – Commercial Bid Form (7 pages)



#### 00370 - Commercial Bid Form

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

00370.1 Bid Submitted by	Bidder Response Column
Company Name	
Mailing Address/Number, Street	
Mailing Address/State, Zip Code	
Country	
Taxpayer ID Number (or EIN)	
Bidder's Bid Date	
Bidder's Bid No.	

00070 0. Company Did Domonstant			
00370.2 General Bid Parameters			Bidder Response Column
Bidder is providing the information defined by the articles comprising Section 00270, INSTRUCTIONS TO BIDDERS, in the corresponding fields of this Section 00370, COMMERCIAL BID FORM.			O BIDDERS, in the
00370.2.1 Bidder's Contact Information			
		Bidder's Representative Name	
		Title	
		Mailing Address/Number, Street	
		Mailing Address/City	
		Mailing Address/State, Zip Code	
		Delivery Address/Number, Street	
	I	Delivery Address/State, Zip Code	
		Country	
		Email Address	
		Phone Number	()-()
		Mobile Phone Number	()-()
		Fax Number	()-()
Business Interruption Plan			
Confirm that Bidder maintains a Business Inter respond to disaster or pandemic to help minim If Yes, plan should be submitted with RFB.	rruption/Disaster Recovery Plan ize impact - <b>Yes/No</b>	that documents how Bidder will	
00370.2.2 Addenda to Request for Bid			
Bidder acknowledges receipt and inclusion of	the following Addenda to the RF	B - Yes/No	
	Addenda Number	Date Issued	Received and Incorporated

00370.3 Bid Pricing Information	Bidder Response Column
00370.3.1 Bid Prices	See Attached Pricing Table(s)
	[Bidder to List Tables Used]

00370.4 Supplemental Bid Information	Bidder Response Column
Bidder provides the following information to supplement the Bidder's bid pricing.	
00370.4.1 Company Status	
Bidder's company status is: (i.e. partnership, individual owned, joint venture, corporation, etc.)	
in State of	
in Country of	

00370.4.2 Contractor License	
Bidder certifies that it is licensed, as required, to engage in the RFB Work scope in the State/Province/Country	
the RFB Work is to be performed Yes/No	
1st License Title	
in State/Province of	
License Number	
2nd License Title	
in State/Province of	
License Number	

#### 00370.4.3 Not Used

00370.4.4 Bid Validity Duration	
Bidder's bid is valid for acceptance by the Purchaser for a period of 180 days from the bid due date Yes/No	
00370.4.5 Firm Non-Escalatable Pricing	
All of Bidder's prices herein bid are firm and are non-escalatable Yes/No	
00370.4.6 Taxes	
Bidder's prices included herein are in accordance with Article 00571.6 Taxes Yes/No	
00370.4.7 Work at Jobsite	
Bidder's source of craft labor to be utilized in the performance of the Work is -	
Open-Shop/Merit-shop/Union-shop	
If applicable, identify the local union(s) used for hiring craft labor: 1st Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
2nd Local Union Name	
Address/Number, Street	
Address/City, State, Zip Code	
Phone	
Email	
Bidder has accounted for all Jobsite existing and controlling conditions and limitations which may affect the	
Work performance and the Bidder's Bid Yes/No	
Bidder proposes that it will perform all the Work at the Jobsite with its own forces Yes/No	
Bidder has indicated proposed sub-subcontracted Work in attached Table 00370.4.7 Yes/No	
Bidder has provided proposed Small Business/Minority/Disadvantaged Entrepreneur Participation Plan with its	
bid Yes/No	

00370.5 Schedule Compliance	Bidder Response Column
Bidder agrees to meet the schedule dates indicated in the RFB documents: - Yes/No	
If No, Bidder has completed and submitted an attached alternative summary level schedule: - Yes/No	

00370.6 Compliance with Request for Bid	Bidder Response Column
NOTE: A bid based on Bidder's standard terms and conditions will not be considered.	
Bidder certifies that its bid complies with all RFB commercial and technical requirements Yes/No	

00370.7 Bid Attachments	Bidder Response Column
In addition to this Commercial Bid Form and Tables indicated herein, the Bidder's Bid contains supplemental in	formation and details attached to
this bid consisting of the following:	
(Attachment 1)	
(Attachment 2)	
(Attachment 3)	
(Attachment 4)	
(Attachment 5) (Add additional lines as needed)	

00370.8 Declarations	Bidder Response Column
The Bidder declares that it has familiarized itself with the conditions affecting the Work. The Bidder also declares that only the persons or firms interested in the bid as principal or principals are named herein; that no other persons or firms have any interest in this bid or in the Subcontract to be entered into; that this bid is made without connection with any person, company, or party likewise submitting a bid; and that it is in all respects for and in good faith, without collusion or fraud Yes/No	
If written notice of acceptance of this bid is delivered to the Bidder within "Bid Validity" days after the date set for receipt of bid, or any time thereafter before the bid validity expires, the Bidder will, within 5 days after receipt of a formal Subcontract for signature, exercise and deliver to Purchaser a signed Subcontract in the form provided by the Purchaser in accordance with the documents provided herein <b>Yes/No</b>	

**Bidder Authorized Signature:** 

\*must be signed, not typed

#### Table 00370.3.1 - Unit Price Bid Form

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.

Bid Submitted by: (Company Name)

00370.3 Bid Pricing Information

00370.3.1 Unit Pricing

Bidder proposes to complete the RFB Work based on firm, fixed, unit prices (US dollars), which prices multiplied by the final Work quantities would represent the full consideration to Bidder for its complete and satisfactory performance of the Work in compliance with all the terms and conditions of the RFB Documents. The Unit Prices in this Table include the cost of all the work which is required or implied by the RFB documents or which may be inferred therefrom, and which is customarily provided in furnishing a complete and finished work item of its kind. Further, any and all alterations, modifications, and adjustments to the work item, which is reasonably foreseeable or customarily encountered in providing and installing equipment, material, and services of the work item kind, will be performed without additional compensation.

In the event of a Purchaser-approved change in the scope of Work for which a unit price from this Table is not applicable, as determined by the Purchaser, the Subcontractor shall provide a new unit price for review and acceptance by the Purchaser. Subcontractor shall provide all information requested by the Purchaser to substantiate the value of the new unit price.

00370.3.1.1 Unit Prices Breakdown			Bidder Resp	onse Columns	
Item	Item Description	Unit of	Estimated	Unit	Extension
Number	Aillie stere Course Internet state	Measure	Quantity	Price	Price
71.0419 Raleign N	inington Sewer Improvements				
	A d = b 10 = = 4 = =		4		¢
01000-01		Lump Sum	1		\$ -
01100-02	Erosion Control	Lump Sum	1		\$ -
01551-5.02		Lump Sum	1		\$ -
02220-01	Removal Of Obstructions And Structures	Lump Sum	1		\$ -
02230-01	Clearing And Grubbing	Lump Sum	1		\$ -
02530-6.01			1		\$ -
02530-6.02		I on	500		\$-
02530-6.04.02	Pit Run Gravel Backfill	Ion	4,400		\$-
02530-6.07.15.21	21 Inch Polyvinyl Chloride (PVC) Gravity Sewer Pipe	Linear Foot	105		\$-
02530-6.07.15.04	4 Inch Polyvinyl Chloride (PVC) Gravity Sewer Pipe	Linear Foot	30		\$ -
02530-6.07.15.24	24 Inch Polyvinyl Chloride (PVC) Gravity Sewer Pipe	Linear Foot	10		\$-
02530-6.09.01.12	12 Inch Ductile Iron Force Main, Class 50	Linear Foot	306		\$ -
02530-6.09.09.12	12 Inch HDPE Dr11 Or PVC SDR 17 Force Main W/ Tracer Wire	Linear Foot	8,835		\$-
02530-6.09.09.04	4 Inch HDPE Dr11 Force Main, Connection From Fire Station	Linear Foot	18		\$-
02530-6.17.02.04	4 Inch Sewer In Bored Hole Without Liner Pipe (HDPE)	Linear Foot	98		\$-
02530-6.17.02.14	W/Tracer Wire From Fire Station	Linear Foot	298		\$-
02530-6.25.10.16	14 Inch Sewer In Bored Hole Without Liner Pipe (HDPE) w/ Tracer Wire	Linear Foot	78		\$-
02531-6.01	16 Inch Steel Casing Pipe	Each	2		\$-
02531-6.02	Standard Depth Sewer Manhole	Vertical Foot	32		\$-
02531-6.03	Extra Depth Sewer Manhole	Vertical Foot	18		\$-
02531-6.05	Sewer Manhole Drop Construction	Each	4		\$-
02531-6.05A	Special Structure - Tracer Wire Junction Box	Each	9		\$ -
02531-6.06	Special Structure - Air/Vacuum Valve With Vault	Each	2		\$ -
02531-6.09	Sewer Manhole Rim And Cover	Each	24		\$-
02531-6.10	Sewer Manhole And Structure Abandonment	Day	15		\$-
02531-6.11	Dewatering	Day	15		\$-
02531-6.13	Bypass Pumping	Lump Sum	1		\$-
02531-6.13	Pumping Station - Duncan Road	Lump Sum	1		\$-
02630-01	Pumping Station - Fire Station	Lump Sum	1		\$-
02720-01.04	Site Preparation And Restoration	Square Yard	445		\$-
02750-01.05	Graded Aggregate Base Course, 4" Thick	Square Yard	445		\$-
02820-5.01	Portland Cement Concrete Pavement, 5" Thick	Linear Foot	250		\$-
02820-5.02	Chain Link Fence (6 Foot)	Each	2		\$-
02891-03	Fence Gates	Each	26		\$ -
02920-5.01	Steel Stanchions	Per 1,000 SF	44		\$ -
02950-05	Seeding (With Mulch)	Square Foot	705		\$ -
	71.0419 Raleigh Millington Sewer Improveme	ents - Base Es	stimated Ur	nit Price Value	\$ -

Item Number	Item Description		Estimated Quantity	Unit Price	Extension Price
Alternate 1 (must	be included in bid)				
02530-6.09.08.02	2 Inch HDPE Dr11 Force Main Force Main, Connection From Airport	Linear Foot	35		\$-
02531-6.13	Pumps & Controls - Charles Baker Airport	Lump Sum	1		\$-
71.0419 Raleigh Millington Sewer Improvements - Alternate 1 Subtotal				\$-	

Alternate 2 (must be included in bid)					
02530-6.09.08.04	4 Inch HDPE Dr11 Force Main Force Main, Connection From Airport (Including Any Necessary Bores Under Driveways Or Other Obstacles)	Linear Foot	3,037		\$ -
02530-6.17.02.04	4 Inch Sewer In Bored Hole Without Liner Pipe (HDPE) W/Tracer Wire From Airport	Linear Foot	476		\$ -
02531-6.05A	Special Structure - Air/Vacuum Valve With Vault	Each	1		\$ -
71.0419 Raleigh Millington Sewer Improvements - Alternate 2 Subtotal				\$ -	

71.0419 Raleigh Millington Sewer Improvements - Alternate 1 TOTAL Estimated Unit Price Valu	ıe	\$ -
71.0419 Raleigh Millington Sewer Improvements - Alternate 2 TOTAL Estimated Unit Price Valu	le	\$ -

Source: 00370, 2012, v.1.0

#### Table 00370.4.7 - Sub-Subcontracts

Bidder should refer to Section 00270, Instructions to Bidders, when completing this Bid Form. Bidder shall complete this form entirely and return it with Bidder's Bid.							
Bid Submitted by:	(Company Name)						
00370.4.7 Sub-Subcontracts							
Bidder proposes that specific portions of the below. The value of each Sub-subcontract is	Work scope not performed by Bidder will be S indicated as an approximate percentage value	ub-Subco e of the to	ntracted to th tal monetary	e Sub-subcontractors value of the Bidder's E	indicated Bid.		
Subcontractor must obtain a safety prequalif to their arrival at the Jobsite. Refer to the "S	ication for any Sub-subcontractor that will be p ubcontracting" article within the terms and con	erforming ditions for	any portion c applicable su	f the Work at the Jobs ubmission information	site, prior		
00370.4.7.1 Sub-Subcontracted Work							
Scope of Sub-Subcontracted Work	Sub-subcontractors (Name and Address)	MBE or WBE	% of Total Work Value	Safety Information Included (Y/N)	Current EMR		
% of Work performed by Bidder.	(Bidder Company Name)		100%				
(a)							
(b)							
(c)							
(d)							
(e) (f)							
(i) (g)							
(9)							
Total Percentag	<b>je Value</b> (Must Equal 100%)	•	100%				

#### 00370.7 Schedule Compliance

00370.7.1 Construction Milestone Completion Dates and Applicable Liquidated Damages						
ltem	Milestone Description	Construction Milestone Completion Date	*LDs Apply?	Bidder Complies? (Yes/No)		
1	Substantial Completion <sup>1</sup> of Work under this Subcontract	<b>335</b> calendar days after Notice to Proceed	Yes			
2	Final Completion <sup>2</sup> of all Work under this Subcontract	<b>365</b> calendar days after Notice to Proceed	Yes			

In accordance with Subcontract Article 00574.4 Work Hours, the Work will be completed by TBD.

\*LD indicates that completion of the Work after the "Construction Milestone Completion Date" is subject to liquidated damages per applicable Articles of Section 00571.

\*Note: Subcontractor performance will directly impact future procurements for the SARP10 Program, schedule is critical and must be maintained.

<sup>1</sup> Substantial Completion is defined as the date the project is sufficiently complete, in accordance with the construction contract documents, so that the owner may use the facilities for the intended purpose.

<sup>2</sup> Final Completion is defined as: (a) the Work is complete and complies with the requirements of this Subcontract; and (b) Subcontractor has fulfilled all its obligations under this Subcontract except obligations that survive completion of the Work.

#### 00370.8 Schedule of Submittals

#### Effective Date: TBD

	Deference				Submittal Dates		der
Item	Section	Submittal Item	Cale Da	ndar Iys	Event	Due Date	Bid
00370	.8.1 Comme	rcial Submittals		r			
C01	None	Executed Subcontract in the form provided by the Purchaser	5	After	Receipt of Subcontract for Signature		
C02	00571	Payment Estimate Breakdown	10	After	Effective Date and Prior to First Payment with monthly updates		
C03	00571	Security Instruments	10	After	Effective Date		
C04	00572	Lien Waivers and Report of Disadvantaged Business Enterprise Participation Form		With	Each Invoice		
C05	00572	Final Lien Waivers from Subcontractor, Sub- subcontractors, and Sub-subcontractors' subcontractors and Report of Disadvantaged Business Enterprise Participation Form		With	Final Invoice		
C06	00571	Final Payment Invoice and Report of Disadvantaged Business Enterprise Participation Form	45	After	Issuance of the Notice Of Final Completion and Acceptance		
C07	00572	Contractor Licenses	14	Before	Mobilization Onsite		
C08	00572	Written Notice and Supporting Documentation, of all Claims	5	After	Occurrence of Event Giving Rise to the Claim		
C09	00572	Insurance Certificates for Purchaser Approval		Prior to	Mobilization		
C10	00572	Initial Issue Subcontractor's Work Execution Schedule	30	After	Effective Date		
C11	00571	Subcontractor Actual Man-hours Expended and Quantities Installed	Weekly	After	Mobilization Onsite		
C12	00575	Subcontractor's Daily Report	Daily	After	Mobilization Onsite		
C13	00575	Signed Daily Reports		Daily	After Mobilization Onsite		
C14	00575	Weekly Coordination Meeting Agenda Input	Weekly	Prior to	Weekly Coordination Meeting		
C15	00575	Subcontractor's Safety, Health and Accident Prevention Program		Prior to	Mobilization Onsite		
C16	00575	Subcontractor's Hazardous Waste Project Health and Safety Plan		Prior to	Mobilization Onsite		
C17	00575	Safety and Health Representative Resume		Prior to	Assignment and Mobilization		
C18	00575	Verification of meeting Hazardous Waste Requirements of 29CFR1910.120	5	Prior to	Mobilization Onsite		
C19	00575	Hazardous Materials Documentation		With	Each Hazmat Shipment		
C20	00575	Safety and Health Records	Monthly	After	Mobilization Onsite		_
C21	00575	Evidence that Jobsite Personnel have Passed Drug Testing	10	Prior to	Mobilization Onsite		
C22	00575	Fall Protection Plan	5	Prior to	Starting Work Operations		_
C23	00575	Chemical Hazard Communication Plan, as applicable	5	Prior to	Mobilization Onsite		
C24	00575	Substance Abuse Program	5	Prior to	Mobilization Onsite		
C25	00672.3	Certificate of Nondiscrimination for Subcontractor and Sub-subcontractors		With	Bid		
C26	00672.4	Equal Business Opportunity Program Compliance Form for Subcontractor and Sub- subcontractors		With	Bid		
C27	00672.7	Bid Bond		With	Bid		
	Taskaiss	Technical Data Cubmittela	Weekly.	A (1			Ve

# 00571 - Supplementary Terms and Conditions

## 00571.1 Notices and Correspondence

The parties agree to send all notices arising out of or related to this Subcontract by one of the following methods: (a) personal delivery; (b) certified mail with return receipt; (c) nationally recognized overnight mail or courier service, with delivery receipt requested; or (d) email. The parties may send routine correspondence by email or first-class mail, each without confirmation of receipt. The parties agree to address notices and correspondence as indicated in this article. Subcontractor agrees that delivery of a notice or of correspondence by Purchaser to Subcontractor's at the jobsite constitutes personal delivery.

#### **Electronic Technical Correspondence**

#### Addressed to Purchaser:

To: Jerry Caldwell CaldwellJ@bv.com

#### Addressed to Subcontractor:

To: [[name]] [[email address]] Cc: [[name]] [[email address]]

#### Non-Electronic Technical Correspondence

#### Addressed to Purchaser:

Overland Contracting Inc. 845 Crossover Lane, Suite 120 Memphis, TN 38117 Attention: Jerry Caldwell 421810.71.0419

#### Addressed to Subcontractor:

[[subcontractor entity]] [[street address]] [[city, state, zip code]] Attention: [[name]] 421810.71.0419

#### Electronic Commercial Correspondence (excluding invoices)

#### Addressed to Purchaser:

To: Ginny Dorsey Dorsey@bv.com

#### Addressed to Subcontractor:

To: [[name]] [[email address]] Cc: [[name]] [[email address]]

## Non-Electronic Commercial Correspondence (excluding invoices)

#### Addressed to Purchaser:

Overland Contracting Inc. 8400 Ward Parkway Kansas City, MO 64114 Attention: Ginny Dorsey 421810.71.0419

## Addressed to Subcontractor:

[[subcontractor entity]] [[street address]] [[city, state, zip code]] Attention: [[name]] 421810.71.0419

#### **Electronic Invoices**

Subcontractor will submit invoices via the web-based project management platform, Prolog. Invoices will be reviewed, and either approved or returned to Subcontractor for correction. The OCI Project Manager will forward invoices to Black & Veatch Accounts Payable, once they are approved.

In accordance with section 00572.4 Invoicing and Payment, each invoice must clearly show the invoice number, the complete Subcontract project number, the Purchase Order number, the Work covered by the invoice, taxes, and the billing period (if applicable).



## 00571.2 Not Used

## 00571.3 Payment Terms

The following payment terms shall apply in addition to the corresponding provisions contained in Article 00572.4 Invoicing and Payment.

The Parties will meet each month at an agreed time in order to determine the quantity of materials used and man-hours expended during the invoice period. The Parties will use the field progress measurement system to calculate that month's payment total by adding the Subcontract unit price totals based on actual Work completed.

## 00571.4 Security Instruments

Subcontractor shall give Purchaser separate performance and payment bonds in the format of AIA Document 312 - 2010 Performance Bond and Payment Bond, each in the amount of the Subcontract Price. Subcontractor shall submit the bonds to Purchaser by the due date specified in the Article titled "Schedule of Submittals and Applicable Liquidated Damages". The bonding company must be licensed to bond in the state in which the Project is located and must be rated "A" or better by A.M. Best and included in the Department of the Treasury's Listing of Approved Sureties (Department Circular 570).

## 00571.5 Liquidated Damages

#### 00571.5.1 General

Subcontractor's failure to meet the requirements identified in this Article 00571.5 will cause Purchaser to incur harm that will be very difficult to ascertain with certainty. The Parties therefore agree the liquidated damages specified in this Article 00571.5 represent a reasonable estimate of Purchaser's harm and are not intended as a penalty. Subcontractor's obligation to pay liquidated damages for breach of one specified requirement, does not relieve Subcontractor of its obligation to pay liquidated damages for breach of another specified requirement. Subcontractor's payment of liquidated damages for breach of the specified requirement is Purchaser's sole and exclusive remedy with regard to Subcontractor's breach of that requirement, except for any other express remedies stated in the Subcontract. If Purchaser terminates the Subcontract for cause, liquidated damages will cease to accrue after the termination date and Subcontractor's remaining liability will be calculated in accordance with Article 00572.17.

#### 00571.5.2 Not Used

#### 00571.5.3 Construction Milestone Dates

Each construction milestone subject to liquidated damages for late completion is listed in the article titled "Construction Milestone Completion Dates and Applicable Liquidated Damages". If all portions of the Work comprising the construction milestone do not meet the Subcontract requirements on the construction milestone completion date, liquidated damages will accrue for each failure as shown below.

Beginning on the first calendar day after the specified construction milestone completion date for each construction milestone and continuing until the construction milestone is completed, delay liquidated damages will be assessed at the rate of one thousand (\$1,000) dollars per calendar day.

Beginning on the thirty first calendar day after the specified milestone completion date for each milestone and continuing until the milestone is completed, delay liquidated damages will be assessed at the rate of one thousand dollars (\$1,500.00) per calendar day.

#### 00571.6 Taxes

Subcontractor shall pay all payroll and other related employment compensation taxes for Subcontractor's employees, federal, state and other taxes which may be assessed on Subcontractor's income from the Project, engineering and business license costs (collectively, the "Subcontractor Taxes"). Subcontractor shall administer and pay all sales, use, gross receipts and excise taxes (collectively, the "Project Taxes"). Subcontract price includes Subcontractor Taxes and all Project Taxes. Purchaser will not be responsible



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for any additional charges related to tax that were not included as part of the Subcontract Price. Where applicable. Purchaser shall furnish to Subcontractor a certificate complying with state and local governmental laws, regulations and ordinances identifying any components of the Work to be considered exempt from the Project Taxes. Subcontractor shall cooperate with Purchaser to establish appropriate procedures and minimize the amount of such taxes to the extent reasonable and practical. Subcontractor is responsible for all property taxes on the construction equipment; Owner is responsible for property taxes on all other items incorporated into the project. Subcontractor shall notify Purchaser, and Purchaser shall have the right to review prior to Subcontractor's response to such document, of any correspondence with a federal or local taxing authority as it relates to sales and use, gross receipts, or excise taxes.

# 00572 - General Terms and Conditions

## 00572.1 Definitions

The terms below have the following definitions when used in this Subcontract:

"<u>Applicable Laws</u>" means all laws, statutes, regulations, codes, rules, treaties, ordinances, judgments, permits, decrees, approvals, interpretations, injunctions, writs, orders, or other legal requirements of a governmental body entitled to exercise any administrative, executive, judicial, legislative, police, regulatory or taxing power and having jurisdiction over the jobsite or performance of the Work.

"<u>Claims</u>" means claims, actions, suits, liabilities, demands, damages, losses, costs, expenses (including reasonable attorneys' fees), impacts to price, impacts to schedule, awards, fines and judgments, of every kind and nature.

"<u>Consent Decree</u>" means the negotiated plan between Owner, Department of Justice, Environmental Protection Agency, Tennessee department of Environment and Conservation, and the Tennessee Clean Water Network that requires Owner to develop and implement plans to improve its wastewater systems.

"<u>Final Completion</u>" means: (a) the Work is complete and complies with the requirements of this Subcontract; and (b) Subcontractor has fulfilled all its obligations under this Subcontract except obligations that survive completion of the Work.

"Indemnified Parties" means Owner and its officials, Purchaser, Purchaser's engineer, and the parent companies, related companies, affiliated companies, subsidiaries, successors, and assigns of each, including the shareholders, officers, directors, partners, employees, and agents of each of the above firms. "Indemnified Parties" does not include Subcontractor or any Sub-subcontractor.

<u>"Notice to Proceed"</u> means to written notice provided by Purchaser to Subcontractor releasing Subcontractor to proceed with all or part of the Work.

"Owner" means the City of Memphis, Tennessee.

"Program Manager" means Black & Veatch Corporation or Overland Contracting Inc. (OCI).

"Purchaser" means the party so identified in the Subcontract Agreement.

"<u>Subcontract</u>" means the agreement between Purchaser and Subcontractor consisting of: (a) the Subcontract Agreement; (b) the documents listed in the Subcontract Agreement; (c) written Subcontract revisions; (d) attachments, appendices and exhibits to the Subcontract documents; (e) documents expressly incorporated by reference into the Subcontract; and (e) any requirements that can be reasonably inferred from any of the foregoing.

"Subcontract Agreement" means the Subcontract form executed by Purchaser and Subcontractor.

"Subcontractor" means the party so identified in the Subcontract Agreement.

"<u>Sub-subcontractor</u>" means any party, at any tier, having an agreement with Subcontractor or with a Subsubcontractor, to perform a portion of the Work.

"<u>Substantial Completion</u>" means the project is sufficiently complete, in accordance with the construction contract documents, so that the owner may use the facilities for the intended purpose.

"Work" means that which Subcontractor is to perform or provide under this Subcontract.

## 00572.2 Interpretation

00572.2.1 This Subcontract is the complete and final agreement between the parties relating to the Work. All prior or contemporaneous negotiations and agreements relating to the Work are superseded by this Subcontract. Exceptions or terms submitted by Subcontractor in the course of accepting this Subcontract are void.

00572.2.2 Provisions of this Subcontract that contemplate performance or obligations subsequent to completion or termination of the Work or contain waivers or limitations of liability will survive such completion or termination. Termination of the Work will not affect the rights and obligations that arose before termination.

00572.2.3 If any provision of this Subcontract is held to be unenforceable, the remaining provisions of this Subcontract will remain in effect.

#### 00572.3 Subcontractor's Status

Subcontractor is an independent contractor in the performance of the Work. Subcontractor is solely responsible for the means, methods, sequences, procedures, and safety precautions used or adopted by Subcontractor and any Sub-subcontractor in the performance of the Work. Except as provided in Article 00574.2 and 00574.3, Subcontractor has sole authority and responsibility to employ, manage, discharge, and otherwise control its employees.

## 00572.4 Invoicing and Payment

00572.4.1 Subcontractor shall submit invoices to Purchaser with all documentation required to be submitted with the invoice. Each invoice must be itemized by the Subcontract line number. Each invoice must also clearly show the complete Subcontract project number, the Purchase Order number, the invoice number, the billing period (if applicable), the invoiced amount, retention (if applicable), and the net amount due. The final invoice must contain a copy of Purchaser's notice of Final Completion.

00572.4.2 Subcontractor agrees to provide additional itemization of the Subcontract price as Purchaser reasonably requests. If payment to Subcontractor will be on a time and material basis or a unit price basis, or if Subcontractor files a Claim under Article 00572.13, Subcontractor shall furnish Purchaser complete breakdowns and supporting information in the detail required by Purchaser to verify the accuracy of the invoiced or claimed amounts. Purchaser or Purchaser's designee may audit the aforementioned records at Purchaser's expense.

00572.4.3 Payment by Purchaser does not: (a) constitute approval or acceptance of any portion of the Work; (b) waive any of Purchaser's rights; or (c) relieve Subcontractor from responsibility or liability arising out of or related to this Subcontract. Acceptance by Subcontractor of final payment constitutes a release and waiver of all Claims by Subcontractor against Indemnified Parties.

00572.4.4 Purchaser may withhold or set-off amounts due under this Subcontract on account of Claims arising out of or related to Subcontractor's breach or reasonably anticipated breach of this Subcontract.

00572.4.5 Once Work that has undergone specified QA/QC is submitted, reviewed and approved by the Program Manager, the Subcontractor's invoice will be submitted along with the Program Manager's next invoice to the Owner. The Program Manager's invoice is typically submitted during the second week of each month for work performed during the previous month. Typical payment from the Owner to the Program Manager is anticipated to be forty-five (45) calendar days upon Owner's acceptance of invoice, and the Program Manager will cause the Purchaser to pay the Subcontractor within two weeks of Program Manager's receipt of payment from the Owner.

00572.4.6 Subcontractor agrees that all payments received by Subcontractor under this Subcontract will first be used for, and constitute trust funds for, the payment of all labor and materials used in the Work.



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Purchaser may, but is not obligated to, issue joint checks to Subcontractor and a Sub-subcontractor or make payment directly to a Sub-subcontractor. Purchaser will deduct amounts paid by joint check to Subcontractor and a Sub-subcontractor or paid directly to a Sub-subcontractor from payment due Subcontractor under this Subcontract. Purchaser may also deduct a reasonable fee to cover administrative costs for such payments. Subcontractor agrees to accept the issuance of joint checks and agrees with Purchaser that neither the right to issue nor the issuance of any joint check is intended to create any contractual relationship with a third party, or any third-party beneficiary rights to payment by Purchaser.

## 00572.5 Schedule

Performance of the Work as scheduled under this Subcontract is of the essence. Subcontractor shall submit a Work schedule to the Purchaser at the initial preconstruction conference between the Parties. The schedule shall show the sequence of Work towards to complete the same by the required Work completion date specified hereunder. The Work schedule shall be updated and presented at each progress meeting throughout the Work progression under this Subcontract. Subcontractor shall give Purchaser written notice of any delay or anticipated delay within three calendar days after the occurrence of the event giving rise to the delay. Subcontractor's notice must identify the cause of the delay or the anticipated delay and the actions Subcontractor is undertaking to recover from or avoid the delay.

#### 00572.6 Waivers of Lien

As a condition precedent to payment, Subcontractor shall furnish a lien waiver in the form of Article 00672.1 with each invoice except the final invoice. As a condition precedent to payment of the final invoice, Subcontractor shall furnish a lien waiver in the form of Article 00672.2 with the final invoice. If a lien is filed and Subcontractor does not remove or bond around the lien within seven calendar days after receipt of written notice from Purchaser or Owner, Purchaser or Owner may remove the lien. Subcontractor shall reimburse Purchaser or Owner, as applicable, for all costs and expenses incurred by Purchaser or Owner in removing the lien, including reasonable attorneys' fees and court costs.

## 00572.7 Assignment and Subcontracting

00572.7.1 Subcontractor may not assign all or part of this Subcontract voluntarily, by operation of law, or otherwise, nor may Subcontractor assign any of the money payable under this Subcontract, without obtaining Purchaser's prior written consent.

00572.7.2 Except for the supply of expendable materials and minor components or the supply of a portion of the Work for which a Sub-subcontractor is named in this Subcontract, Subcontractor may not subcontract the Work without first obtaining Purchaser's written consent. In addition, Subcontractor must obtain a safety prequalification for any Sub-subcontractor that will be performing any portion of the Work, at the Jobsite, as outlined in Article 00575.9. If Subcontractor subcontracts any portion of the Work, Subcontractor remains responsible for complying with the Subcontract requirements and is liable to Purchaser for the acts and omissions of Sub-subcontractors, including their failure to comply with the requirements of this Subcontract or fulfill the obligations imposed on Subcontractor by this Subcontract, as if the acts and omissions were those of Subcontractor. Purchaser has the right to contact Sub-subcontractors to discuss their progress of the Work.

## 00572.8 Passage of Title, Risk of Loss, and Delivery

Subcontractor warrants that the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will be free of all liens, claims, charges, security interests, encumbrances or defects in title. Title to the Work (excluding Subcontractor-furnished items that are not intended to become a permanent part of the project) will pass to Purchaser upon the earlier of Subcontractor's receipt of payment or delivery of the Work to the jobsite. Subcontractor retains the risk of loss of the Work until Purchaser issues the notice of Final Completion. The terms of delivery have the meanings assigned them in the 2020 edition of the Incoterms published by the International Chamber of Commerce, except as modified in this Subcontract.



## 00572.9 Final Completion

Subcontractor shall notify Purchaser in writing when Subcontractor believes the Work meets the requirements for Final Completion. Purchaser will inspect the Work within ten calendar days after Purchaser's receipt of Subcontractor's notice. If Purchaser identifies any defective or non-conforming Work, Subcontractor shall correct that Work in accordance with Article 00572.10. Purchaser will issue a notice that Final Completion has been achieved when the Work meets the requirements for Final Completion. Purchaser's issuance of the notice of Final Completion does not relieve Subcontractor of its obligations under this Subcontract.

## 00572.10 Warranty

00572.10.1 Subcontractor warrants to Purchaser and Owner that the Work: (a) will be new when delivered to the jobsite; (b) will be free from defects in design, material, and workmanship; (c) will comply with Applicable Laws; (d) will comply with the requirements of this Subcontract; and (e) will be fit for the purposes specified. Subcontractor also warrants to Purchaser and Owner that elements of the Work for which this Subcontract does not establish express standards of quality and fitness will comply with good industry practices for the specific application. Subcontractor agrees that Owner may directly enforce the warranties of this Article 00572.10.1.

00572.10.2 Subcontractor shall correct any breach of this warranty within five calendar days after Purchaser gives Subcontractor written notice of the breach. The cost of warranty work and removal or replacement of other work will be at Subcontractor's expense. Subcontractor shall work diligently and without interruption to correct the breach. In the case of emergency where, in the reasonable judgment of Purchaser, delay could result in serious loss or damage to persons or property, Purchaser may correct the defect or nonconformity at Subcontractor's expense.

00572.10.3 The warranty for the Work extends until one year after Final Completion. The warranty applies to all repairs and replacements to the same extent the warranty applies to the original Work. The warranty period for repaired Work or replacements will be extended for a period of one year after the repair or replacement is complete or until the original warranty period expires, whichever occurs later.

00572.10.4 This project is being implemented to provide services to the City of Memphis, through the City's Program Manager, for implementation of the Consent Decree executed on September 20, 2012, civil action number 2:10-cv-02083-SHM-dkv (CD). The City negotiated the Consent Decree with the United States Environmental Protection Agency and the Tennessee Department of Environment and Conservation to implement an assessment and rehabilitation program of the City's wastewater collection and transmission system. Per section II, paragraph 5 of the Consent Decree all contractors performing work required by the Consent Decree must be notified by the City that a copy of the Consent Decree is posted on the City's webpage. This article provides the required notification. The Consent Decree may be reviewed by accessing the City's webpage at:

http://www.memphistn.gov/Government/PublicWorks/ConsentDecree.aspx

This page provides a link to the Consent Decree and associated documents. An explanation of each document is also provided. Click on any link to access. Alternatively, the Consent Decree is available at:

## http://www.sarp10.com/consent-decree/

00572.10.5 Subcontractor acknowledges that Owner's failure to achieve 100 percent compliance with the Consent Decree requirements may result in the imposition of penalties, costs, and other damages imposed against the Owner and Purchaser. To the extent caused by Subcontractor's failure to perform the Work in accordance with this Subcontract or to the extent caused by the negligence of Subcontractor or any Sub-subcontractor, Subcontractor agrees to pay penalties and costs incurred by Owner and Purchaser under the Consent Decree.



## 00572.11 Compliance with Laws

00572.11.1 Subcontractor shall comply with all Applicable Laws in effect during its performance of Work, including but not limited to the City of Memphis Prevailing Wage Ordinance, the Fair Labor Standards Act, Occupational Safety and Health Administration (OSHA), and the Americans with Disabilities Act (ADA). Subcontractor shall obtain all licenses, permits, and inspections applicable to the Work except for licenses, permits, and inspections identified in this Subcontract as Purchaser's or Owner's responsibility. Subcontractor shall also comply with the USA's Foreign Corrupt Practices Act.

00572.11.2 Purchaser and Subcontractor shall abide by the requirements of 41 CFR §§ 60-1.4(a), 60-4.3(a), 60-300.5(a) and 60-741.5(a). These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

00572.11.3 Neither party shall engage in any conduct or activity in the performance of this Subcontract that constitutes a conflict of interest under Applicable Laws.

00572.11.4 Subcontractor shall comply with 18 U.S.C. §874, 40 U.S.C. §3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this Subcontract and any Sub-subcontracts hereunder.

00572.11.5 This project, for which the Work has been specifically sought hereunder, is being supported with the American Rescue Plan Act (ARPA), Coronavirus State and Local Fiscal Recovery Fund (SLFRF) Grant Program and is administered through the TDEC State Water Infrastructure Grants (SWIG) agency. Therefore, certain restrictions and other federal requirements attach to this opportunity.

## 00572.12 Business Practices

00572.12.1 Subcontractor shall uphold the good name and reputation of Purchaser and shall not take any action which is intended to, or which causes damage to or discredits Purchaser. Subcontractor shall not:

- (a) Offer to give or agree to give any director, officer, employee or agent of any potential client a gift or consideration of any kind as an inducement or reward for: (i) doing or declining to do, or for having done or declined to do, any action in relation to obtaining or executing any contract or (ii) for showing or declining to show any favor or disfavor to any person in relation to any possible project; or
- (b) Induce or attempt to induce any officer, servant, or agent of any private or public body to depart from his or her duties to his or her client or, in the case of any officer, servant or agent of a public body, his or her duties to the applicable public body, the applicable body politic, or both.

00572.12.2 Subcontractor shall not engage or employ, on a full, part-time or any other basis during the term of the Prime Agreement and for a period of one year after the termination or expiration, any professional or technical personnel who are or have been at any time during the term of the Prime Agreement in the employ of Owner without the explicit written consent of Owner.

00572.12.3 Nondiscrimination:

(a) Subcontractor certifies and agrees that all persons employed by it, its affiliates, subsidiaries, or holding companies are and will be treated equally without regard to or because of race, creed, color, religion, ancestry, national origin, sexual orientation, sex, age, condition of physical or mental handicap, marital status, or political affiliation, in compliance with all Applicable Laws. Subcontractor shall certify, at Purchaser's request that it is in full compliance with all applicable EEO rules and laws.



(b) Purchaser and Owner reserve the right to investigate any claims of illegal discrimination by Subcontractor and in the event a finding of discrimination is made and upon written notification thereof, Subcontractor shall take all necessary steps to cure and rectify such action to the reasonable satisfaction of Purchaser and Owner. Subcontractor's failure or refusal to do so shall be cause for termination of this Subcontract in accordance with the terms of this Subcontract.

00572.12.4 Purchaser is an affirmative action employer. Accordingly, the parties hereby incorporate by reference the requirements of Executive Order 11246, as amended, and the applicable regulations contained in 41 C.F.R. Parts 60-1 through 60-60; 29 U.S.C. Section 793 and the applicable regulations contained in 41 C.F.R. Part 60-741; 38 U.S.C. Section 4212 and the applicable regulations contained in 41 C.F.R. Part 60-250 and/or 60-300; and 29 C.F.R. Part 471, Appendix A to Subpart A.

00572.12.5 Subcontractor represents and warrants that it has a code of conduct or other set of compliance requirements that is at least as broad as Purchaser's Code of Conduct for Global Business Relationships (hereinafter "Code of Conduct"), or that it will comply with Purchaser's Code of Conduct in all dealings that affect Purchaser. The Code of Conduct and its amendments are expressly incorporated herein by reference and full text of the same can be found at:

https://www.bv.com/sites/default/files/reports-studies/Code-of-Conduct-for-Global-Business-Relationships

## 00572.13 Claims

Subcontractor must give written notice, with appropriate supporting documentation, of all Claims for extra compensation or additional time for performance of the Work within three calendar days after occurrence of the event giving rise to the Claim. Subcontractor acknowledges that failure of Subcontractor to give Purchaser notice and appropriate supporting documentation within the required time frame constitutes a waiver of all Claims arising out of or related to the event.

## 00572.14 Subcontract Revisions and Work Authorizations

00572.14.1 Purchaser may make additions, deletions, reductions in scope, or other changes to the Work. If a proposed change will cause a material increase or decrease in Subcontractor's cost or time for performance, Subcontractor shall so notify Purchaser in writing, accompanied by supporting documentation, within three calendar days after Subcontractor's receipt of Purchaser's notice of change. If Purchaser agrees with Subcontractor's notice, the parties will negotiate an equitable adjustment to the Subcontract price, to the schedule, or both, in accordance with the Subcontractor's fee for overhead and profit as listed in Article 00572.14.2 below. These adjustments will be reflected in a written Subcontract revision.

00572.14.2 The Subcontractor's fee for overhead and profit shall be determined as follows:

For costs incurred for labor the maximum fee shall be fifteen percent to the Subcontractor or the Sub-subcontractor performing the Work.

For costs incurred for materials and equipment the maximum fee shall be five percent to the Subcontractor or the Sub-subcontractor providing the materials and equipment.

If applicable, the Subcontractor may receive an additional fee of five percent on labor or materials and equipment performed or provided by a Sub-subcontractor, as long as the total combined fee does not exceed fifteen percent.

00572.14.3 A written Subcontract revision is required before Subcontractor is entitled to payment for the Work performed under the Work authorization. Subcontractor will bear the expense of performing any change not supported by a written Work authorization or written Subcontract revision. Purchaser will not be liable to Subcontractor for Claims arising from a decrease in the Work. No change is effective without a written Work authorization or a written Subcontract revision issued by Purchaser.



#### 00572.15 Non-Disclosure

Subcontractor shall not make any news releases, authorize or participate in any interview concerning this Subcontract, or issue other advertising pertaining to the project or this Subcontract without the prior written approval of Purchaser. Subcontractor shall treat all information provided by Purchaser as confidential and only disclose such information as necessary to perform the Work, and will require the employees, agents, and Subcontractors who need to know to adhere to the terms of this provision.

## 00572.16 Suspension of Work

Purchaser may, at any time and in its sole discretion, suspend performance of all or part of the Work by written notice to Subcontractor. If the suspension is unrelated to Subcontractor's failure to comply with this Subcontract, Purchaser will adjust the schedule to reflect the reasonable delay due to the suspension and will reimburse Subcontractor for the reasonable and direct additional costs incurred by Subcontractor due solely to the suspension. Subcontractor shall promptly resume performance of all or part of the suspended Work in accordance with Purchaser's written authorization to resume the Work.

#### 00572.17 Termination for Cause

If Subcontractor defaults in any obligation under this Subcontract and does not cure the default within ten calendar days after receipt of Purchaser's written notice identifying the default, Purchaser may terminate all or part of the Work.

#### 00572.18 Termination Without Cause

Purchaser may, at any time and in its sole discretion, terminate all or part of the Work. Subject to Subcontractor's compliance with this Subcontract, Subcontractor will recover from Purchaser, as the complete and final settlement for the terminated Work and all related Claims, a sum equal to Subcontractor's direct cost for the terminated Work satisfactorily performed as of the effective date of termination, plus an allowance for reasonable overhead and profit on such direct cost.

#### 00572.19 Purchaser's Remedies

00572.19.1 Purchaser may reject defective or nonconforming Work and return the rejected Work to Subcontractor, at Subcontractor's risk and expense, for repair, replacement or credit, at Purchaser's option. If Purchaser chooses to accept defective or nonconforming Work, Subcontractor shall correct the defect or nonconformity in accordance with Article 00572.19.2 However, if Purchaser chooses to accept defective or nonconforming Work and Purchaser will negotiate an equitable reduction in the Subcontract Price to account for the defect or nonconformity.

00572.19.2 If Purchaser discovers a defect or nonconformity in the Work before the Warranty Period begins, Subcontractor shall correct the defect or nonconformity within ten calendar days after Purchaser gives Subcontractor notice of the defect or nonconformity. In the case of emergency, where in the reasonable judgment of Purchaser, delay could result in serious loss or damage to persons or property or if Purchaser at its sole discretion determines that the Project schedule would be adversely affected if the correction of such defect or nonconformity is not performed before the ten day period expires, Purchaser may correct the defect or nonconformity at Subcontractor's expense.

00572.19.3 If Subcontractor by its action or inaction indicates that it is unable or unwilling to proceed with the Work in a reasonable time or if Purchaser intends to perform any corrective work under Article 00572.10 or 00572.19.3, Purchaser may, upon written notice to Subcontractor, accomplish the Work in question by the most expeditious means available and backcharge Subcontractor for the costs incurred. Subcontractor shall sign and return the notice of backcharge within one calendar day after receipt.

00572.19.4 Subcontractor shall pay all direct costs incurred by Purchaser under Articles 00572.19.2 and 00572.19.3, including engineering, labor, material, transportation, insurance, subcontracts, tools, and equipment. Subcontractor shall also pay twenty-five percent of the direct costs incurred by Purchaser under Articles 00572.19.2 and 00572.19.3 for Purchaser's overhead and general and administrative costs. The performance of Work under this Article 00572.19 does not relieve Subcontractor of its obligations under this Subcontract including, but not limited to, warranty, liquidated damages, and indemnity.



00572.19.5 Purchaser's remedies under this Subcontract and existing at law or in equity are cumulative and may be exercised concurrently.

## 00572.20 Indemnity

00572.20.1 SUBCONTRACTOR AGREES TO DEFEND, INDEMNIFY, AND HOLD HARMLESS THE INDEMNIFIED PARTIES AGAINST ANY CLAIM, LOSS, DAMAGE, EXPENSE, OR LIABILITY (INCLUDING ATTORNEYS' FEES AND COSTS OF ANY SUCCESSFUL ENFORCEMENT OF THIS INDEMNITY ARTICLE) ARISING OUT OF THE PERFORMANCE OR NON-PERFORMANCE BY SUBCONTRACTOR OR ITS SUB-SUBCONTRACTORS, OR THEIR OFFICERS, EMPLOYEES, OR AGENTS.

00572.20.2 Providing that Purchaser is not in breach of its obligation to make payments to Subcontractor for the Work, Subcontractor shall indemnify, defend and hold harmless the Indemnified Parties from any claims or mechanic's liens brought against the Indemnified Parties or against the Project as a result of the failure of Subcontractor, or those for whose acts it is responsible, to pay for any services, materials, labor, equipment, taxes or other items or obligations furnished or incurred for or in connection with the Work. Within three (3) days of receiving written notice from Purchaser that such a claim or mechanic's lien has been filed, Subcontractor shall commence to take the steps necessary to discharge said claim or lien, including, if necessary, the furnishing of a mechanic's lien bond. If Subcontractor fails to do so, Purchaser will have the right to discharge the claim or lien and hold Subcontractor liable for costs and expenses incurred, including attorneys' fees.

00572.20.3 Subcontractor will immediately notify Purchaser of any claim or suit made or filed against Subcontractor or its Sub-subcontractors in which Purchaser or Owner is named as a co-defendant.

00572.20.4 Subcontractor expressly understands and agree that any insurance coverage required by this Purchase Order or otherwise provided by Subcontractor shall in no way limit Subcontractors responsibility to indemnify, defend, save and hold harmless the Indemnified Parties.

## 00572.21 Insurance Requirements

00572.21.1 Subcontractor shall, at its sole cost, maintain insurance as required by this Subcontract and shall impose the obligations of this Article 00572.21.1 on all Sub-subcontractors. Subcontractor shall give Purchaser ACORD insurance certificates evidencing the required coverage by the due date identified in article titled "Schedule of Submittals" and as Purchaser may request from time to time. Insurance certificates shall specifically note "City of Memphis SARP10 Program" in the notes or description area. Subcontractor shall ensure the policies:

- (a) Contain a provision or endorsement that the coverage will not be cancelled, materially changed, or renewal refused unless the insurer gives at least thirty calendar days prior written notice to Purchaser.
- (b) Remain in effect through the warranty period if coverage is occurrence-based and remain in effect at least one year after expiration of the warranty period if coverage is claims-based.
- (c) Are primary with respect to insurance covering Indemnified Parties as additional insureds. All insurance carried by Indemnified Parties will be excess insurance.
- (d) Contain a waiver of all rights of subrogation by the insurance carriers in favor of Indemnified Parties.
- (e) Comply with all Applicable Laws of the jurisdiction in which any part of the Work is to be performed including, but not limited to, admitted and compulsory coverage.
- (f) Are rated "A-" or better by A.M. Best's "Insurance Guide and Ratings."

00572.21.2 Subcontractor shall maintain broad form commercial general liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds (using endorsements CG 20 10 and CG 20 37 or their equivalent), against claims arising out of bodily injury or property damage arising from the Work. The policy must include a cross-liability or severability of interest clause, a per project aggregate



endorsement, and coverage for personal injury liability, contractual liability, products and completed operations (covering lawsuits brought in the USA and the country of the jobsite), explosion, building collapse, and damage to underground property. The policy also must not exclude coverage for wildfire and Consultant shall provide a certificate of insurance verifying no such exclusions exist. The policy must include coverage for riggers liability if applicable to the Work. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.3 Subcontractor shall maintain worker's compensation insurance protecting Subcontractor against all claims under applicable worker's compensation laws, including, but not limited to, the United States Longshoremen's and Harbor Worker's Act and the Jones Act. If Subcontractor is required to maintain worker's compensation insurance in the USA, the worker's compensation insurance must contain an "all states" or "other states" endorsement. For Work performed in the USA, Subcontractor shall also maintain employer's liability insurance protecting Subcontractor against claims for injury, disease or death of employees which are not covered by the worker's compensation insurance. Subcontractor shall maintain worker's compensation policy limits as required by statute and, if applicable to this Subcontract, employer's liability policy limits of at least one million dollars for each occurrence.

00572.21.4 Subcontractor shall maintain comprehensive automobile liability insurance protecting Subcontractor, and Indemnified Parties as additional insureds, against all claims for injuries to members of the public and damage to property of others arising from the use of motor vehicles, whether owned, non-owned, or hired. Subcontractor shall maintain policy limits of at least one million dollars for each occurrence.

00572.21.5 Subcontractor shall maintain umbrella liability insurance that follows the form of the commercial general liability insurance, the employer's liability insurance and the automobile liability insurance. The umbrella liability insurance must protect Subcontractor, and Indemnified Parties as additional insureds, against claims in excess of the limits of the commercial general liability insurance, the employer's liability insurance, and the automobile liability insurance. Subcontractor shall maintain policy limits of at least four million dollars for each occurrence.

00572.21.6 Subcontractor is responsible for maintaining any and all property insurance on their own equipment and shall require all Sub-subcontractors to do likewise.

## 00572.22 Audit

Purchaser reserves the right to audit the records of Subcontractor. Accordingly, Subcontractor shall make and keep as the same accrue, full and complete records and books of accounts of revenue and income, and costs and expenses that specifically relate to performance under this Subcontract. Records and books of account, together with any or all memoranda pertaining thereto that may be kept, maintained, or possessed by Subcontractor, shall be opened to examination during regular business hours by Purchaser or its representatives for the purposes of inspecting, auditing, verifying, or copying the same or making extracts therefrom. Subcontractor shall make and keep said records and books of account for a period of seven (7) years after the completion of the contract obligations of the final payment under the Subcontract, whichever is later.

## 00572.23 Governing Law and Disputes

00572.23.1 Except as detailed in Article 00572.23.2, claims and disputes arising out of or related to this Subcontract will be governed by the law of the State of Tennessee, USA, excluding provisions that would apply the law of another jurisdiction. The Parties hereby elect to exclude application of the United Nations Convention on Contracts for the International Sale of Goods pursuant to Article 6 of the Convention.

00572.23.2 Subcontractor agrees to be bound by all decisions arising out of the claims and dispute resolution process set forth in the Prime Agreement to the extent: (a) the decisions relate to the Work; (b) a claim by Owner against Purchaser involves the performance of Subcontractor or the Work; or (c) a Claim of Subcontractor gives rise to a claim by Purchaser against Owner. The initiation of claim and dispute

resolution under the Prime Agreement will stay claim and dispute resolution under this Subcontract on any claim related to the claim under the Prime Agreement. The Parties shall first use their best efforts in an attempt to settle the dispute through negotiations involving themselves and their representatives.

00572.23.3 To the extent Subcontractor will be bound as set forth in Article 00572.23.2, Purchaser consents to Subcontractor's participation in such claim and dispute resolution process. Subcontractor and Purchaser will each bear their own costs associated with their participation in the claim and dispute resolution process. A Party will follow the other Party's directions regarding that other Party's Claims, unless such directions adversely affect the Party's own Claims. In that event, the Parties will agree on how to proceed. Each Party will give the other Party reasonable assistance.

00572.23.4 Disputes between Subcontractor and Purchaser not addressed in Articles 00562.27.2 and 00572.23.3, will be resolved exclusively by the courts of the State of Tennessee located in Shelby County as their jurisdiction permits. To the extent Purchaser or Subcontractor prevails against the other Party on such dispute, reasonable dispute resolution costs including attorney fees are recoverable from the losing Party.

00572.23.5 Pending resolution of any claim or dispute, and without prejudice to Subcontractor's rights, Subcontractor shall continue to perform as directed by Purchaser.

## 00572.24 Hazardous Conditions

00572.24.1 Subcontractor is not responsible for any Hazardous Conditions encountered in the performance of the Work at the Jobsite. Upon encountering any Hazardous Conditions, Subcontractor will stop services immediately in the affected area and duly notify Purchaser. For purposes of this Subcontract, Hazardous Conditions is defined as any materials, wastes, substances and chemicals deemed to be hazardous under any Applicable Law or the handling, storage, remediation, or disposal of which are regulated by Applicable Laws and applies to any hazardous or toxic substance, material, or condition present at the locations in which the Work is performed which was not brought onto such site or sites by Subcontractor for the exclusive benefit of Subcontractor.

00572.24.2 Subcontractor shall be obligated to resume the Work at the affected areas only after Owner's expert provides it with written certification that (i) the Hazardous Conditions have been removed or rendered harmless and (ii) all necessary approvals have been obtained from all Governmental Authority having jurisdiction over the location.

00572.24.3 Subcontractor will be entitled, to an adjustment in its compensation and all times for performance of the Work to the extent Subcontractor cost or time of performance have been adversely impacted by the presence of Hazardous Conditions, subject to submission of appropriate documentation by Subcontractor and Subcontractor's duty to mitigate.

## 00572.25 Force Majeure

00572.25.1 If Subcontractor is delayed in the performance of the Work due to acts, omissions, conditions, events, or circumstances beyond its control, the times for performance shall be reasonably extended by on a not less than day for day basis. By way of example and not of limitation, events that will entitle Subcontractor to an extension of the times for performance include without limitation acts or omissions of Owner or Purchaser, or anyone under Owner's control (including separate contractors), Hazardous Conditions, wars, terrorism, civil unrest, actions and inactions of delay of Governmental Authorities, floods, labor disputes and unrest, unusual delay in transportation, epidemics, earthquakes, tsunami, adverse weather conditions, and acts of God.

00572.25.2 In addition to Subcontractor's right to a time extension for those events set forth above, Subcontractor shall also be entitled to an appropriate increase in the compensation due to the impacts or delays arising from such events. Subcontractor will file all claims in accordance with Article 00572.13.



# 00574 – Jobsite Operations Terms and Conditions

## 00574.1 Subcontractor Scope of Work

Except as expressly provided in this Subcontract, Subcontractor shall furnish all materials, tools, equipment, vehicles, supplies, services, labor and supervision required to perform the Work. Unless otherwise stated in this Subcontract, the Work includes unloading, off transport, hauling, receiving, storing, maintaining, protecting, erecting, installing, cleaning, adjusting, and all other work required to make the Work ready for use.

## 00574.2 Safety Requirements

00574.2.1 Subcontractor shall conduct all operations under this Subcontract in a manner that avoids the risk of bodily harm and damage to property. At a minimum, Subcontractor shall comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements. Subcontractor's failure to comply with the requirements of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements constitutes a material breach of this Subcontract.

00574.2.2 When at the jobsite, Subcontractor shall continuously inspect all Work and conduct surveys of all Work areas to identify any unsafe condition and shall immediately take adequate precautions against any unsafe condition identified. Subcontractor is solely and exclusively responsible for the discovery and correction of such conditions. Subcontractor agrees that nothing contained in this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements shifts responsibility for bodily harm or damage to property sustained resulting from violation of those provisions from Subcontractor to Owner or Purchaser. Subcontractor remains solely and exclusively responsible for compliance with all safety requirements.

00574.2.3 Subcontractor shall immediately correct any unsafe condition identified by Purchaser. If, in Purchaser's sole discretion, Subcontractor has not taken sufficient precautions for the avoidance of bodily harm and damage to property, or in response to Purchaser's identification of an unsafe condition, Purchaser may stop the Work at Subcontractor's expense or implement suitable precautions at Subcontractor's expense, or both. Purchaser's right to stop the Work and to implement suitable precautions does not impose on Purchaser a duty to exercise those rights and does not relieve Subcontractor of responsibility for damage resulting from violation of this Article 00574.2, Section 00575, the Loss Control Manual, or Owner's safety requirements.

00574.2.4 Compliance with this Article 00574.2, Section 00575, the Loss Control Manual, and Owner's safety requirements is the minimum standard required of Subcontractor. Subcontractor is responsible for examining all Work-related requirements and determining whether additional or more stringent health and safety provisions are required or appropriate for the Work. Subcontractor shall notify Purchaser promptly in writing if a charge of noncompliance with this Article 00574.2, Section 00575, the Loss Control Manual or Owner's safety requirements has been filed against Subcontractor or a Sub-subcontractor in connection with the performance of the Work.

## 00574.3 Labor

Subcontractor shall designate a supervisor at the jobsite who has the authority to act on behalf of and to bind Subcontractor in all matters relating to or arising out of this Subcontract. The supervisor must be fluent in English. Subcontractor agrees to replace, at no cost to Purchaser, any Sub-subcontractor or any personnel of Subcontractor or Sub-subcontractor who Purchaser reasonably requests be replaced.

## 00574.4 Work Hours

Typical Work days consist of a Monday through Friday schedule with a 7am start at the earliest, and a 6pm finish at the latest. Saturday Work may be permitted as necessary. Sunday Work will not be permitted, unless deemed by the Program Manager to be of a critical or emergency nature. No Work is



permitted on Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Thursday and Friday, Christmas Eve, Christmas and New Year's Day, during the Subcontract duration.

For weekend operations, requests must be submitted in writing by Wednesdays at 5pm.

In cases where the Program Manager does not have the resources available to observe Saturday, Sunday, and/or night work, the request will be denied, and no time extension or impact will be considered.

Night Work, when deemed necessary by the Program Manager; will be permitted as requested (48-hour advanced notice required). Noise attenuated equipment for night work is required when working in residential neighborhoods.

# 00574.5 Protection and Restoration of Property

00574.5.1 Subcontractor shall, at its expense, protect the Work, the environment, and all other property from hazards arising out of or relating to the Work and from natural elements. Subcontractor shall, at its expense, promptly repair or remove and replace any damage or loss and, to the extent practicable, restore property affected by the Work to its original condition, as determined by Purchaser. Subcontractor is solely responsible for protection of the Work until Final Completion.

00574.5.2 At the completion of the Work, Subcontractor shall remove all Subcontractor-furnished items that are not intended to become a permanent part of the project from the jobsite and shall remove and deposit in Subcontractor-furnished waste facilities all scrap, trash, waste materials, and debris resulting from the Work. Subcontractor shall thoroughly remove all accumulations of dust, scraps, waste, oil, grease, weld spatter, insulation, paint, and other foreign substances resulting from performance of the Work and shall restore all surfaces affected by those substances.



# 00575 - Safety, Health and Accident Prevention

## 00575.1 Project Safety and Health Program

Purchaser will implement and coordinate the overall Project Safety and Health Program as defined in the Loss Control Manual which is available for inspection at <a href="http://www.sarp10.com/safety/">http://www.sarp10.com/safety/</a>.

## 00575.2 Safety, Health, and Accident Prevention Program

00575.2.1 Subcontractor shall implement and maintain a written Safety, Health and Accident Prevention Program specifically applicable to the Work. Subcontractor's Safety, Health and Accident Prevention Program must meet the requirements of Applicable Laws and adhere to the Project Safety and Health Program, if implemented by Purchaser. Subcontractor shall submit Subcontractor's Safety, Health and Accident Prevention Program for Purchaser's review at least thirty calendar days before starting Work at the jobsite. Purchaser's review does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's review limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

00575.2.2 Purchaser may monitor Subcontractor's safety and health performance and may require changes to Subcontractor's Safety, Health and Accident Prevention Program during the performance of the Work. Purchaser's monitoring and requirement of changes does not relieve Subcontractor of Subcontractor's sole responsibility for safety and health in relation to the Work, nor does Purchaser's monitoring and requirement of changes limit Subcontractor's obligation to undertake any action necessary to establish and maintain safe working conditions relating to the Work at the jobsite.

## 00575.3 Hazardous Waste Project Health and Safety Plan

00575.3.1 Subcontractor understands that the Work involves hazardous substances or hazardous wastes. Subcontractor shall comply with all Applicable Laws, Owner's facility rules and regulations, and applicable guidance documents. Subcontractor shall prepare and implement a jobsite-specific Hazardous Waste Project Health and Safety Plan, based on Subcontractor's Safety, Health and Accident Prevention Program and all written programs required by Applicable Laws. Subcontractor is responsible for the completeness and accuracy of Subcontractor's Hazardous Waste Project Health and Safety Plan. Subcontractor shall submit Subcontractor's Hazardous Waste Project Health and Safety Plan. Subcontractor shall submit Subcontractor's Hazardous Waste Project Health and Safety Plan to Purchaser at least thirty calendar days before starting Work at the jobsite and shall maintain a copy at the jobsite for review by Purchaser, Owner, and regulatory personnel.

00575.3.2 Before starting Work at the jobsite, Subcontractor shall submit written verification that:

- (a) personnel assigned to the Work have received forty-hour health and safety training that meets the requirements of 29 CFR 1910.120(e) or 1926.65(e);
- (b) the assigned field supervisor has completed eight hours of supervisor training that meets the requirements of 29 CFR 1910.120(e)(4) or 1926.65(e)(4); and
- (c) personnel assigned to the Work are participating in a medical surveillance program that meets the requirements of 29 CFR 1910.120(f) or 1926.65(f).

## 00575.4 Protective Clothing, Equipment and Instrumentation

Subcontractor agrees to furnish special protective clothing, respiratory protective equipment, and monitoring instrumentation as required by Applicable Laws, the project's safety-related plans and programs, and Purchaser's and Owner's rules and regulations. Subcontractor shall ensure that personnel performing Work at the jobsite properly use the clothing, equipment, and instrumentation. Subcontractor shall furnish and maintain all safety equipment, including but not limited to, barriers, signs, warning lights, and guards necessary for adequate protection of persons and property.



#### 00575.5 Safety and Health Representative

The Subcontractor shall identify a qualified person to be its representative for Environmental, Safety, Health & Security matter and make this person available as needed and requested by the Purchaser. The representative must have authority to correct unsafe conditions and to stop Work in the area of an unsafe condition. In addition, the representative shall routinely visit the jobsite.

#### 00575.6 Safety and Health Goal

Subcontractor shall endeavor to attain the project's safety goal of zero injuries. Subcontractor shall maintain accurate accident and injury reports and shall furnish Purchaser a monthly summary of injuries and man-hours lost due to injuries by the third of each month. Subcontractor accident rates must be calculated monthly in accordance with the Bureau of Labor Statistics incident rate, frequency rate, and days away from work rate methods. If Subcontractor or Sub-subcontractor accident rates exceed the project's safety goal, Subcontractor shall take immediate corrective action, which may include, but is not limited to:

- (a) Submittal of a written corrective action plan to Purchaser by Subcontractor;
- (b) Additions or modifications to Subcontractor's Safety, Health and Accident Prevention Program;
- (c) Removal from the jobsite of any Subcontractor or Subcontractor personnel not implementing or following the necessary safety and health measures; and
- (d) Increasing the amount of Subcontractor safety and health training.

## 00575.7 Drug Prevention Program

As part of the Work, Subcontractor shall assist Purchaser in administering the project requirements for a drug detection and prevention program. Subcontractor agrees that all costs for drug testing and alcohol testing are included in the Subcontract price. Subcontractor must provide evidence to Purchaser that all personnel assigned to the Work at the jobsite have passed the drug test within three calendar days of completion of the test. The drug detection and prevention program will include, but will not be limited to, the following: (a) a pre-jobsite assignment test; and (b) post-jobsite assignment tests, such as reasonable suspicion tests, post-accident tests, and unannounced random drug tests of ten percent of the workforce on a monthly basis.

## 00575.8 Fall Protection

The OSHA Fall Protection Standard 29 CFR 1926 Subpart M shall be strictly adhered to by the Subcontractor. Fall protection is required for all of Subcontractor's Work operations one hundred percent of the time, whether climbing, traveling, or working. NO WORK OPERATION is exempt from the six (6) foot fall protection requirement.

Prior to starting work operations requiring fall protection, Subcontractor shall submit to Purchaser a fall protection plan. The fall protection plan shall include, but not be limited to, the following:

- Name of qualified person in charge of operation.
- Description of work operation.
- List of fall exposures.
- Description of fall protection methods used to eliminate fall exposures.
- Training and enforcement methods used to ensure employee compliance with the plan.

Fall protection body harnesses, lanyards, and lifelines shall be used in accordance with OSHA Standard 1926 Subpart 502D, with the following exceptions:



- Full body harnesses shall be used in lieu of safety belts.
- Only lanyards with shock absorbers and locking type snap hooks shall be used.
- At least two lanyards shall be used to provide one hundred percent fall protection when moving around obstructions, connection points, or other similar items.

Fall protection guardrail systems shall comply with OSHA Standard 1926 Subpart 502(b) except manila, plastic, or synthetic rope shall not be used as guardrails.

## 00575.9 Sub-subcontractor Safety Prequalification

Prior to any Sub-subcontractor performing Work on the Jobsite the Sub-subcontractor must obtain a Subsubcontractor safety prequalification from Purchaser. In order to obtain the safety prequalification, Subcontractor or its Sub-subcontractor shall submit to Purchaser evidence that the Sub-subcontract has an Experience Modification Rating or equivalent rating of 1.0 or less and that incident rates (Recordable Incident Rate, Loss Time Incident Rate, and Days Away/Restricted or Job Transfer rate) are below the national average during the last three years. In addition, Subcontractor or Sub-subcontractor must submit sufficient information to allow Purchaser to evaluate any Occupational Safety and Health Administration (OSHA) violations received by Sub-subcontractor within the last three years and any other documentation Purchaser may reasonably require. Purchaser's safety manager will review the submission and provide a safety prequalification if Purchaser, in its sole discretion, determines the Sub-subcontractor meets Purchaser's safety requirements. Subcontractor or its Sub-subcontractor must submit the requirements prior to Sub-subcontractor first mobilizing to the Jobsite.

## 00575.10 Confined Spaces

All employees entering confined spaces and all attendants for such entries including supervisors shall receive confined space entry training and emergency rescue training at a minimum of once per year.

## 00575.11 Third Party Medical Triage

Subcontractor shall retain the services of a third-party medical triage company that meets the following criteria:

- Must employ medical doctors that understand occupational medicine and the rules set forth by OSHA for first aid treatment of work-related injuries and illnesses
- Ability to provide virtual real-time consultation with medical doctors for injury triage, with injured worker
- Available 24 hours a day, 7 days per week, and 365 days per year

Subcontractor shall require retention of identical services for each subcontractor, with the further requirement that each lower tier subcontractor shall include identical requirements in any lower tier subcontracts, which might in turn be made.



# **00672 - General Conditions Attachments**

## 00672.1 Partial Waiver and Release of Lien Rights

#### AFFIDAVIT AND <u>PARTIAL</u> WAIVER OF CLAIMS AND LIENS AND RELEASE OF RIGHTS FOR SUBCONTRACTORS

The undersigned, who is the			(designate title) of
	which is the	Subcontractor	(designate whether
subcontractor, supplier or other	wise) for the <u>Raleig</u>	h Millington Sewer I	mprovements (designate the
type of work, supplies or servic	es rendered) on the imp	rovements construct	ted on the premises hereafter
identified, declares that his or h	er contract with <b>Overla</b> r	nd Contracting, Inc	. (Purchaser) is in the total
amount of \$	_, which includes extras	and all change orde	ers to the date hereof.

The undersigned further states that as of _	(date) the	e total value of work
completed, and material stored is \$	Of this amount \$	has
been received (the receipt and sufficiency of which	is hereby acknowledged by the	undersigned including
\$ in payment of Payment Application	on or Invoice Number	).

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to **Overland Contracting, Inc. (Purchaser)** any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or **Overland Contracting, Inc. (Purchaser)** or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

## Project Name: Raleigh Millington Sewer Improvements

## Address of Project:

City: <u>Memphis</u>	County: <u>Shelby</u>	State: TN	Zip Code:
----------------------	-----------------------	-----------	-----------

The undersigned further represents and warrants that he or she is duly authorized and empowered to sign and execute this waiver on his or her own behalf and on behalf of the company or business for which he or she is signing; that he or she has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner through the date of said payment application or invoice; that he or she has paid for all the labor, materials, equipment, and services that he or she has used or supplied to the above premises through the date of said payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against **Overland Contracting, Inc.** (**Purchaser**) as of the date of the aforementioned payment application; and that any materials which have been supplied or incorporated into the above premises were either taken from his or her fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)** for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.


SARP10 Program	Raleigh Millington	RFB Issue
421810.71.0419	Sewer Improvements	02May2025

The undersigned further accepts and acknowledges the receipt of the aforesaid sums in full accord and satisfaction for the aforementioned claims with full knowledge that the contractors. City of Memphis (Owner) and Overland Contracting, Inc. (Purchaser), their successors and assigns, are relying thereon; and furthermore, the undersigned agrees to perform, now and in the future, each and every covenant and provision of this written contract or supplier's agreement (as the case may be) as modified or changed in writing with Overland Contracting, Inc. (Purchaser) or any subcontractor of Overland Contracting, Inc. (Purchaser) hereby acknowledging that said contract or supplier's agreement is now in full force and effect.

In addition, for and in consideration of the amounts and sums received, the undersigned hereby waives, releases and relinquishes any and all claims, rights or causes of action whatsoever arising out of or in the course of the work performed on the above-mentioned project, contract or event transpiring prior to the date hereof, excepting the right to receive payment for work performed and properly completed and retainage, if any, after the date of the above-mentioned payment application or invoices.

Signed and delivered the	day of	, 20
--------------------------	--------	------

Company \_\_\_\_\_

By: \_\_\_\_\_\_\_(Printed Name)

(Signature)

Title:

Before me, the undersigned Notary Public in and for the said County and State, personally appeared

\_\_\_\_\_, and acknowledged execution of the foregoing affidavit as his or her voluntary act and deed and further stated that the facts recited are true of his or her personal knowledge.

My Commission Expires: \_\_\_\_\_

Notary Public

Residence County/State:



# 00672.2 Final Waiver and Release of Lien Rights

### AFFIDAVIT AND <u>FINAL</u> WAIVER OF CLAIMS AND LIENS AND RELEASE OF RIGHTS FOR SUBCONTRACTORS

The undersigned, who is the _			(designate title) of
	which is the	Subcontractor	(designate whether
subcontractor, supplier or other	wise) for the <u>Raleig</u>	h Millington Sewer I	mprovements (designate the
type of work, supplies or service	es rendered) on the imp	rovements construct	ed on the premises hereafter
identified, declares that his or he	er contract with <b>Overla</b> r	nd Contracting, Inc.	. (Purchaser) is in the total
amount of \$	, which includes extras	and all change orde	ers to the date hereof.

The undersigned further states that a	as of	(date) all work on said project has been					
performed and completed in accordance with the plans and specifications for the project, and said wor							
has been accomplished in accordance	has been accomplished in accordance with the terms and conditions of his or her subcontract and those						
documents which, by reference, are a	part of said subcontract.	The total value of work completed and					
material stored is \$	Of this amount \$	has been received (the					
receipt and sufficiency of which is here	by acknowledged by the	undersigned including \$					
in payment of Payment Application or I	Invoice Number	<u>)</u> .					

In consideration of the amounts and sums received, the undersigned does hereby waive and release to the **City of Memphis (Owner)** and to **Overland Contracting, Inc. (Purchaser)** any and all claims and liens and rights to liens upon the premises described below and upon improvements now thereon, and upon the monies or other considerations (due as of the date of the aforesaid payment application or invoices from the **City of Memphis (Owner)** or **Overland Contracting, Inc. (Purchaser)** or from any other person, firm or corporation), said claims and liens and rights to liens being on account of labor, services, materials, fixtures or apparatus heretofore furnished by or at the request of the undersigned. The premises as to which said claims and liens and rights to liens are hereby released are identified as follows:

# Project Name: Raleigh Millington Sewer Improvements

#### Address of Project:

City: Memphis County: Shelby State: TN Zip Code: \_\_\_\_\_

The undersigned further represents and warrants that he or she is duly authorized and empowered to sign and execute this waiver on his or her own behalf and on behalf of the company or business for which he or she is signing; that he or she has properly performed all work and furnished all the materials of the specified quality per plans and specifications and in a good and workmanlike manner as required by the contract; that he or she has paid for all the labor, materials, equipment, and services that he or she has used or supplied to the above premises as required by the contract; that he or she has no other outstanding and unpaid payment applications, invoices, retentions, holdbacks, chargebacks or unbilled work or materials against **Overland Contracting, Inc. (Purchaser)**; and that any materials which have been supplied or incorporated into the above premises were either taken from his or her fully-paid or open stock or were fully paid for and supplied as stated on the payment application or invoice.

The undersigned further agrees to reimburse and does hold harmless and fully indemnify the **City of Memphis (Owner)** and **Overland Contracting, Inc. (Purchaser)** for any losses or expenses should any such claims, lien or right to a lien be asserted (by the undersigned or by any laborer, materialman or subcontractor of the undersigned), including, without implied limitation, attorneys' fees incurred in the defense thereof.



SARP10 Program 421810.71.0419	Raleigh Millington Sewer Improvements					
The undersigned further accepts satisfaction for the aforementioned <b>(Owner)</b> and <b>Overland Contracti</b> thereon; and furthermore, the und covenant and provision of this writ or changed in writing with <b>Overlan</b> <b>Contracting, Inc. (Purchaser)</b> he full force and effect.	s and acknowledges the receip d claims with full knowledge tha i <b>ng, Inc. (Purchaser)</b> , their suc lersigned agrees to perform, no tten contract or supplier's agree <b>nd Contracting, Inc. (Purchas</b> ereby acknowledging that said o	t of the aforesaid sums in full accord and at the contractors, <b>City of Memphis</b> accessors and assigns, are relying w and in the future, each and every ement (as the case may be) as modified <b>er)</b> or any subcontractor of <b>Overland</b> contract or supplier's agreement is now in				
In addition, for and in considerat releases and relinquishes any and course of the work performed on t date hereof, except retainage, if a invoices.	tion of the amounts and sums r d all claims, rights or causes of the above-mentioned project, co ny, after the date of the above-	eceived, the undersigned hereby waives, action whatsoever arising out of or in the ontract or event transpiring prior to the mentioned payment application or				
Signed and delivered the	day of	, 20				
Company		-				
By: (Printed Name)		-				
(Signature)		-				
Title:		-				
Before me, the undersigned Notar	ry Public in and for the said Cou, and ac	unty and State, personally appeared knowledged execution of the foregoing				
affidavit as his or her voluntary ac personal knowledge.	t and deed and further stated th	hat the facts recited are true of his or her				
My Commission Expires:	<u> </u>					
Notary Public						
Residence County/State:						



# 00672.3 Certificate of Nondiscrimination

As Bidder, Contractor, or Subcontractor on Purchaser's Contract, **Raleigh Millington Sewer** Improvements

The undersigned states that it does not discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national origin or sex and, if awarded a contract for this project, agrees in performance of work:

- 1. Not to discriminate against any subcontractor, employee, or applicant for employment on the grounds of race, color, national original or sex;
- 2. To maintain payrolls of laborers and mechanics employed on this contract until seven (7) years after final release and final payment by the City;
- 3. To require a similar certificate to be executed by each subcontractor at the time a subcontract is executed under the contract with the requirement that such subcontractor agrees to require a similar certificate of requirement on any lower tiers of subcontracts.
- 4. To conform to federal law, state statutes, executive orders, and local ordinances identified and listed under Non-discrimination.

Subcontractor's Name

Date

Signature

Printed or Typed Name and Title

# THIS FORM MUST BE SUBMITTED WITH THE BID OR THE BID MAY BE CONSIDERED NON-CONFORMING.



SARP10 Program	Raleigh Millington	RFB Issue
421810.71.0419	Sewer Improvements	02May2025

### 00672.4 Equal Business Opportunity Program

This form must be submitted with Bidder's bid. Failure to execute and submit this document with Bidder's bid may cause the Bid to be rejected as non-conforming. In addition, each Sub-Subcontractor must execute the form.

This Subcontract will be subject to the requirements of the City of Memphis Ordinance #5384 which establishes the Equal Business Opportunity ("EBO") Program. It is up to the Respondent to ensure that all requirements of this ordinance are met. The Ordinance may be accessed on the City's website at <u>www.memphistn.gov</u> under "Business – Contract Compliance". The intent of the EBO Program is to increase the participation of locally owned minority and women owned business enterprises ("M/WBE").

SARP10 DBE Participation Goal: DBE minimum **15%** (Vendors from the City of Memphis EBO list only)

#### **Participation Plan**

The Participation Plan must include: (1) level and dollar amount of participation your firm anticipates achieving in the performance of contract resulting from this RFB; (2) the type of work to be performed by the M/WBE participation; and (3) the names of the M/WBE and/or DBE firm(s) the Respondent plans to utilize in the performance of the contract resulting from this RFB.

#### Eligible M/WBE and/or DBE Firms

To qualify as a M/WBE firm, per the requirements of City of Memphis Ordinance #5384, a firm must be included on the City of Memphis EBO list of certified M/WBE firms.

A list of the City's eligible M/WBE firms may be requested from Purchaser as a guide only. If a Bidder desires to utilize an M/WBE firm not included on the list, it is the Bidder's responsibility to confirm that the desired firm is certified by the City of Memphis. Such confirmation must be obtained from the City's Contract Compliance Office, in writing, before the bid/response due date. Requests for verification must be submitted to the City's Contract Compliance Office listed below:

Ken Moody City of Memphis, Contract Compliance Office 125 North Main Street, Suite 546 Memphis, TN 38103 Phone: (901) 576-6210 Fax: (901) 576-6560 Email: <u>ken.moody@memphistn.gov</u>



## MINORITY/WOMEN BUSINESS ENTERPRISE COMPLIANCE FORM

#### SUBCONTRACT TITLE: Raleigh Millington Sewer Improvements

Project Participation Goal: DBE minimum 15%

The following sections must be completed by Bidder. A certified subcontractor or supplier is defined as a firm from the list of certified firms provided with this specification.

Bidder's Name

<u>Section A</u> - If the Bidder is a certified firm, so indicate here with a check mark.

\_\_\_\_\_ MBE \_\_\_\_\_ WBE \_\_\_\_\_ DBE

<u>Section B</u> - Identify below those certified firms that will be employed as subcontractors or suppliers on this Project. By submitting this Proposal, the Bidder commits to the use of the firms listed below.

\$ = Show the dollar value of the subcontract to be awarded to this firm

% = Show the percentage this subcontract is of your base Proposal

M/WBE = Show by inserting an M or W whether the subcontractor is an MBE or WBE

<u>\$</u>	<u>%</u>	M/WBE	DBE	CERTIFIED SUBCONTRACTOR NAME, ADDRESS, TEL #
\$	%		= Total	M/WBE and/or DBE

THIS FORM MUST BE SUBMITTED WITH THE PROPOSAL OR THE PROPOSAL MAY BE CONSIDERED NON-CONFORMING



00672.5 Report of Disadvantaged Business Enterprise Participation Form (1 page)



# SUBCONTRACTOR'S REPORT OF **DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION**

Project Name: Raleigh Millington Sewer Improvements Month of , 2025						
General Contractor:						
Contact Person:	Telephone:					
Address:	Email:					
Amount of Subcontract: _\$	MBE %: WBE %:					
DBE Information: Circle Either M	BE or WBE and Complete Form.					
MBE / WBE Firm Name:	Contact Person:					
Date of Award:	Contract Value: <u></u>					
Completed to Date: _\$	Paid to Date:_\$					
Work Description:	Telephone:					
Amount Invoiced This Period: _\$	_ Email:					
MBE / WBE Firm Name:	Contact Person:					
Date of Award:	Contract Value: <u>\$</u>					
Completed to Date: _\$	Paid to Date: _\$					
Work Description:	Telephone:					
Amount Invoiced This Period: _\$	_ Email:					
MBE / WBE Firm Name:	Contact Person:					
Date of Award:	Contract Value: <u>\$</u>					
Completed to Date: _\$	Paid to Date: _\$					
Work Description:	Telephone:					
Amount Invoiced This Period: _\$	_ Email:					
MBE / WBE Firm Name:	Contact Person:					
Date of Award:	Contract Value: <u></u>					
Completed to Date: _\$	Paid to Date:_\$					
Work Description:	Telephone:					
Amount Invoiced This Period:	_ Email:					

# Attach additional pages as required.

General Contractor's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# 00672.6 Not Used



# 00672.7 Bid Bond

Know all men by these presents, that we, the undersigned,

	as
Principal, and	as surety,
Hereby held and firmly bound unto the sum of and truly to be made, We hereby jointly and severally bine successors and assigns.	as Owner on for the payment of which, well d ourselves, our heirs, executors, administrators,

Signed this \_\_\_\_\_\_ day of \_\_\_\_\_\_, 2025.

This condition of the above obligation is such that whereas the principal has submitted to the Purchaser a certain bid, attached hereto and hereby made a part of hereof to enter into a contract in writing for the construction of:

#### SARP 10 Program 421810.71.0419 Raleigh Millington Sewer Improvements

Now therefore,

- A) If said bid shall be rejected, or in the alternative,
- B) If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto (properly completed in accordance with said bid), required insurance certificates, and shall furnish a Bond for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bond,

Then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the amount of this obligation as herein stated.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extension of the time within which the Purchaser may accept such bid; and said surety does hereby waive notice of any such extension.

In witness whereof, the principal and the surety hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year set forth above.

#### CONTRACTOR

\_\_\_\_\_

Contractor's Company Name

Signature (principal)

Printed or Typed Name and Title

Surety Name

By:

Attorney in Fact - Signature

**SURETY** 

Printed or Typed Name and Title



# 00672.8 Schedule Impact Due to Weather

Program Manager will determine Contractor's entitlement to an extension of the Contract Time as a result of weather delays, based on the data included in Tables 1 and 2. Extensions of time will be granted at the discretion of the Program Manager for circumstances not covered by the flow chart.

The following rules apply to any analysis for weather related delays to this Project. Weather delay days may be awarded if the first two rules are met. Additional days may be awarded if conditions in Rule 3 are met for unusually heavy precipitation independent of Rules 1 and 2.

Rule 1: The average monthly precipitation amount must have been exceeded.

If the total amount of actual precipitation in a month exceeds the average for that month shown in Table 1, the first test has been met. Go to rule number 2. (Precipitation is defined as the quantity of water deposited by rain, hail, sleet, or snow.)

<u>Rule 2</u>: The number of days in a month with actual precipitation greater than the threshold amount shown in Table 2 has been exceeded.

The numbers of days with actual precipitation greater than the threshold amounts shown in Table 2 are eligible for award as weather delays days. Additional days may be awarded for unusually heavy precipitation independent of meeting the rules above.

Rule 3: Unusually heavy precipitation has occurred.

Precipitation greater than one inch in a single day may be justification for an additional day, time extension for each precipitation day. This rule may be applied singly but not in addition with any other rule.

# National Weather Service Data for Memphis International Airport – Years 2014-2024

#### Table 1

			Ave	erage Pre	cipitation	by Mont	h (In Incl	nes)			
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4.48	6.13	7.20	5.57	4.26	4.75	5.22	4.31	2.83	4.08	3.78	5.85

# Table 2

		Average	e Numbei	r of Days	with Pre	cipitation	Greater	than 0.2	5 Inches		
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	6	6	6	5	4	5	4	2	4	4	6

Any weather-related extension of Contract time shall be non-compensable. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather days is less than expected, shall contribute to the project float and shall not affect the Contract Times. Application for a weather-related extension of time shall be submitted to the Program Manager and shall state the extension requested and be supported by the relevant weather data.



# 00672.9 SARP10 Safety Guidelines

#### Black & Veatch Memphis SARP10 Safety Guidelines

Anyone working for the SARP10 Program must comply with these basic safety requirements, except where their individual employer's safety requirements are more stringent. It is the employer's responsibility to ensure that their employees are informed of the Project safety policies and that they work in compliance with the Program safety policies.

Black & Veatch is committed to the safety and health of all employees, subcontractors, vendors and visitors. In our effort to minimize hazards and provide the safest worksite possible, we expect all workers on the Program to know and practice the following safe work rules as a minimum. The following rules are not all inclusive.

# Noncompliance with the Rules We Live By will result in removal from the Program.

# Rules We Live By

- **Confined Spaces** Comply with all requirements of Confined Space Entry permits and DO NOT enter a confined space without a permit.
- **Fall Protection** Comply with the Fall Protection procedures when working above the applicable working height. Always use 100 percent of the fall protection techniques when tying off. Note: An open manhole is a fall exposure and must be protected.
- Lock Out Tag Out (LOTO) Follow all Lock Out/Tag Out procedures at all times.
- **Trench and Excavation** Do not start any excavation activities without a Trench & Excavation permit and comply with all requirements. Excavations must be properly sloped, shored or shielded before entering, and proper access/egress must be in place.
- **Drugs and Alcohol** Drugs and alcohol have NO place in the work environment. Do NOT come to work if you are under the influence of illegal drugs or alcohol.
- You Make a difference today. Don't walk by any unsafe situation and be a Safety Leader.

# PPE Requirements

- Safety glasses with side shields, ANSI Z87.1 approved are mandatory on the worksite.
- Hard hats, ANSI Z89.1 approved, with no modifications or deformities are mandatory on the worksite.
- Good quality, over the ankle, work boots with safety toes (steel toe) are required. Sneakers of any kind are prohibited.
- High visibility work vests with reflective markings shall be worn in all construction areas. Must be ANSI Class II specification as and be fluorescent (orange or lime green)
- You are the person most responsible for your safety. Observe and obey all signs and barricades.

# **General Safety and Health Requirements**

- 100% fall protection is required when working on unprotected surfaces at or above 6 feet. Full body harnesses and shock absorbing lanyards with double locking hooks are the only acceptable method of personnel fall protection.
- DO NOT use the top two steps of a step ladder or the top three steps of a straight ladder. Use the 3-point rule (both feet / one hand or two hands / one foot) when using ladders.
- When on site, be aware of moving vehicles and equipment. Before traveling in front of or behind pieces of equipment make eye contact with the operator and wait for an indication to proceed. Spotters are required at all times.
- DO NOT cross a red barricade without permission from the owner of that barricade.
- Immediately correct safety hazards if within your authority. If you cannot make the correction report it to your supervisor. Unresolved hazards or conditions not corrected by the previous methods must be brought to the attention of the Site Project Manager.
- Immediately report injuries, fires, spills, near misses, accidents or unsafe conditions or practices to the Safety Department.
- Pay attention to barricades, signs and announcements.

# 00770 – Loss Control Manual

The Loss Control Manual is available for viewing on the SARP10 website:

http://www.sarp10.com/safety/

Contact Tom Gilmer, Safety Manager for additional information:

mailto:GilmerTR@bv.com

(913) 458-4207



# **Technical Specifications**

**PLEASE NOTE:** Any drawings and / or maps relating to this RFB package will be available for viewing and / or downloading on the SARP10 website.



# **SPECIFICATIONS**

# City of Memphis Raleigh Millington Sewer Improvements For SARP 10

A2H No. 21117.06

Prepared By:



ENGINEERS · ARCHITECTS · PLANNERS

A2H, Inc.

3009 Davies Plantation Road Lakeland, TN 38002 901.372.0404 www.A2H.com





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# SECTION 00115

# LIST OF DRAWING SHEETS

SHEET NO	SHEET NAME	<b>REV DATE</b>
G0.0	COVER	
C0.0	GENERAL NOTES	
C0.1	FEMA FLOOD EXHIBIT	
C1.0	DEMOLITION PLAN	
C2.0	SITE PLAN (OVERALL)	
C2.1	SITE PLAN (ENLARGEMENT 1)	
C2.2	SITE PLAN (ENLARGEMENT 2, ALTERNATE 1)	
C2.3	SITE PLAN (ENLARGEMENT 3)	
C2.4	SITE PLAN (ENLARGEMENT 4, ALTERNATE 2)	
C4.0	EROSION PREVENTION & SEDIMENT CONTROL PLAN	
C6.1	12 IN FORCE MAIN PLAN & PROFILE (STA. 10+00 - STA. 24+00)	
C6.2	12 IN FORCE MAIN PLAN & PROFILE (STA. 24+00 - STA. 39+00)	
C6.3	12 IN FORCE MAIN PLAN & PROFILE (STA. 39+00 - STA. 54+40.40)	
C6.4	12 IN FORCE MAIN PLAN & PROFILE (STA. 52+01.12 - STA. 67+00)	
C6.5	12 IN FORCE MAIN PLAN & PROFILE (STA. 67+00 - STA. 82+00)	
C6.6	12 IN FORCE MAIN PLAN & PROFILE (STA. 82+00 - STA. 97+20)	
C6.7	12 IN FORCE MAIN PLAN & PROFILE (STA. 97+20 - STA. 105+00)	
C6.8	2 IN FORCE MAIN PLAN & PROFILE (STA. 10+00 - STA. 24+00)	
C6.9	2 IN FORCE MAIN PLAN & PROFILE (STA. 24+00 - STA. 38+00)	
C6.10	2 IN FORCE MAIN PLAN & PROFILE (STA. 38+00-STA. 45+13)	
C7.0	TRAFFIC CONTROL PLAN - PHASE-1	
C7.1	TRAFFIC CONTROL PLAN - PHASE-1	
C7.2	TRAFFIC CONTROL PLAN - PHASE-1	
C7.3	TRAFFIC CONTROL PLAN - PHASE-1	
C7.4	TRAFFIC CONTROL PLAN - PHASE-2	
C7.5	TRAFFIC CONTROL PLAN - PHASE-2	
C7.6	TRAFFIC CONTROL PLAN - PHASE-2	
C7.7	TRAFFIC CONTROL PLAN - PHASE-2	
C7.8	TRAFFIC CONTROL PLAN - PHASE-3	
C7.9	TRAFFIC CONTROL PLAN - PHASE-3	
C7.10	TRAFFIC CONTROL PLAN - PHASE-3	
C7.11	TRAFFIC CONTROL PLAN - PHASE-3	
C7.12	TRAFFIC CONTROL PLAN - PHASE-4	
C7.13	TRAFFIC CONTROL PLAN - PHASE-4	
C7.14	TRAFFIC CONTROL PLAN - PHASE-4	
C10.0	DETAILS	
C10.1	DETAILS	
C10.2	DETAILS	
C10.3	DETAILS	

C10.4	DETAILS	
C10.5	DETAILS	
E0.0	COVER SHEET	
E1.0	ELECTRICAL OVERALL SITE PLAN	
E1.1	ENLARGED SITE PLAN - NEW PUMP STATION	
E1.2	ENLARGED SITE PLAN - NEW PUMP STATION YARD	
E1.3	ENLARGED SITE PLAN - FIRE STATION	
E2.0	ELECTRICAL DETAIL	
E2.1	ELECTRICAL DETAIL	
S0.0	GENERAL STRUCTURAL NOTES	
S1.0	PUMP STATION & VALVE VAULT FOUNDATION & LID FRAMING	

# **END OF SECTION**

#### SECTION 00801 AIRPORT CONSTRUCTION SAFETY REQUIREMENTS

#### PART 1 GENERAL

#### 1.01 SUMMARY

- A. This section contains the minimum level of safety requirements for construction projects at Memphis International Airport, General DeWitt Spain Airport, and/or Charles W. Baker Airport.
- B. Related work:
  - 1. Other contract documents affecting construction safety include, but are not limited to, the DIVISION 0 AND DIVISION 1 specifications.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION

#### 3.01 CONTRACTOR PERSONNEL SAFETY ORIENTATION

A. The Contractor shall be responsible for briefing all construction personnel on the requirements contained in this section prior to their working in the construction area and at periodic intervals throughout the course of the contract. These briefings will be documented in writing.

#### 3.02 SCHEDULING WORK

- A. See Specification section 01100, SEQUENCE OF CONSTRUCTION & LIQUIDATED DAMAGES.
- B. See General Provision Section 80, Paragraph 80-04, Limitation of Operations.

#### 3.03 CONSTRUCTION SECURITY

A. See Specification section 00802, AIRPORT SECURITY REQUIREMENTS.

## 3.04 LIMITATION ON CONSTRUCTION

- A. The limits of construction, material storage areas, equipment parking and other areas defined as available for the contractor's exclusive use during construction shall be identified and defined by the contractor prior to starting work on the project. Temporary barricades, flagging and flashing caution lights may be required at access points, taxiway crossings and pavement tie-ins. The type markings, barricades and flashing caution lights are designated on the construction plans and must be inspected and approved by the Airport Authority.
- B. The Contractor shall store all materials and park construction equipment, when not in use only in the areas designated on the plans or during the pre-construction conference.
- C. Stockpiling of dirt and construction materials shall be constrained in a manner preventing movement resulting from jet blast or wind in excess of 10 knots.
- D. Construction debris, waste, wrappings or loose material capable of causing damage to aircraft engines, propellers, or landing gear shall not be allowed on active aircraft movement areas. Material meeting this criteria shall be contained and removed immediately from the AOA.
- E. Open flame, welding, or torch cutting operations are prohibited in the construction area unless written permission has been given by the Airport Authority and adequate fire and safety precautions have been taken.
- F. The use or possession of explosives is prohibited on Airport property.
- G. Extensive stockpiles of construction materials will not be permitted near runway ends, runway edges, taxiways or aircraft parking aprons.
- H. Excavation and open trenches may be permitted within runway safety areas and up to the edge of structural pavement on taxiways and aprons, on a case-by-case basis, i.e. cable trenches, pavement tie-ins, etc.; but only with prior approval of the Owner and, where required, the FAA.

I. Hazardous areas, into which no part of an aircraft may enter, (i.e., excavations, open trenches, material stockpiles, etc.) must be permanently delineated by use of barricades with alternate orange and white markings. The barricades are to be supplemented with orange flags (20x20 inch minimum) made and installed so that they are always in the extended position and properly oriented. For nighttime use, the barricades are supplemented with flashing red lights. Light intensity and barricade spacing must adequately delineate the hazardous area. Flare pots are prohibited.

Note: The Contractor shall designate an individual by name who is on call 24 hours per day for emergency maintenance of airport hazard lighting and barricades.

J. FAA approval is required in advance of scheduled operation of any crane or other construction equipment with top elevation exceeding 300 feet mean sea level or that will penetrate any navigable surface as defined under FAR PART 77. Advance notification of intended use will be provided by the Owner well in advance of intended use.

# 3.05 CONSTRUCTION VEHICLE TRAFFIC

- A. Access to the construction site is as shown on the plans or as directed by the Owner. No other access point is authorized unless designated in writing by the Airport Authority. Construction traffic will operate only on designated haul routes within the construction area limits.
- B. Drivers of construction vehicles will be knowledgeable of construction routes or will be escorted by other Contractor or Owner designated personnel who are knowledgeable.
- C. The Contractor will be responsible for traffic control in the various construction areas of the work site. The Contractor will not permit unauthorized personnel or vehicles on the construction site.
- D. The Contractor shall be responsible for immediate cleanup of any debris deposited along construction routes, as result of his construction traffic.
- E. Directional signing at the construction access gate and along the delivery route to work site temporary storage areas shall be as designated and approved by the Owner.
- F. Construction vehicle identification shall be as prescribed in Specification Section 00802, AIRPORT SECURITY REQUIREMENTS.
- G. No construction vehicle is authorized on any active AOA pavement surface or to enter runway safety areas without specific authorization from the Owner.

# 3.06 REPORTING PROPERTY DAMAGE OR PERSONNEL INJURY

- A. All persons involved in any accident whether personal injury, aircraft or automotive, occurring on Airport property, shall make a full report to the Airport Police (922-8298) as soon after the accident as possible. The report shall include, but not be limited to, the names, addresses of all principals and witnesses, if known, and a statement of the facts. Construction accidents fall under this category.
- B. In the event of personnel injury, call 911.

# END OF SECTION

#### SECTION 00802 AIRPORT SECURITY REQUIREMENTS

# PART 1 GENERAL

#### 1.01 CONTRACTORS SECURITY AND VEHICLE PROCEDURES OVERVIEW

A. This overview outlines procedures concerning Airport security requirements, vehicle operation, and maintenance requirements for contractors at Memphis International Airport or any airport owned and operated by the Memphis-Shelby County Airport Authority. The sponsor Memphis-Shelby County Airport Authority (Airport Authority), airline, tenant, or concessionaire at the Airport who has hired the contractor is responsible for ensuring the contractor understands and complies with all the rules and regulations. This is a consolidated synopsis of the contractor requirements from the Airport Security Program and the Airport Rules and Regulations.

#### 1.02 DEFINITIONS

- A. Aircraft shall mean any contrivance known or hereinafter invented, used or designed for navigation of or flight in the air.
- B. Air Operations Area (AOA) that part of the Airport used or intended to be used for landing, taking off, surface maneuvering, loading, unloading, or servicing the aircraft.
- C. Airport shall mean the Memphis International Airport and/or the General DeWitt Spain Airport and/or the Charles W. Baker Airport where applicable.
- D. Airport Restricted Area area of Memphis International Airport that is not intended for public uses or access. These are areas designated by the Airport Authority as restricted areas and clearly identified with signs designating those areas as "RESTRICTED AREA." The restricted area also includes the AOA.
- E. AOA Driver's Permit permit issued by the Airport Authority for operating unescorted motor vehicles on the AOA.
- F. Construction Restricted Area any area, inside or outside of the Airport Restricted Area, which is fenced, or in some like manner defined by the Contractor. The Contractor is responsible for the security of the Construction Restricted Area.
- G. Director shall mean the Director of Operations and Public Safety or his duly authorized representatives.
- H. Job Site a predetermined geographic area with specific boundaries established by the Airport Authority.
- I. Movement Area runways, taxiways, and other areas of the Airport used for taxiing, takeoff, and landing of aircraft, except loading ramps and parking areas.
- J. Personal Escort remaining within sight of the individual under escort at all times while in the Airport restricted areas at a distance not to exceed 20 feet.
- K. Public Area any area within Airport facilities open to the general public.
- L. SIDA Security Identification Display Area.
- M. Unescorted Identification Badge pictured identification badge issued by the Airport Authority, which allows bearer to enter Airport Restricted Areas where there is a job related need.
- N. Vehicle Escort means the following of an authorized escort vehicle into the Airport Restricted Areas.

# PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

#### 3.01 AMENDMENTS AND SPECIAL NOTICES

- A. The Contractor will be bound by any future amendments, additions, deletions, or corrections of the Airport Rules and Regulations promulgated by the Airport Authority, as dictated by changes in Federal Transportation Security Administration (TSA) regulations, as dictated by changes in Federal Aviation Administration (FAA) regulations, or safety requirements at Memphis International Airport or any airport owned and operated by Memphis-Shelby County Airport Authority.
- B. Special regulations, notices, memoranda, or directions of an operations nature of interest to persons engaged in business with the Airport Authority, as generated by the Director, shall be issued under the authority of the Airport Regulations and shall have the same effect as the Airport Rules and Regulations.
- C. The Director is authorized to interpret and construe these regulations wherever necessary, either by directions of general or specific application, and his interpretation and construction should be deemed a part of the regulations and binding upon all persons.

#### 3.02 ENFORCEMENT AND COMPLIANCE WITH AIRPORT REGULATIONS

- A. The uniformed Airport Police Officers of the Airport Authority and other representatives as designated by the Director are empowered to require compliance with Airport Rules and Regulations, ordinances of the City of Memphis, laws of the State of Tennessee, and federal rules and regulations. No authority is either hereby expressed or implied, however, that would permit any individual other than the Director to change, alter, or amend Airport Rules and Regulations.
- B. It shall be unlawful for any person to do or commit any act forbidden herein or fail to perform any act required by Airport Rules and Regulations.

#### 3.03 SCOPE

- A. All users of and persons on Airport property shall be governed by the Airport Rules and Regulations and directions of the Director. Airport Rules and Regulations are subject to change by the Airport Authority Board of Directors at any time.
- B. Airport Rules and Regulations are not intended to amend, modify or supersede federal, state, or local laws or regulations.
- C. If any portion of the Airport Rules and Regulations shall be invalid or unenforceable, all other portions shall remain in effect and be construed to achieve the purposes hereof.

# 3.04 IDENTIFICATION REQUIREMENTS

A. Identification badges are not required on this project.

# 3.05 VEHICLE PARKING AND OPERATION

- A. General.
  - 1. All streets on the Airport shall have the status of dedicated city streets for the purpose of traffic enforcement.
  - 2. Motor vehicles operated on the public roadways and parking lots of the Airport shall be governed by the traffic ordinance of the city and state laws applicable and, in addition thereto, the following regulations shall be applicable.
- B. Traffic Rules and Regulations in the Air Operations Area.
  - 1. The driver of any motor vehicle operating within the Airport boundary shall comply with the lawful orders, signals or directives of Airport Police Officers.

- 2. All drivers operating motor vehicles within the Airport boundary must possess a valid state driver's license.
- 3. Riding on trailer hitches, fenders, or on any portion of a vehicle not equipped with proper seats, running boards, or handholds is prohibited. Standing up in a moving motor vehicle, riding outside of a moving motor vehicle, or riding with arms or legs protruding from the body of the vehicle is prohibited.
- 4. All vehicle lights shall be lighted during the hours of darkness or during the time of reduced visibility when said vehicle is being operated in the restricted area.
- 5. No person shall operate any motorized vehicle when vision is restricted due to the load being carried, or for any other reason.
- 6. No person under the influence of alcoholic beverages or narcotic drugs shall operate any motor vehicle or motorized equipment on the Airport.
- 7. It shall be the responsibility of the operator to ascertain that the vehicle is in good operating condition. Operators are required to check proper operation of the vehicle's brakes before commencing any operation on airport.
- 8. Vehicles dripping oil, gasoline, water, or debris of any kind, shall be restricted.
- 9. Pedestrians and aircraft shall at all times have right-of-way over vehicular traffic. All vehicles must pass to the rear of taxiing aircraft.
- C. Radio Equipment.
  - 1. All vehicles operating in the aircraft movement area must be equipped with a two-way radio and, when the movement area is being controlled, be in continuous communication with the Control Tower, unless being escorted by authorized escort vehicle.
  - 2. The installation of two-way radios does not permit the operation of vehicles on the Airport without proper authorization of the Director.
- D. Contractor Employee Parking.
  - 1. Employee parking is not available on the job site. The Contractor must provide for remote parking for employees and transport them to the job site.
- E. Authorized Contractor Vehicles.
  - 1. Unless otherwise authorized, the Contractor and each subcontractor shall be permitted to have no more than one (1) vehicle per trade on the job site. All Contractor vehicles authorized access to Airport restricted areas shall be:
    - a. Owned or hired by the Contractor or subcontractor;
    - b. Insured under company policy;
    - c. On a pre-approved list; and
    - d. Marked in accordance with Airport regulations.
  - 2. Passenger type vehicles, including pickup trucks, must have the company name displayed on each front door of the vehicle. The company name must be readable, but at a minimum (the letter size shall be 4.5"). The vehicle must display the appropriate Airport registration decal. Specialized equipment such as bulldozers, cranes, etc., will be exempted from this requirement.
  - 3. Cranes used during daylight hours shall have a red flag affixed to the top of boom. Cranes shall have a red obstruction light on the top of boom when used at night. Crane booms shall not be left erect when not in use or following end of workday.
- F. Emergency Vehicles and Conditions.
  - 1. Any person operating a motor vehicle on the air operations area shall immediately yield the right-of-way to the police, ambulance, fire department, or other emergency vehicle giving an audible or visual signal or as otherwise directed by an Airport law enforcement officer or fire/rescue department personnel.
  - 2. Emergency conditions existing on the air operations area will not mitigate or cancel existing regulations for non-emergency vehicles in areas not affected by the emergency.

- 3. Under emergency conditions such as an aircraft accident or fire, access to the scene is denied to all vehicles or persons except those whose duties require their presence. Permits and licensing shall be rendered invalid in the area of emergency conditions and the Airport Authority shall determine when normal operations may be resumed.
- G. Passing Aircraft.
  - 1. All vehicles shall pass to the rear of taxiing aircraft and shall pass no nearer than 200 feet horizontal distance.
- H. Passenger Concourse.
  - 1. No motorized vehicles or carts of any type shall be used in any concourse or terminal lobby unless approved by the Director.
  - 2. No vehicle or motorized equipment shall be driven under concourses except at authorized vehicle pass-throughs designated by the Director.
- I. AOA Driving Lanes.
  - 1. Vehicles on the aircraft parking apron at the terminal and air cargo buildings shall be operated within the marked driving lanes and in compliance with marked traffic control signs except for the following:
    - a. Authorized vehicles engaged in parking apron repair and inspection; and
    - b. Vehicles exceeding a width of 12 feet which shall follow marked lanes as closely as possible.
  - 2. Vehicles shall enter and exit designated driving lanes at a point nearest to the origin and destination.
  - 3. No vehicles or equipment shall be parked in a manner as to obstruct any portion of the driving lanes.
- J. Taxiing Aircraft.
  - 1. Vehicles shall yield to taxiing aircraft or aircraft under tow.
- K. Speed Limits.
  - 1. No person shall operate a motor vehicle or other motorized equipment at a speed greater than the following:
    - a. Five miles per hour in designated drives under the terminal;
    - b. Fifteen miles per hour on paved service roads in the vicinity of the terminal and air cargo buildings; or
    - c. Twenty-five miles per hour on all aprons or ramps unless the area has an otherwise posted speed limit.
    - d. Fifteen miles per hour on all aprons or ramps at General DeWitt Spain Airport and Charles W. Baker Airport unless the area has an otherwise posted speed limit.
- L. Inspection of Vehicles.
  - 1. Contractors authorized to operate vehicles on the air operations area shall be responsible for ensuring that each motor vehicle is inspected at least each 12 months by a qualified mechanic, is in good mechanical condition and has all the required safety equipment.
  - 2. The Contractor shall remove from service any vehicle, which, in the opinion of the Director, is defective and in need of repair and said vehicle will not be returned to service until properly repaired.
- M. Violations of Restricted Area Traffic Regulations.
  - 1. The penalties for a violation of restricted area traffic regulations shall be as follows:
    - a. First offense within any 12-month period: retraining;
    - b. Second offense within any 12 month period: retraining and fine not to exceed \$50.00;
    - c. Third offense within any 12 month period: retraining and fine not to exceed \$100.00; and

- d. Fourth offense within any 12 month period: revocation of privilege to drive in restricted area (unescorted or escorted).
- 2. The above set penalties do not negate the right of the Airport Authority to immediately revoke driving privileges, dependent upon the seriousness of the violation.
- N. Vehicle Registration.
  - 1. The Contractor shall list all construction vehicles requiring passage through the access gate on the "AOA Access Decal Request Form," which will be provided upon request.
  - 2. Each vehicle approved will be issued a windshield decal, which must be affixed to the driver's side of the windshield. This decal is not transferable. Only those vehicles so marked will be allowed through the access gate with the following exceptions:
    - a. dump trucks;
    - b. concrete trucks;
    - c. vehicles making deliveries; and
    - d. cranes, tracter, etc.
- O. Delivery Vehicles.
  - 1. Each day the Contractor shall give the access gate guard a written list of deliveries expected. No delivery will be cleared into the restricted area unless it is on the list or the construction supervisor is contacted for clearance.

#### 3.06 GENERAL INFORMATION

- A. Access to Public Facilities.
  - 1. Contractor employees are not authorized to use public facilities, (i.e., rest rooms, eating facilities, boarding gate hold rooms or other public areas of the terminal), except as specifically authorized by the Airport Authority and as necessary for access to job site.
  - 2. Contractors shall provide adequate rest room and break facilities within the job site and staging areas as appropriate.
  - 3. All public areas authorized for use by the Contractor's employees are to be kept in a clean and sanitary manner, free of all construction debris.
- B. Accident Reports.
  - 1. All persons involved in any accident whether personal injury, aircraft or automotive, occurring on Airport property, shall make a full report to the Airport Police (922-8298) as soon after the accident as possible. The report shall include, but not be limited to, the names, addresses of all principals and witnesses, if known, and a statement of the facts. Construction accidents fall under this category
  - 2. To request paramedics call 911.
- C. Airport Rules and Regulations.
  - 1. The Contractor shall conform to the "Memphis-Shelby County Airport Authority Rules and Regulations."
  - 2. The Contractor shall conform to "Memphis-Shelby County Airport Authority's Air Operations Area Rules and Regulations and its Airport Security Program."
- D. Alcoholic Beverages and Narcotic Drugs.
  - 1. No person shall have any alcoholic beverages or narcotic drugs on Airport property.
- E. Damages.
  - 1. Contractors shall be fully responsible for all damages to buildings, equipment, real property and appurtenances in the ownerships or custody of the Airport Authority caused by negligence, abuse or carelessness on the part of their employees, agents, customers, visitors, suppliers or persons with whom they do business.
- F. Disorderly Conduct.
  - 1. No person shall commit any disorderly, obscene or indecent act nor commit any nuisance.

- 2. Abusive behavior by Contractor supervisors or their employees will not be tolerated.
- G. Debris and Cleanup.
  - 1. No person shall dispose of any garbage, trash, refuse or any other material on the Airport except in the receptacles provided for that purpose.
  - 2. No person shall dispose of any fill or building materials or any other materials on Airport property except in such areas as are specifically designated by the Director.
  - 3. Contractors are responsible for the cleanliness of the job site and access to the job site as appropriate. All Contractors must establish an active ongoing program to eliminate any foreign objects which may cause damage to aircraft or cause personal injury to other persons. Contractors must pay particular attention to haul routes used to and from the job site to clean up any debris which may be tracked onto or dropped on the air operations area. Contractor will immediately remove such debris to eliminate the hazard. END OF THE WORKDAY CLEANUP WILL NOT SUFFICE. Cleanup shall be done to the satisfaction of the Airport Authority. All Active taxiway crossings and work areas adjacent to the taxiways shall be kept clean.
  - 4. If it should become necessary for the Airport Authority to remove debris left by a Contractor, the Contractor shall be billed at 2 1/2 times the actual cost of the cleanup or a minimum of \$250 per trip whichever is greater.
- H. Firearms and Explosives.
  - 1. No person shall have any firearm, explosive or incendiary device on or about their person or accessible property while on Airport property.
- I. Fire Equipment.
  - 1. All Contractors shall supply and maintain adequate and readily accessible fire extinguishers for the particular hazard involved as directed by the Airport Authority or the Fire Marshal. All fire apparatus shall be maintained in first class operable condition.
  - 2. The Contractor shall maintain the following items on site:
    - a. Two-pound dry chemical extinguisher, or
    - b. Four-pound carbon dioxide extinguisher.
  - 3. Carbon tetrachloride chlorobromethene or other vaporizing liquid extinguishers are not permitted inside buildings due to their high toxicity unless approved in writing by the Fire Marshal.
- J. Gambling.
  - 1. No person shall conduct gambling in any form or operate gambling devices anywhere on Airport property.
- K. Hazards.
  - 1. No person shall use flammable volatile liquids having a flash point of less than 100oF in cleaning of parts, appliances, or for any other purpose unless such operations are conducted in the open air not within 50 feet of an aircraft, away from structures and equipment or in properly ventilated, approved paint booths.
  - 2. No person shall keep or store any flammable liquids, gases, oil, oil wastes, flares, paints, or other similar material in any building within the Airport boundary except that such materials may be kept in specially provided rooms or receptacles approved by the Fire Marshal.
  - 3. Contractors shall provide suitable metal receptacles with covers for the storage of wastes, rags, or other rubbish.
  - 4. No person shall start any open fires of any type, including flare posts, torches or fires in containers formerly used for oil, paint, or similar materials on any part of an Airport without permission of the Director.
- L. Picketing and Public Demonstrations.

- 1. Subject to applicable federal, state and local regulations and laws, no persons shall walk in a picket line as a picketer or take part in any labor or other public demonstration on any Airport property or facilities therein except in those places which may be specifically assigned for use of such picket lines or other public demonstration by the Director.
- M. Restricted Areas.
  - 1. No persons shall enter any area posted as being restricted or closed to the public except for the following:
    - a. Persons assigned to duty therein;
    - b. Persons authorized by the Director; or
    - c. Persons under contractual agreement with the Airport Authority or tenants of the Airport Authority.
  - 2. All persons in restricted areas of Memphis International Airport must be duly authorized and must have displayed on their person an official identification badge which will clearly establish the individual by name, contractor affiliation, and construction project completion date.
  - 3. The identification badge must be worn on the outermost garment above the waist except in those cases where there exists an overriding safety consideration approved by the FAA.
- N. Signs on the Airport.
  - 1. Signs may not be installed in public view on the Airport without prior approval of the Airport Authority. Proposals should be documented and submitted to the Airport Authority with an accompanying sketch depicting the general appearance and location of the desired sign, and the name and telephone number of an individual to contact.
- O. Smoking.
  - 1. Smoking cigarettes, cigars, pipes, and electronic cigarettes is prohibited in all hangars, buildings, rooms, terminals, and aprons of the Airport unless posted as a designated smoking area. This regulation applies to all public and non-public areas including restaurants, bars, lounges, and tenant leased areas except as expressly authorized in writing by the President. No person shall smoke or carry lighted cigars, cigarettes, pipes, matches or any naked flame in or on any fuel storage areas, Air Operations Area, public aircraft parking and storage area, in any other place where smoking is specifically prohibited by signs or upon any open space within 50 feet of any fuel carrier which is not in motion. Smoking by tank vehicle drivers, helpers, repairmen, or other personnel is prohibited while they are driving, making deliveries, filling or making repairs to tank vehicles. No person shall smoke or permit any open flame within 100 feet of any aircraft undergoing fuel service or within at least 50 feet of any hangar or building.
- P. Storage of Equipment.
  - 1. Contractors shall store or stock material or equipment in a neat and orderly manner and in a manner not to constitute a hazard to personnel or property.
- Q. Trash Containers.
  - 1. Areas to be used for trash and garbage containers shall be designated by the Director and no other areas shall be used. Only trash containers approved by the Director shall be used by contractors for the collection of trash and garbage. The placement of trash or garbage outside approved containers is strictly prohibited.
- R. Utilities.
  - 1. The following instructions must be adhered to without exception:
    - a. No contractor or employee for any craft shall turn off any utilities without contacting the Airport Authority. This includes water, electrical and HVAC;
    - b. No one shall open any electrical substations, distribution or motor control centers without first notifying the Airport Authority. No branch circuits shall be turned off or on, without obtaining permission from the Airport Authority; and

- c. No one shall turn off the water or the HVAC or open any drain lines without notifying the Airport Authority.
- 2. All notifications for utility disruption must be made through the Airport Authority and coordinated with as much notice as possible but a minimum of 72 hours prior to scheduled shutoff.
- 3. The Airport Authority has a responsibility to keep the Airport in operation; it is your responsibility to conform to the above instructions. You may contact the Airport Authority.

# FOR ANY QUESTIONS CONCERNING SECURITY REGULATIONS CONTACT THE SECURITY COORDINATOR AT 901-922-8146

#### END OF SECTION

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01140 WORK RESTRICTIONS

### PART 1 – USE OF PREMISES

1.01 The Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment, the Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against the Owner by any such owner or occupant because of the performance of the Work, the Contractor shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. The Contractor shall indemnify and hold the Owner harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequently out of any action, legal or equitable, brought by any such other party against the Owner to the extent based on a claim arising out of the Contractor's performance of the Work.

1.02 During the progress of the Work, the Contractor shall keep the premises free from accumulations of 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, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by the Owner. The Contractor shall restore to original condition all property not designated for alteration by the Contract Documents.

1.03 The Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall the Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

## PART 2 – RIGHTS-OF-WAY AND EASEMENTS

2.01 The Owner will provide lands, including rights-of-way, permanent easements, and temporary construction easements considered by the Owner to be sufficient for the construction of the facilities included in the Contract. Reference is made to Section 01700.

2.02 The Contractor, at his expense, shall provide any additional land, by temporary agreement or other means, required by him for storage of equipment and materials or for construction activities. He shall be responsible for obtaining temporary agreements or property owner's permission as necessary to gain access to the site of the Work and to lands provided by the Owner for that Work. The above is considered to be incidental to the Work, and no additional payment to the Contractor will be made.

2.03 Should lands to be provided by the Owner not be acquired on some portions of the Project after the Notice to Proceed is issued or after Work is under way, and should such conditions delay the progress of the Work, an extension will be made to the Contractor by the Owner on the time allowed for the Contract in an amount to be determined by the Owner. No other considerations or compensation will be due the Contractor from the Owner for delays of Work due to the inability of the Owner to acquire rights-of-way or easements by a specific time.

2.04 The Contractor will be held responsible for any damage to crops or property outside the lands provided by the Owner for the construction of the Project.

2.05 The Contractor is warned that the locations of utilities and obstructions within the lands provided and shown on the Plans are approximate only and are not intended as an accurate and completed representation. Obstructions and utilities not shown on the Plans but encountered by the Contractor must also be removed and, if necessary, replaced in the original state or protected by the Contractor at no cost to the Owner. Utilities are considered to be all publicly and privately owned facilities for providing services such as electrical power, natural gas, water, telephone, and CATV but excluding City owned

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01140 WORK RESTRICTIONS

sewer and drainage facilities and traffic control equipment. If utilities are encountered in the construction, whether shown on the Plans or not, the Contractor shall be subject to the provisions of Specification Section 01710.

# PART 3 – MAINTENANCE OF TRAFFIC AND ACCESS TO PROPERTIES

#### 3.01 TRAFFIC CONTROL PLAN.

No road, street, or highway, or any lane or section thereof, shall be closed to traffic an no construction operations that will for any reason render the roadway or any lane or section of the roadway unsuitable for use of the traveling public shall be started until a Traffic Control Plan as described in Section 02890, Division 2 of these specifications has been approved by the Owner.

# 3.02 MAINTENANCE OF TRAFFIC.

Unless otherwise stipulated in the Contract Documents, all roads and streets, while under construction, shall be kept open to all traffic by the Contractor. Where so provided on the Plans, the Contractor may direct the traffic over approved detour routes. The Contractor shall keep the portion of the Project being used by public traffic in such condition that traffic will be adequately and safely accommodated. He shall also provide and maintain in a safe condition temporary approaches, or access to, crossings and intersections with trails, roads, streets, businesses, parking lots, railroads, residences, garages, and farms. The Contractor shall bear all expense of maintaining traffic over the section of road or street under construction and maintaining such approaches, crossings, intersections, or other features as may without direct compensation, except that materials used at the direction of the Owner to be necessary construct and maintain such approaches, crossings, intersections, and other features will be paid for by the Owner at Contract unit prices. All public roads and streets that are designated on the Plans as detours, but not designated as "Haul Roads", will be maintained by the Owner; however, detour roads constructed by the Contractor shall be maintained by the Contractor for the life of the Contract at no additional cost to the Owner other than the first cost of construction.

## 3.03 PUBLIC USE DURING CONSTRUCTION.

After the completion of any length of pavement for a road or street considered usable by the Owner, the same shall be opened for public traffic; however, such public use will not constitute an acceptance of that section by the Owner. The Contractor shall maintain such sections until final acceptance by the Owner.

# 3.04 MAINTENANCE OF ACCESS TO PROPERTIES.

The Contractor must maintain proper, sufficient, and continuous ingress and egress to private properties and access to buildings unless otherwise specified in the Contract Documents or where temporary interference to access is authorized by the Owner. Provision shall be made for owners and occupants to reach their premises. The Contractor shall provide access to private properties by bridging, use of steel plates, or other means acceptable to the Owner. Where temporary interference is authorized, it shall be interrupted only for such time as necessary to provide temporary substitutes for surfaces disturbed by the construction and to restore street and sidewalk surfaces after the completion of the Work. The expense to the Contractor in fulfilling the obligations of this subsection (01140 para. 3.04) are considered incidental to the Contract, and no extra compensation will be allowed.

# PART 4 – WORK IN PRIVATE PROPERTY

4.01 Where Work is done in private property and easements thereon, the Contractor shall conduct his operations so as to cause the property owners the least inconvenience. The Work shall be completed without delay and the premises cleaned up and all walks, driveways, fences, streets, shrubbery, trees, turfed areas and similar facilities, repaired or replaced.

#### PART 5 – MAINTENANCE DURING CONSTRUCTION

5.01 The Contractor shall maintain the Work of any Project involving public traffic of any kind during construction until the Project or authorized sections thereof are complete and accepted by the Owner.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01140 WORK RESTRICTIONS

This maintenance shall constitute continuous and effective Work prosecuted day by day, with adequate equipment and forces so that the facilities affecting traffic are kept in satisfactory condition at all times.

# END OF SECTION 01140

# PART 1 – GENERAL

- 1.1 Scope. Welding, cutting, open torches and other hot work operations and equipment shall comply with this section.
- 1.2 Permits. Permits shall be required as set forth in Section 3.3.
- 1.3 Restricted areas. Hot work shall only be conducted in areas designed or authorized for that purpose by the personnel responsible for a Hot Work Program. Hot work shall not be conducted in the following areas unless approval has been obtained from the fire code official:
  - 1. Areas where the sprinkler system is impaired.

2. Areas where there exists the potential of an explosive atmosphere, such as locations where flammable gases, liquids or vapors are present.

3. Areas with readily ignitable materials, such as storage of large quantities of bulk sulfur, baled paper, cotton, lint, dust, or loose combustible materials.

- 4. At other locations as specified by the fire code official.
- 1.4 Cylinders and containers. Compressed gas cylinders and fuel containers shall comply with this chapter and Chapter 30 of the 2009 International Fire Code (2009 IFC).
- 1.5 Design and installation of oxygen-fuel gas systems. An oxygen-fuel gas system with two or more manifold cylinders of oxygen shall be in accordance with NFPA 51.

# PART 2 - DEFINITIONS

2.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown below.

HOT WORK. Operations including cutting, welding, Thermite welding, brazing, soldering, grinding, thermal spraying, thawing pipe, installation of torch-applied roof systems or any other similar activity.

HOT WORK AREA. The area exposed to sparks, hot slag, radiant heat, or convective heat as a result of the hot wok.

HOT WORK EQUIPMENT. Electric or gas welding or cutting equipment used for hot work.

HOT WORK PERMITS. Permits issued by the City of Memphis Fire Prevention Bureau for the facility where hot work operations will be conducted.

HOT WORK PROGRAM. A permitted program, carried out by the City of Memphis Fire Prevention Bureau. The intent is to have trained; on-site, responsible personnel ensure that required hot work safety measures are taken to prevent fires and fire spread.

RESPONSIBLE PERSON. A person trained in the safety and fire safety considerations concerned with hot work. Responsible for reviewing the sites prior to the commencement of hot work operations and following up as the job progresses.

TORCH-APPLIED ROOF SYSTEM. Bituminous roofing systems using membranes that are adhered by heating with a torch and melting asphalt back coating instead of mopping hot asphalt for adhesion.

3-28-16

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01141 – WELDING AND OTHER HOT WORK

# PART 3- GENERAL REQUIREMENTS

3.1 General. Hot Work conditions and operations shall comply with this chapter.

3.2 Temporary and fixed hot work areas. Temporary and fixed hot work areas shall comply with this section.

3.3 <u>Hot work program permit</u>. Hot work permits shall be requested from:

City of Memphis Fire Prevention Bureau 2668 Avery Avenue Memphis, TN 38112 Ph (901) 636-5401 Fire.Prevention@memphistn.gov

An approved Hot Work Permit must be on site prior to the commencement of any hot work operations.

3.4 Signage. Visible hazard identification signs shall be provided where where the hot work area is accessible to persons other than the operator of the hot work equipment, conspicuous signs shall be posted to warn others before they enter the hot work area. Such signs shall display the following warning:

## CAUTION HOT WORK IN PROGRESS STAY CLEAR.

# PART 4 – FIRE SAFETY REQUIREMENTS

4.1 Protection of combustibles. Protection of combustibles shall be in accordance with Section 4.1.1 through 4.1.9.

4.1.1 Combustibles. Hot Work areas shall not contain combustibles or shall be provided with appropriate shielding to prevent sparks, slag or heat from igniting exposed combustibles.

4.1.2 Openings. Openings and cracks in walls, floors, ducts or shafts within the hot work area shall be tightly covered to prevent the passage of sparks to adjacent combustible areas, or shielded by metal fire-resistant guards, or curtains shall be provided to prevent passage of sparks or slag.

4.1.3 Housekeeping. Floors shall be kept clean within the hot work area.

4.1.4 Conveyor systems. Conveyor systems that are capable of carrying sparks to distant combustibles shall be shielded or shut down.

4.1.5 Partitions. Partitions segregating hot work areas from other areas of the building shall be noncombustible. In fixed hot work areas, the partitions shall be securely connected to the floor such that no gap exists between the floor and the partition. Partitions shall prevent the passage of sparks, slag, and heat from the hot work area.

4.1.6 Floors. Fixed hot work areas shall have floors with noncombustible surfaces.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01141 – WELDING AND OTHER HOT WORK

4.1.7 Precautions in hot work. Hot work shall not be performed on containers or equipment that contains or has contained flammable liquids, gases or solids until the containers and equipment have been thoroughly cleaned, inert or purged; except that "hot tapping" shall be allowed on tanks and pipe lines when such work is to be conducted by approved personnel.

4.1.8 Sprinkler protection. Automatic sprinkler protection shall not be shut off while hot work is performed. Where hot work is performed close to automatic sprinklers, noncombustible barriers or damp cloth guards shall shield the individual sprinkler heads and shall be removed when the work is completed. If the work extends over several days, the shields shall be removed at the end of each workday.

4.1.9 Fire detection systems. Approved special precautions shall be taken to avoid accidental operation of automatic fire detection systems.

4.2 Fire watch. Fire watches shall be established and conducted in accordance with Sections 4.2.1 through 4.2.6

4.2.1 When required. A fire watch shall be provided during hot work activities and shall for a minimum of 30 minutes after the conclusion of the work. The fire code official, or the responsible manager under a hot work program, is authorized to extend the fire watch based on the hazards or work being performed.

Exception: Where the hot work area has no fire hazards or combustible exposures.

4.2.2 Location. The fire watch shall include the entire hot work area. Hot work conducted in areas with vertical or horizontal fire exposures that are not observable by a single individual shall have additional personnel assigned to fire watches to ensure that exposed areas are monitored.

4.2.3 Duties. Individuals designated to fire watch duty shall have fire-extinguishing equipment readily available and shall be trained in the use of such equipment. Individuals assigned to fire watch duty shall be responsible for extinguishing spot fires and communicating an alarm.

4.2.4 Fire training. The individuals responsible for performing the hot work and individuals responsible for providing the fire watch shall be trained in the use of portable fire extinguishers.

4.2.5 Fire hoses. Where hose lines are required, they shall be connected, charged and ready for operation.

4.2.6 Fire extinguisher. A minimum of one portable fire extinguisher with a minimum 2-A:20-B:C rating shall be readily accessible within 30 feet of the location where hot work is performed.

4.3 Area reviews. Before hot work is permitted and at least once per day while the permit is in effect, the area shall be inspected by the individual responsible for authorizing hot work operations to ensure that it is a fire safe area.

4.3.1 Pre-hot work check. A pre-hot work check shall be conducted prior hot work operations to ensure that all equipment is safe and hazards are recognized and protected. A report of the check shall be kept at the work site during the work and available upon request. The pre-hot work check shall determine all of the following:

1. Hot work equipment to be used shall be in satisfactory operating condition and in good repair.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01141 – WELDING AND OTHER HOT WORK

2. Hot work site is clear of combustibles or combustibles are protected.

3. Exposed construction is of noncombustible materials or, if combustible, then protected.

4. Openings are protected.

5. Floors are kept clean.

6. No exposed combustibles are located on the opposite side of partitions, walls, ceilings or floors.

7. Fire watches, where required, are assigned.

8. Approved actions have been taken to prevent accidental activation of suppression and detection equipment in accordance with Sections 4.1.8 and 4.1.9.

9. Fire extinguishers and fire hoses (where provided) are operable and available.

#### PART 5 – GAS WELDING AND CUTTING

5.1 General. Devices or attachments mixing air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall not be allowed unless approved.

5.2 Cylinder and container storage, handling and use. Storage, handling and use of compressed gas cylinders, containers and tanks shall be in accordance with this section.

5.2.1 Cylinders connected for use. The storage or use of a single cylinder of oxygen and a single cylinder of fuel gas located on a cart shall be allowed without requiring the cylinders to be separated when the cylinders are connected to regulators, ready for service, equipped with apparatus designed for cutting or welding and all of the following:

1. Carts shall be kept away from the cutting or welding operation or fire-resistant shields shall be provided.

2. Cylinders shall be secured to the cart to resist movement.

3. Carts shall be in accordance with Section 2703.10.3 of the 2009 IFC.

4. Cylinder valves not having fixed hand wheels shall have keys, handles or nonadjustable wrenches on valve stems while the cylinders are in service.

5. Cylinder valve outlet connections shall conform to the requirements of CGA V-1.

6. Cylinder valves shall be closed when work is finished.

7. Cylinder valves shall be closed before moving the cart.

5.2.1.1 Individual cart separation. Individual carts shall be separated from each other in accordance with Section 2703.9.8 of the 2009 IFC.

5.3 Precautions. Cylinders, valves, regulators, hose and other apparatus and fittings for oxygen shall be kept free from oil or grease. Oxygen cylinders, apparatus and fittings shall not be handled with oily hands, oily gloves, or greasy tools or equipment.
# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01141 – WELDING AND OTHER HOT WORK

5.4 Acetylene gas. Acetylene gas shall not be piped except in approved cylinder manifolds and cylinder manifold connections, or utilized at a pressure exceeding 15 pounds per square inch gauge (psig) (103 kPa) unless dissolved in a suitable solvent in cylinders manufactured in accordance with DOT 49 CPR Part 178. Acetylene gas shall not be brought in contact with unalloyed copper, except in a blowpipe or torch.

5.5 Remote locations. Oxygen and fuel-gas cylinders and acetylene generators shall be located away from the hot work area to prevent such cylinders or generators from being heated by radiation from heated materials, sparks or slag, or misdirection of the torch.

5.6 Cylinders shutoff. The torch valve shall be closed and the gas supply to the torch completely shut off when gas welding or cutting operations are discontinued for a period of 1 hour or more.

5.7 Prohibited operation. Welding or cutting work shall not be held or supported on compressed gas cylinders or containers.

5.8 Tests. Tests for leaks in piping systems and equipment shall be made with soapy water. The use of flames shall be prohibited for leak testing.

## PART 6 – ELECTRIC ARC HOT WORK

6.1 General. The frame or case of electric hot work machines, except internal-combustion-engine-driven machines, shall be grounded. Ground connections shall be mechanically strong and electrically adequate for the required current.

6.2 Return circuits. Welding current return circuits from the work to the machine shall have proper electrical contact at joints. The electrical contact shall be periodically inspected.

6.3 Disconnecting. Electrodes shall be removed from the holders when electric arc welding or cutting is disconnected for any period of 1 hour or more. The holders shall be located to prevent accidental contact and the machines shall be disconnected from all power source.

6.4 Emergency disconnect. A switch or circuit breaker shall be provided so that fixed electric welders and control equipment can be disconnected from the supply circuit. The disconnect shall be installed in accordance with NFPA 70.

6.5 Damaged cable. Damaged cable shall be removed from service until properly repaired or replaced.

## PART 7 – CALCIUM CARBIDE SYSTEMS

7.1 Calcium carbide storage. Storage and handling of calcium carbide shall comply with Chapter 27 of of the 2009 IFC and Chapter 9 of NFPA 51.

## PART 8 – ACETYLENE GENERATORS

8.1 Use of acetylene generators. The use of acetylene generators shall comply with this section and Chapter 6 of NFPA 51 A.

8.2 Portable generators. The minimum volume of rooms containing portable generators shall be 35 times the total gas- generating capacity per change of all generators in the room. The gas-generating capacity in cubic feet per change shall be assumed to be 4.5 times the weight of carbide per charge in

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01141 – WELDING AND OTHER HOT WORK

pounds. The minimum ceiling height of rooms containing generators shall be 10 feet (3048 mm). An acetylene generator shall not be moved by derrick, crane or hoist while charged.

8.3 Protection against freezing. Generators shall be located where water will not freeze. Common salt such as sodium chloride or other corrosive chemicals shall not be utilized for protection against freezing.

## PART 9 - PIPING MANIFOLDS AND HOSE SYSTEMS FOR FUEL GASES AND OXYGEN

9.1 General. The use of piping manifolds and hose systems shall be in accordance with Section 9.2 through 9.7, Chapter 30 of the 2009 IFC and Chapter 5 of NFPA 51.

- 9.2 Protection. Piping shall be protected against physical damage.
- 9.3 Signage. Signage shall be provide for piping and hose systems as follows:
  - 1. Above-ground piping systems shall be marked in accordance with ASME AI3.1.
  - 2. Station outlets shall be marked to indicate their intended usage.
  - 3. Signs shall be posted, indicating clearly the location and identify of section shutoff valves.

9.4 Mani-folding of cylinders. Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be located at least 20 feet away from combustible material such as oil or grease, and gas cylinders containing flammable gases, unless the gas cylinders are separated by a fire partition.

9.5 Identification of manifolds. Signs shall be posted for oxygen manifolds with service pressures not exceeding 200 psig (1379 kPa). Such signs shall include the words:

### LOW-PRESSURE MANIFOLD DO NOT CONNECT HIGH-PRESSURE CYLINDERS MAXIMUM PRESSURE 250 PSIG

9.6 Clamps. Hose connections shall be clamped or otherwise securely fastened.

9.7 Inspection. Hoses shall be inspected frequently for leaks, burns, wear, loose connections or other defects rendering the hose unfit for service.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01270 UNIT PRICES

### PART 1 – PAYMENT

1.01 The Contractor shall receive and accept compensation on the basis of the Contract unit price provisions set forth in Specification Section 00710 Article 4 of the Contract General Conditions, or of other specifications provided for the work.

1.02 In all cases of conflict between unit price and the amount shown on the Proposal Sheets, the unit price shall govern. The amount to be considered in the Proposal will be the product of the quantity shown multiplied by the unit price shown by the Bidder.

1.03 Payment procedures shall be as defined in Specification Section 00710 Article 4 Paragraph 4.2 of the Contract General Conditions.

1.04 Compensation to the Contractor as provided for in the Contract and as described above shall be full payment for completion of the Work as specified, indicated, or directed, and in full accordance with all provisions, stipulations, requirements, and conditions of the Contract; for completing all incidentals thereto; for furnishing all materials, equipment, tools, labor, and incidentals required to complete the Work; for cleaning up the site; and for all risk, loss, damage, or expense of whatever character arising out of the nature or performance of the Work.

1.05 If the "Payment" clause in the Specifications relating to any unit price in the Proposal Sheet(s) requires that the price of any Contract item cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other item which may appear elsewhere in the Specifications.

1.06 When the accepted quantities of Work vary from the quantities in the Proposal Sheet(s), the Contractor shall accept as payment in full, so far as Contract items are concerned, payment at the original Contract unit prices for the accepted quantities of Work done. No allowance will be made on any claim of the Contractor for extra compensation except as provided for in Specification Section 00710 Article 9 of the General Conditions.

### CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 – PRECONSTRUCTION CONFERENCE

1.01 Within ten (10) working days after the Notice to Proceed, but before the Contractor starts the Work at the site, a conference attended by the Contractor, Owner and others as appropriate will be held to discuss the schedules referred to in Specification Section 00710, Articles 3, 4 and 15 of the Contract General Conditions to discuss procedures for handling Shop Drawings and other submittals and for processing the Application for Payment, and to establish a working understanding among the parties as to the Work.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01550 – VEHICULAR ACCESS AND PARKING

## PART 1 – STREET NAME MARKERS AND TRAFFIC CONTROL SIGNS

1.01 Street name markers are to be maintained by the Contractor during the construction period. If construction requires removal of any street name markers, the Contractor shall temporarily reinstall the markers as near the intersections as possible. When construction is completed, the Contractor shall reinstall any markers removed at a location designated by the Owner, except that if the marker is a concrete post it shall be removed and disposed of by the Contractor.

1.02 All regulatory signs shall remain in service unless otherwise approved by the Owner. Existing STOP, YIELD, ONE WAY, DO NOT ENTER, TURNING PROHIBITION, and other regulatory signs are to be maintained by the Contractor during the construction period. All regulatory signs shall remain in service unless approved by the Owner. If any such signs must be removed or temporarily relocated during any phase of the construction, the Contractor shall notify the Owner and receive his approval before removing or relocating signs. The Contractor shall provide temporary signing to replace those removed or replaced as directed by the Owner. The contractor shall notify the Owner when construction has progressed to the point where any such signs removed or relocated can be returned to their proper locations.

1.03 The Contractor shall furnish, install, and remove any temporary parking restriction signs required for construction.

## PART 2 – CONSTRUCTION TRAFFIC CONTROL DEVICES

2.01 Where any land or section of road, street, or highway is closed for construction operations of any type, or when traffic is to be maintained along a road, street, or highway under construction or affected by construction activities, or when any section thereof is opened to traffic prior to completion of all Work on the section, the Contractor shall protect the workers and provide for safe and convenient public travel by providing, erecting, and maintaining to the satisfaction of the Owner and in accordance with the Traffic Control Plan all signs, signals, markings, barricades, warning lights, flaggers, and other traffic control devices required for the type of operation being performed. Construction traffic control devices shall be provided by the Contractor according to the requirements of the Plans and Sections 02890 and 02891 of these Standard Construction Specifications.

2.02 Where detours are used, detour signing meeting the requirements of MUTCD shall be placed along the approaches and complete route of the detour and maintained for the course of the Work. Detour signing shall be included in and installed and maintained according to the Traffic Control Plan.

2.03 Closure of a road, street, or highway to all but local traffic will not relieve the Contractor of the responsibility to provide for safe and convenient public travel. The Contractor shall provide, erect, and maintain according to the Traffic Control Plan and to the satisfaction of the Owner, all traffic control devices necessary to protect the Work and to safeguard local traffic.

## PART 3 - COMPENSATION

3.01 The expense to the Contractor in fulfilling the obligations of this Specification are considered as incidental to the Work of the Contract and no direct compensation will be allowed except that payment to the Contractor for traffic control devices used will be made by the Owner according to Sections 02890 and 02891 of these Standard Construction Specifications.

## PART 1 - SCOPE

This work shall consist of furnishing, erecting, illuminating, handling, and maintaining all construction signs (warning, regulatory, and guide), barricades, and other traffic control devices designated for installation at locations specified by the Plans or the approved Traffic Control Plan, or directed or approved by the Owner for the purpose of handling traffic safely through construction work zones. This work shall include the provision of flaggers or special measures necessary to assure the handling of traffic safety through construction work zones.

## PART 2 - MATERIALS

### 2.01 GENERAL REQUIREMENTS

A. All signs, barricades, markers, lights, and other traffic control devices for use in construction work zones shall meet the requirements of Part VI of the Tennessee Manual on Uniform Traffic Control Devices (MUTCD). Materials used in the fabrication, construction, and installation of the construction signs, barricades, and other traffic control devices shall conform to the requirements of the MUTCD, the Plans, and the section of these Specifications as follows"

1.	Signs	Specification Section 02891 Para. 2.02
2.	Pavement Markings	Specification Section 02760 Para. 2.01
3.	Drums, Cones, Barricades, Barriers, and Warning Lights	Specification Section 01550 Para, 2.02

B. Items are not required to be new. Used items may be acceptable provided the following conditions are met:

- 1. Units are in good repair, clean, and structurally sound.
- 2. Reflective sheeting on any unit is clean and in good repair.
- 3. All legends and messages are sharp, clean, and legible.

4. Reflectivity of said units during the hours of darkness shall provide acceptable, clean and uniform delineation without dead spots.

C. No test reports are required, but the Owner will visually inspect all units and accessories for compliance with the various dimensional and material stipulations noted before approving their use in the work. The approval of any unit for use is subject to satisfactory field performance and does not preclude the Owner ordering replacements for deteriorated, damaged or otherwise unsatisfactory performance of units; said replacements for these previously approved units shall be without additional compensation.

#### 2.02 CHANNELIZING AND WARNING DEVICES.

Reflectorization of channelizing and warning devices shall be accomplished using materials meeting the requirements of Specification Section 02891 Paragraph 2.02 F.

#### A. Traffic Cones.

Traffic cones and tubular markers shall be a minimum of 18 inches in height with a broadened base and shall be made of materials to withstand impact without damage to themselves or to vehicles. Orange shall be the predominant color on cones and tubular markers. For nighttime use they shall be reflectorized or equipped with lighting devices for maximum visibility. The design of traffic cones and tubular markers shall be according to the requirements of Section 6C of the MUTCD.

### B. Vertical Panels.

Vertical panels used as channelizing or warning devices shall be 8 to 12 inches in width and a minimum of 24 inches in height. They shall be orange and white striped and reflectorized. The design or vertical panels shall be according to Section 6C of the MUTCD.

#### C. Drums.

Drums used for traffic warning or channelization shall be approximately 36 inches in height and a minimum of 18 inches in diameter. The markings shall be horizontal, circumferential, orange and white reflectorized stripes meeting the requirements of Section 6C of the MUTCD.

#### D. Barricades.

A barricade is a portable or fixed device having from one to three rails with alternate orange and white reflectorized stripes used to control traffic by closing, restricting, or delineating all or a portion of the right-of-way. Barricades shall be of one of three types: Type I, Type II, and Type III. The characteristics and design of each type of barricade shall be according to Section 6C of the MUTCD.

#### E. <u>High Level Warning Devices.</u>

High level warning devices are used to supplement other controls and warning devices and are designed to be seen over the top of preceding vehicles. They shall consist of an orange diamond and three flags. The lowest point of all three flags shall be no less than 8 feet above the roadway. The design shall be according to the requirements of Section 6C of the MUTCD.

#### F. Warning Lights.

As used herein, warning lights are portable, lens directed, enclosed lights. The color of the light emitted shall be yellow. They may be used either in a steady burn or flashing mode. Warning lights shall be in accordance with the current requirements of ITE Standard for Flashing and Steady Burn Warning Lights (Table 01551-1) and Section 6E of the MUTCD.

#### TABLE 01551-1

#### WARNING LIGHTS

	Type A Low Intensity	Type B <u>High Intensity</u>	Type C <u>Steady Burn</u>
Lens Directional Faces	1 or 2	1	1 or 2
Flashing Rate per Minute	55 to 75	55 to 75	Constant
Flash Duration <sup>1</sup>	10%	8%	Constant
Minimum Effective Intensity <sup>2</sup>	4 Candelas	35 Candelas	
Minimum Beam Candle Power <sup>2</sup>			2 Candelas
Hours of Operation	Dusk to Dawn	24 hrs/day	Dusk to Dawn

<sup>1</sup> Length of time that instantaneous intensity is equal to or greater than effective intensity.

<sup>2</sup> These values must be maintained within a solid angle 9<sup>0</sup> on each side of the vertical axis and 5<sup>0</sup> above and 5<sup>0</sup> below the horizontal axis.

#### 2.03 OTHER CONSTRUCTION TRAFFIC CONTROL DEVICES.

Other construction traffic control devices may be required for a project by the Traffic Control Plan or by the Owner including, but not limited to, illumination of signing, illumination of the work zone, provision of special

signs, provision of special lighted variable message signs and advance warning flashing or sequencing arrow panels, and installation of portable concrete or metal barriers. The requirements for such special traffic control devices shall be included in the Plans or Special Provisions for the Project.

## PART 3 - CONSTRUCTION REQUIREMENTS

### 3.01 GENERAL REQUIREMENTS.

A. A Traffic Control Plan shall be developed by the Owner or Contractor and approved by the Owner before any road, street, or highway, or any section or lane thereof is closed to traffic and construction operations that will for any reason render the roadway generally unsuitable for use of the traveling public are started. Where the Plans and Contract Documents for projects involving roads, streets, and highways do not specify a Traffic Control Plan, and where so required by the Contract Documents, the Contractor shall prepare and submit to the Owner for approval a Traffic Control Plan for the project which shall include, but not be limited to, signing; application and removal of pavement markings; construction; scheduling; closure of streets or lanes; detours; methods and devices for delineation and channelization; placement and maintenance of devices for delineation and channelization; scheduling; traffic regulations; and surveillance and inspection. The Traffic Control Plan shall define in detail the sequence of construction and the proposed number, type, color, size, and placement of construction traffic control devices for each construction phase, all in accordance with Part VI of the Tennessee Manual on uniform Traffic Control Devices for Streets and Highways (MUTCD).

B. The Contractor shall designate or otherwise provide personnel to furnish continuous surveillance over his traffic control operations. This designee will also be available at night to respond to calls involving damage to barricades, lights, signs, and similar items, either through vandalism or traffic accident. The Contractor shall make known the name of the person providing the surveillance at the preconstruction conference.

C. All traffic control devices necessary for the first stage of construction shall be properly placed and in operation before any construction is allowed to start. When work of a progressive nature is involved, such as resurfacing a road under traffic, the necessary signs shall be moved concurrently with advancing operation.

D. All construction signs shall be erected such that all supports are vertical, sign panels generally perpendicular to the travelway and legends horizontal so that they effectively convey the intended message. These signs shall be mounted on stationary or temporary supports as directed by the Owner and dependent on the type work being performed. In general, work being performed at spot locations and of short duration will necessitate the use of temporary supports properly weighted for stability. If the construction signs are not to be lighted, the supports shall not extend above the top edge of the sign panel.

E. The location, horizontal and vertical placement with respect to the pavement, legends, sheeting, dimensions, and spacing of supports of warning signs, barricades, and other traffic control devices shall be as required by the Plans, the Traffic Control Plan, the MUTCD, and as directed or approved by the Owner. The Contractor must advise and have the approval of the Owner prior to installing or removing traffic control devices from the project.

F. During periods of nonuse, construction signs and other devices shall be removed from the work area, or covered with opaque material, or otherwise positioned so they do not convey their message to the traveling public. If covered, the covering material shall be installed in accordance with the Plans and in such manner that no damage will occur to the sign panel during installation. Covering material shall be maintained in a neat manner during its use.

G. All construction signs, barricades, and other devices which require lighting, as designated by Plans or directed by the Owner, shall be provided with warning lights or electric incandescent or

fluorescent lighting. It will be the Contractor's responsibility to install electric lighting in a safe manner and in accordance with the latest edition of the National Electrical Code, National Electrical Safety Code, and/or all local codes. The Contractor will be responsible for investigating, procuring, and bearing the expense of a continuous power source whether by battery, generator, or commercial A.C. supply.

H. Flaggers with proper attire and flags shall be provided when ordered by the Owner or when the Contractor deems flaggers necessary to safely handle traffic through the construction zone. Flaggers shall wear either an approved uniform or a vest of fluorescent orange color an be equipped with either a red flag of fluorescent material or a paddle with a reflective red and white STOP sign on one side and a reflective orange and black SLOW sign on the other side. Flaggers are considered a general requirement of all traffic control schemes and no direct payment will be made for such.

I. If at any time the Owner determines that proper provisions for safe traffic control are not being provided or maintained, he may order suspension of the work until the proper level is achieved. In cases of serious or willful disregard for safety of the public or his employees by the Contractor, the Owner may proceed forthwith to place the traffic control measures in proper condition and deduct the cost thereof from payment due or becoming due the Contractor.

#### 3.02 MAINTENANCE

A. The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades, and other traffic control devices. Maintenance shall include but shall not be limited to replacement of sign panels, barricades, and other devices which in the opinion of the Owner are damaged or deteriorated beyond effective use; replacement of broken supports; plumbing of leaning signs; cleaning of dirty signs, barricades, and other devices; repair of defaced signs; and replacement of stolen items.

B. All items used for traffic control shall be generally maintained in its original placement condition and such maintenance will be considered a part of the original installation cost. Failure to maintain all traffic control devices in such manner as to provide adequate continuous safety to the public will be cause for action by the Owner as noted in Specification Section 01551 Paragraph 3.01.I.

## PART 4 – MEASUREMENT

Each accepted item related to traffic control for construction work zones shall be measured as described herein. All work not described herein shall be considered incidental to the provision of traffic control for construction work zones.

#### 4.01 TRAFFIC CONTROL PLAN.

Development of a Traffic Control Plan for the construction work zone will be paid for on a lump sum basis and no measurement will be made.

#### 4.02 TRAFFIC CONTOL DEVICES FOR CONSTRUCTION WORK ZONES.

Furnishing, erecting, and maintaining traffic control devices and other incidentals and personnel required for handling traffic safely through construction work zones will be paid for on a lump sum basis and no measurement will be made.

#### PART 5 – PAYMENT

Payment for accepted work shall be made at the appropriate contract price which shall be payment in full for all work required under the pay item. Payment will be made under the pay items listed at the end of this Specification Section.

### 5.01 TRAFFIC CONTROL PLAN.

Payment will be made for the work completed and accepted by the Owner at the contract lump sum price, which shall be full compensation for development of a Traffic Control Plan.

#### 5.02 TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES.

A. Payment will be made for the work completed and accepted by the Owner at the contract lump sum price, which shall be full compensation for furnishing, erecting, illuminating, handling, and maintaining all construction signs (warning, regulatory, and guide), barricades, and other traffic control devices designated for installation at locations specified by the Plans, the Traffic Control Plan, or directed or approved by the Owner for the purpose of handling traffic safety through construction work zones for the duration for the project. Payment shall also include provision for flaggers or special measures necessary to assure the handling of traffic safely through construction work zones.

B. Payment will be made under:

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
01551-5.01	TRAFFIC CONTROL PLAN	Lump Sum
01551-5.02	TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES	Lump Sum

# CITY OF MEMPHIS – STANDARD CONSTUCTION SPECIFICATIONS SECTION 01570 TEMPORARY CONTROLS

## PART 1 – MAINTENANCE OF WATER COURSES AND SURFACE DRAINAGE

1.01 Where the Work contemplated in the Contract intercepts or in any way affects any stream, ditch, drain, or culvert, the Contractor shall, where necessary, arrange for keeping the same open by rebuilding, repairing, or extending the same or by building drains, culverts, or other structures of approved materials. Unless otherwise provided for in the Plans and Contract Documents, the expense to the Contractor in fulfilling the obligations of this Section 01570 are incidental to the Contract, and no extra compensation will be allowed.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01580 – PROJECT IDENTIFICATION

## PART 1 – PROJECT SIGNS

1.01 From the time that construction begins until the Project is completed, the Contractor shall provide a sign at each end of the Project, clearly visible to the public. The sign shall be constructed and shall provide project information as shown in the Design Standards. The sign shall be maintained in a suitable and acceptable condition, as determined by the Owner, for the duration for the project.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01610 – BASIC PRODUCT REQUIREMENTS

### PART 1 – GENERAL

1.01 All materials and permanently installed equipment (for example, traffic signalization equipment, sewer pumps, and other such items) furnished by the Contractor for the Work shall conform to the requirements of the Plans and Contract Documents, including the applicable City of Memphis Standard Construction Specifications and Design Standards.

1.02 Throughout the entire Project, all units of any one item of installed equipment shall be of the same manufacture and model unless otherwise approved by the Owner.

### PART 2 – EQUIVALENT MATERIALS AND EQUIPMENT

2.01 Section 00710 Article 5 of the Contract General Conditions allows for the substitution of equivalent materials and equipment, with the written approval of the Owner.

2.02 Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of materials and equipment required for the Work. It is not intended to exclude products equivalent in quality and similar in design. Whenever any article, material, or equipment is identified by using the name of a manufacturer or vendor, the term "or approved equal" if not inserted shall be implied.

2.03 If the Contractor proposes to furnish materials or supplies other than those specified, he shall furnish complete descriptive data, including performance capabilities, specifications, and other data as required in Section 00710 Article 5 of the Contract General Conditions. The provisions of this substitution of materials shall not relieve the Contractor of the responsibility of meeting the requirements of the Plans and Contract Documents. All materials must be approved by the Owner before any installation will be permitted.

#### PART 3 – LIST OF MAJOR EQUIPMENT AND MATERIALS

3.01 The Contractor shall submit to the Owner for approval, with due promptness after award of Contract but in no case later than at the preconstruction conference, a list of major equipment and materials which he proposes to provide. The list shall include in sufficient detail to identify the materials, the name of the manufacturer's model number of all material that is identified on the Plans or in the Contract Documents, including catalog literature for standard equipment and detailed scale drawings of any nonstandard or special equipment and of any proposed deviation from the Plans. A signed statement shall accompany this list stating that materials and equipment are in exact accordance with Project specifications. No charge shall be made to the Owner for any materials or equipment purchased, labor performed, or delay to the Work prior to approval of materials by the Owner.

#### PART 4 – SOURCE OF SUPPLY

4.01 The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Owner before delivery is started.

#### PART 5 – SAMPLES AND TESTING

5.01 Representative samples of materials included for incorporation in the Work shall be submitted to the Owner for his examination and/or testing when so specified or requested.

5.02 All testing of materials shall be made in accordance with the standard methods of testing of the ASTM, AASHTO, NEMA, ITE, or other applicable standard specifications.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01610 – BASIC PRODUCT REQUIREMENTS

### PART 6 - PROPOSAL QUANTITIES

6.01 The quantities appearing in the Proposal Sheet(s) of the Proposal are approximate and are proposed and shown for the comparison of bids and award of a Contract except that quantities shown on the Proposal Sheet(s) for Item No. 02315-01, Excavation (Unclassified) and Item No. 02330-01, Embankment (Unclassified) are absolute unless a Plans change is made. For all other items of construction, the Owner does not guarantee or assume any responsibility that the quantities indicated on the Plans or in the Proposal will hold true and accurate in the construction of the Project. The Contractor shall not plead deception or misunderstanding because of variation from these quantities. Unless otherwise provided in the Contract Documents, payment to the Contractor will be made only for the actual quantities of Work performed and accepted, and materials and equipment furnished and placed in accordance with the Contract. The Contractor is reminded of the limitation provided by Section 838 of the Charter of the City of Memphis which limits the total amount of the increase in the Contract Price, for any reason, to ten (10) percent of the original Contract award amount. There are no specific limitations on the amount by which the Contract Price and project quantities may be decreased.

## PART 7 – MEASUREMENT

### 7.01 Measurement of Quantities

- A. All Work completed under the Contract will be measured by the Owner according to United States standard measure.
- B. The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois.
- C. The determination of quantities for specific items will be made as set for the in the subsection titled "Measurement" under the applicable Sections of the Standard Construction and Material Specifications hereof, or of other Specifications provided for the Work.
- D. Longitudinal and transverse measurements for surface area computations will be to the exact dimensions shown in the horizontal plane on the Plans or as ordered in writing by the Owner.
- E. Structures will be measured according to the lines and exact dimensions shown on the Plans or as altered to fit field conditions by direction to the Owner.
- F. In all cases where measurement of materials is based on certified weights, the Contractor shall furnish the Owner certified weigh bills showing the net weight of materials received in each shipment. In no instance will the Owner pay for materials in excess of the amounts represented by the certified weigh bills.
- G. When certified scale weights are not used for measurement, all materials which are measured or proportioned by weight shall be weighed on accurate, approved scales, by competent, qualified personnel, at locations designated by the Owner.
- H. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the Owner directs, and each truck shall bear a plainly legible identification mark.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01610 – BASIC PRODUCT REQUIREMENTS

I. Measurements for payment will be made to the nearest fractional units specified below, unless otherwise specified herein or in the Contract Documents for the project.

Unit of Measurement	<u>Nearest Unit</u>
Linear Foot Square Foot Square Yard Ton Cubic Yard	0.1 LF 0.1 SF 0.1 SY 0.1 Ton 0.01CY
1,000 01 0111	0.1 0111

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01710 SITE EXAMINATION

## PART 1 – INSPECTION OF SITE

1.01 Each Bidder shall inspect and carefully examine the site of the Work, including the surrounding terrain and access facilities, before submitting a Proposal. He shall also examine in detail the Plans, Specifications and all other documents making up the Proposal which cover the Work. During the site visit, he shall fully inform himself as to all existing conditions and limitations and shall include, in the unit prices of the Proposal, sums to cover the cost of all items contemplated by the Plans as required by the conditions existing on the site. It is mutually agreed that submission of a Proposal shall be considered prima facie evidence that the Bidder has made such examinations and has fully familiarized himself with the character, quality, and quantity of Work to be performed, and of the materials to be furnished. Reference if made to Section 00710, Article 10 of the Contract General Conditions for other requirements relating to the Contractor and the site of the Work.

### PART 2 – PHYSICAL CONDITIONS

2.01 The Contractor shall have full responsibility with respect to subsurface conditions at the site.

#### 2.02 EXISTING STRUCTURES.

Reference is made to the Supplemental Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities covered later in this section) which are at or contiguous to the site that have been utilized by the Owner in preparation of the Contract Documents. The Contractor shall have full responsibility with respect to physical conditions in or relating to such structures.

- A. <u>Report of Differing Conditions:</u> If the Contractor believes that:
  - 1. Any technical data on which the Contractor is entitled to rely as provided for in paragraph 2.02 is inaccurate, or
  - 2. Any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents,

The Contractor shall, promptly after becoming aware thereof and before performing any Work in connection therewith (except in an emergency as permitted by Section 00710 Article 12.4 I of the Contract General Conditions) notify the Owner in writing about the inaccuracy or difference.

B. <u>Owners Review</u>: The Owner will promptly review the pertinent conditions and determine the necessity of obtaining additional explorations or tests with respect thereto.

C. <u>Possible Document Change:</u> If the Owner concludes that there is a material error in the Contract Documents a Change Order may be issued as provided in 00710, Article 9, of the Contract General Conditions to reflect and document the consequences of the inaccuracy or difference.

D. <u>Possible Price and Time Adjustments:</u> In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are authorized by law and approved by the Owner.

#### 2.03 UNDERGROUND FACILITIES.

A. <u>Shown or Indicated</u>: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to the Owner by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. The Owner shall not be responsible for the accuracy or completeness of any such information or data; and,

2. The Contractor shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection thereof as provided in Section 00710 Article 12.4.and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

If an Underground Facility is uncovered or revealed at or B. Not Shown or Indicated: contiguous to the site which was not shown or indicated in the Contract Documents and which Contractor could not reasonably have been expected to be aware of. Contractor shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by Section 00710 Article 12.4I), identify the owner of such Underground Facility and give written notice thereof to that owner and to the Owner. The Owner will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, the Contractor shall be responsible for the safety and protection of such Underground Facility as provided in Section 00710 Article 12.4. The Contractor may be allowed an increase in the Contract Price or and extension of the Contract Time, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and of which the Contractor could no reasonably have been expected to be aware. If the parties are unable to agree as to the amount or length thereof, the Contractor shall follow the procedures in Section 00710 Article 11.2.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01720 SITE PREPARATION

## PART 1 – REFERENCE POINTS

1.01 The Owner shall provide engineering surveys to establish reference points for construction which in the Owner's judgment are necessary to enable the Contractor to proceed with the Work. The Contractor shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of the Owner. The Contractor shall report to the Owner whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

## PART 2 – SURVEYING AND STAKING

2.01 The responsibilities of the Owner and the Contractor for the surveying and staking necessary for the construction of Project facilities shall be as defined herein unless otherwise defined in the contract Documents.

2.02 The Owner will provide all surveying necessary to establish the horizontal and vertical control of the Project including the setting of monuments and benchmarks for such control.

2.03 The Contractor will provide all construction survey and staking necessary for layout and construction from the control point provided by the Owner, which shall be considered incidental to the work of the Contractor.

2.04 All surveying and staking provided by the Owner will be furnished one time only unless otherwise provided in the Contract Documents. The Contractor shall be responsible for protecting and preserving all such surveys provided by the Owner, including monuments, benchmarks, survey stakes, reference points, or other survey markers and shall be required to bear the expense of replacing or resetting same if damaged or destroyed by other than Owner forces.

2.05 The Contractor will provide all surveying and staking necessary to establish or re-establish property corners as directed by the Owner. Property corners will be established when the project has required the taking of right-of-way. Property corners will be re-established when the area of the property corner has been disturbed during construction, whether or not a property corner marker existed prior to construction. The establishment of a property corner means that a property corner is to be set in accordance with standard surveying practices and conventions. The property corner shall be marked with either a crow's foot in either the top of the curb or the back of the sidewalk on the property line where the property line is adjacent to curb and gutter construction or by the setting of a ½" diameter or larger, minimum 18 inches long, recessed iron pin. The establishment of the property corners must be performed under the supervision of a Registered Land Surveyor licensed to practice surveying in the State of Tennessee.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 01740 SITE CLEANING

## PART 1 – CLEANING UP / DISPOSAL OF DEBRIS

1.01 Before final acceptance of the Work, all rights-of-way, easements, material pits, waste areas, and access roads used by the Contractor, all streams in and over which he has worked, and all ground occupied by the Contractor in connection with the Work shall be cleaned of all debris, construction plant, and materials.

1.02 Clean up shall include the Work described in Section 01140 Paragraph 1.02 of the General Requirements.

1.03 Right-of-way and easement areas not designated for alteration by the Contract Documents shall be restored to their original condition, in accordance with the Plans and Specifications.

1.04 Waste and debris shall be disposed of in areas outside of the rights-of-way and easements and provided by the Contractor, unless otherwise stipulated in the Plans or Contract Documents or allowed by the Owner. Where the Owner has granted permission to dispose of waste and debris within the right-of-way, the Owner will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance of the completed Project.

1.05 Disposal of waste or debris in active public waste or disposal areas will not be permitted without prior approval of the Owner.

1.06 Burning of debris will be allowed only with the written permission of the Owner and acquisition of a permit from the Memphis and Shelby County Health Department by the Contractor. If perishable material is burned, it shall be burned under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

1.07 No direct payment will be made to the Contractor for the Work under this Section (01740). Payment at the Contract prices for the various items in the contract will be full compensation for all Work covered by this Section.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATION SECTION 02220 SITE DEMOLITION

### PART 1 - SCOPE

1.01 This work shall consist of the removal and satisfactory disposal of all buildings, structures, old pavements, fences, and abandoned pipe lines. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits; the preservation from injury or defacement of all vegetation and objects designated to remain; and all necessary replacement of fences, trees, hedges, shrubs, and flowers.

### PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the Work shall be on the project and approved before the Work will be permitted to begin.

### PART 3 – CONSTRUCTION REQUIREMENTS

### 3.01 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

A. The Contractor shall raze, remove, and dispose of all buildings, foundations, bridges, drainage structures, curbs, curbs and gutters, pavements, sidewalks, and other obstructions not covered under Specification Section 02230 Paragraph 3.01 except for those for which other provisions have been made. Demolition of buildings shall be done in accordance with all applicable sections of the City Building Code.

B. Structures and obstructions shall be removed to a depth of not less than one (1) foot below natural ground except that within construction limits removal shall be to a depth of not less than two (2) feet below subgrade elevation. Basement floors shall be broken up to prevent holding of water and bridges and drainage structures shall be removed or broken up in a manner to prevent voids below subgrade elevation, and the cavities left shall be filled to the level of the surrounding ground and compacted in accordance the provisions of Specification Section 02335 Paragraph 3.01. With the approval of the Owner, sewer and drainage pipes and structures may be abandoned in place and filled with sand or grout. Any blasting or other operations necessary for the removal of an existing structure or obstruction which may damage new work shall be completed prior to placing the new work. Where property line adjustments are required by the Work, existing fencing shall be removed from the original property lines, replaced with in-kind fencing along the new property lines, and tied back to the old fence.

C. When specified on the Plans or Right-of-Way Agreement or so directed by the Owner, all fences removed for construction purposes shall be replaced with salvaged existing materials or with acceptable in-kind new materials to enclose the original enclosed area as nearly as possible and tie back to the old fence.

D. When specified on the Plans, trees, hedges, shrubs, flowers, or other growth shall be replaced or substituted for in-kind as nearly as possible to its original position, and growth established at the completion of the contract.

E. All pavements, base courses, sidewalks, curbs, gutters, and other improvements designated for removal shall be removed and the material disposed.

F. All salvageable pipe, frames and grates, manhole rims and covers, precast manhole sections, cobblestones, or granite curbs shall be carefully removed and every precaution taken to avoid damage. These salvaged items shall be taken to Collins Yard or other designated storage locations as directed by the Owner.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATION SECTION 02220 SITE DEMOLITION

#### 3.02 DISPOSAL OF DEBRIS

A. All material from removal of structures and obstructions except salvaged items shall be disposed of off the Project and it shall be the Contractor's responsibility to secure any permits necessary for the disposal.

#### PART 4 – MEASUREMENT

4.01 A. This item will be paid from a lump sum basis and no measurement will be made.

#### PART 5 – PAYMENT

5.01 Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price will be full compensation for removal and disposal of structures and obstructions; backfilling of depressions below subgrade elevation, protection of trees to remain; restoration of fences, trees, hedges, shrubs, flowers, or other growth as required; and moving salvageable materials to designated storage locations in accordance with the stipulations and provisions of the contract.

#### 5.02 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02220.01	Removal of Obstructions and Structures	Lump Sum

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02230 SITE CLEARING

### PART 1 - SCOPE

1.01 This work shall consist of clearing and grubbing, removal, and disposal of all vegetation and debris within the limits of the rights-of-way and easement areas. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits; the preservation from injury or defacement of all vegetation and objects designated to remain; and all necessary replacement of fences, trees, hedges, shrubs, and flowers.

### PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the Work shall be on the project and approved before the Work will be permitted to begin.

### PART 3 – CONSTRUCTION REQUIREMENTS

### 3.01 CLEARING AND GRUBBING

A. The Owner will establish rights-of-way lines and construction limits. All trees, shrubs, edges, fences, and other items to remain shall be as indicated on the Plans or as directed by the Owner.

B. The rights-of-way shall be cleared of all vegetation and debris except items designated to remain. All other trees, stumps, roots, brush, hedges, and other protruding obstructions within the excavation area shall be completely grubbed. In embankment areas, sound undisturbed stumps and roots which will be a minimum of five (5) feet below subgrade or slope of embankment will be allowed to remain in place provided undercutting or other corrective measures are not stipulated in the plans or directed by the Owner and providing stumps do not extend more than six (6) inches above the ground surface. If excavation is not required, the area shall be grubbed to a minimum depth of six (6) inches below existing grade to remove grass, roots, and other organic material.

C. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed by the Owner. Tree limbs and branches shall be trimmed to provide twenty (20) feet vertical clearance over the entire right-of-way. All trimming shall be done by skilled workmen in accordance with good tree surgery practices, and cut or scarred surfaces of trees or shrubs to remain shall be treated with an approved asphalt base paint prepared especially for tree surgery.

D. Within embankment areas, all depressions resulting from grubbing operations shall be backfilled with suitable material and left uniform. All depressions in excavation areas below subgrade elevation shall be backfilled with suitable material and compacted in accordance with the provisions of Specification Section 02315.

E. When specified on the Plans or Right-of-Way Agreement or so directed by the Engineer, all fences removed for construction purposes shall be replaced with salvaged existing materials or with acceptable in-kind new materials to enclose the original enclosed area as nearly as possible and tie back to the old fence.

#### 3.02 DISPOSAL OF DEBRIS

A. All material from removal of structures and obstructions except salvaged items shall be disposed of off the Project and it shall be the Contractor's responsibility to secure any permits necessary for the disposal.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02230 SITE CLEARING

### PART 4 – MEASUREMENT

4.01 A. This item will be paid from a lump sum basis and no measurement will be made.

### PART 5 – PAYMENT

5.01 Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price will be full compensation for clearing and grubbing vegetation; removal and disposal of vegetation, debris, backfilling of depressions below subgrade elevation, protection of trees to remain; restoration of fences, trees, hedges, shrubs, flowers, or other growth as required; and moving salvageable materials to designated storage locations in accordance with the stipulations and provisions of the contract.

5.02 Payment will be made under:

Item No.	Pay Item	<u>Pay Unit</u>
02230-01	Clearing and Grubbing	Lump Sum

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02260 STEEL SHEET PILING

## PART 1 – SCOPE

1.01 This work shall consist of the furnishing and placing of steel sheet piling of the sizes, weights, and dimensions shown on the Plans or directed by the Owner for channel stabilization, slope stabilization, special protection, or other purposes.

#### PART 2 – MATERIALS AND EQUIPMENT

#### 2.01 MATERIAL

A. Steel Sheet Piles.

1. Steel sheet piles shall meet the requirements of ASTM A 328 unless otherwise specified on the Plans. Size and thickness of sheets shall be as shown on the Plans. The Contractor shall furnish 3 certified copies of mill test reports containing the true chemical and physical analysis of piling material.

#### B. Coal Tar Epoxy Coating.

- 1. The coating system shall be composed of 1 coat of Coal Tar Epoxy composed as follows:
  - a. Solids by Volume (Mixed)
  - b. Dry Film Thickness
  - c. Color
  - d. Finish
  - e. Curing Time at 75°F

77.0 plus or minus 1.0% 14 to 20 mils per coat Black Semi-gloss 6 hours (maximum)

#### 2.02. EQUIPMENT.

A. Steel sheet piles shall be driven with vibratory or gravity hammers specifically designed for pile driving. All driving equipment shall be on hand and approved by the Owner before work can proceed.

## PART 3 – CONSTRUCTION REQUIREMENTS

3.01 HANDLING AND STORAGE.

A. Steel sheet piles shall be handled and stored by methods that will not injure the pile. The pile shall be stored above ground upon platforms, blocking, or other supports. They shall be kept free from dirt, grease, and other foreign matter and shall be protected insofar as practical from corrosion.

### 3.02 DRIVING SHEET PILES.

A. Sheet piles shall be driven with adequate hammers as necessary to drive the piles to the line, grade, and required depth shown on the Plans. In order to maintain satisfactory alignment, the sheet piles shall be driven in such increments of penetration as may be found necessary to prevent distortion, twisting out of position or pulling apart at the interlocks.

B. Piles shall be kept moving during driving operations by continuous operation of the hammer except when interrupted by an emergency. The piles when in place in the completed structure shall be practically watertight at the joints.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02260 STEEL SHEET PILING

#### 3.03 JETTING SHEET PILES.

A. The use of jets will not be permitted at locations where the stability of embankments or other improvements would be endangered. The written approval of the Owner shall be obtained prior to jetting specific sheet piling. In case it is necessary to obtain the penetration desired, the Contractor may supply and operate one or more high pressure water jetting systems to erode the material adjacent to the pile and thereby facilitate driving the sheet piles. The jetting may not be done ahead of the actual driving operation. Jetting shall take place simultaneously with the driving operation. The jets shall be withdrawn and the final penetration of the sheet pile obtained by driving with the hammer alone for at least the last foot of penetration.

#### 3.04 PILING CUT-OFF AND DAMAGES.

A. The tops of sheet piling shall be cut-off or driven down to the elevation indicated on the Plans, or as approved by the Owner.

B. If the sheet piles are appreciably distorted or otherwise damaged below cut-off elevation, the damaged piles shall be removed and replaced at the Contractor's expense.

C. Any sheet pile damaged during driving by reason of internal defects or improper driving or which is either out of its required line and grade shall be withdrawn and replaced with a new pile at the Contractor's expense.

#### PART 4 – MEASUREMENT

4.01 Steel sheet piling will be measured for payment by the linear foot of sheet piling measured horizontally along the piling face for the various vertical piling lengths, metal thicknesses and sections specified, complete in place.

#### PART 5 – PAYMENT

5.01 The accepted quantities of steel sheet piling will be paid for at the contract unit price per linear foot, which unit price shall be full compensation for finishing and driving the piling, painting as required, jetting if required and permitted by the Owner, and all other labor, material, equipment and incidentals needed to complete the work.

#### 5.02 PAYMENT WILL BE MADE UNDER:

Item No.

Pay Item

02260-01 02260-01.\_\_\_.\_\_\_ STEEL SHEET PILING \_\_\_\_ Thick Steel \_\_\_\_ Section Sheet Piling \_\_\_\_ Vertical Length Pay Unit

Linear Foot Linear Foot

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02315 EXCAVATION & FILL

### PART 1 – SCOPE

1.01 This work consists of excavating; disposal of unsuitable material from roadbed excavations; construction and removal of temporary detours ordered by the Owner. Excavation shall consist of the removal of all material shown on the Plans in cut sections or necessary undercutting as ordered by the Owner.

### PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of excavation and hauling shall be on the project and approved by the Owner before the work will be permitted to begin.

#### PART 3 – CONSTRUCTION REQUIREMENTS

#### 3.01 GENERAL

A. Prior to beginning excavation all necessary Clearing and Grubbing and Removal of Structures and Obstructions shall have been completed in the area in accordance with Sections 02220 and 02230 of these Specifications. The removal of unsuitable material and/or undercutting ordered by the Owner will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively. Unsuitable material above subgrade or from undercutting in cuts shall be disposed of as directed by the Owner at no additional cost to the Owner. Any imbalance of material quantities caused by these operations or change in actual shrinkage factor shall be the Contractor's responsibility. The Owner's decision on the suitability of material or the need for undercutting shall be final.

B. If approved by the Owner, gravel for undercut backfill or stabilization and Portland cement for stabilization will be used and paid for as separate items in the contract.

C. When ordered by the Owner, water used for dust control will be paid for as a contract item.

D. The Contractor shall provide for proper drainage of the project area to protect from ponding and erosion.

#### 3.02 EXCAVATION

A. Excavation (unclassified) shall consist of the removal of all suitable or unsuitable material in cut sections to the lines, grades, and cross-sections shown on the Plans. All slopes, ditches and berms shall be shall be neatly trimmed to the lines given. Excavation beyond given lines or to correct slides, regardless of the location, will be at the Contractor's expense, and the suitability of the material from slides for embankment construction will be determined by the Owner.

B. Surplus excavated material, if determined to be suitable by the Owner, may be used to widen embankments or to flatten slopes or may be deposited in such other places and for such other purposes on the right-of-way as the Owner may approve. No payment to the Contractor shall be made for the placement of surplus excavated material. Materials unsuitable for construction of embankment or use as backfill shall be removed to off-site waste disposal areas. The Contractor shall secure waste disposal areas and dispose of surplus and unsuitable materials in such areas. It is the Contractor's responsibility to obtain written permission from the owners of all property(s) to be used for waste disposal areas prior to removal of material to disposal sites. The Contractor shall dispose of all materials on the sites to the satisfaction of the property owner(s).

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02315 EXCAVATION & FILL

#### PART 4 – MEASUREMENT

- 4.01 A. <u>Excavation (Unclassified</u>) Excavation will be computed by the cubic yard and only in cut sections of the project. No measurement will be made for material from off the project required for the satisfactory completion of the project. Measurements will be made for excavation material in its original position by cross-sections and the average-end-area method. Original cross-sections and final cross-sections will be taken from the sections shown on the Plans. Excavation volumes so measured will not include an allowance for removal of material from the Contractor's stripping operation. No measurement will be made for excavation outside the project construction limits shown on the Plans or the removal of slides.
  - B. <u>Water.</u> Water for dust control will be measured by the 1,000 gallon unit.

C. <u>Dredging.</u> This item will be paid for on a lump sum basis and no measurement will be made.

D. <u>General.</u> It is the intent of these Specifications to pay only for quantities of Excavation as shown on the Plans or Proposal. Plan changes in grade or project limits may alter payment to the limits allowed in the General Conditions of Division 0.

### PART 5 – PAYMENT

#### 5.01 Excavation (Unclassified)

A. Payment will be made at the contract unit price per cubic yard in its original position in cut sections which price will be full compensation for the excavation and hauling of acceptable materials to designated embankment areas and the disposal of excess or unacceptable materials off the project or as directed by the Owner.

#### 5.02 <u>Water</u>

A. Water for dust control will be paid for at the contract unit price per 1,000 gallons (M.G.), which price will be full compensation for furnishing and distributing the water as directed by the Owner.

#### 5.03 Dredging

A. Payment will be made for the work, completed and accepted by the Owner, at the contract ump sum price, which shall be full compensation for removal and disposal of debris.

#### 5.04 Payment will be made under:

Item No.	Pay Item	<u>Pay Unit</u>
02315-01	Excavation (Unclassified)	Cubic Yard
02315-02	Water	M.G.
02315-03	Dredging	Lump Sum

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02330 EMBANKMENT

### PART 1 - SCOPE

1.01 This work consists of building controlled embankments; disposal of unsuitable material from beneath embankment areas; construction and removal of temporary detours ordered by the Owner and the sloping, shaping and dressing of all slopes.

1.02 Embankment work shall consist of constructing roadway or street embankments including preparation of the areas upon which they are to be constructed by the placing and compacting of material in holes, pits, and other depressions within the embankment area, all in conformity with the lines, grades, and typical cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments.

### PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of embankment construction shall be on the project and approved by the Owner before the work will be permitted to begin. Compaction shall be accomplished by any type of compacting equipment that will produce the required result.

### PART 3 – CONSTRUCTION REQUIREMENTS

3.01 GENERAL

A. Prior to beginning embankment operations all necessary Clearing and Grubbing and Removal of Structures and Obstructions shall have been completed in the area in accordance with Sections 02220 and 02230 of these Specifications. The removal of unsuitable material and/or undercutting ordered by the Owner will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively. If there is insufficient suitable material from excavation on the project, it shall be the Contractor's responsibility to obtain the additional material off the project to complete embankments according to the lines, grades, and cross-sections on the Plans.

B. When ordered by the Owner, water used for dust control will be paid for as a contract item.

C. The Contractor shall provide for proper drainage of the project area to protect from ponding and erosion.

### 3.02 EMBANKMENTS

A. This work shall consist of constructing roadway or street embankments including the preparation of the area upon which they are to be constructed, the placing and compacting of approved materials where unsuitable material has been removed, and the placing and compaction of embankment material in holes, pits, and other depressions not filled in accordance with Sections 02220 and 02230. All work shall be in accordance with these Specifications and in conformity with the lines, grades, and cross-sections shown on the Plans. Only approved materials shall be used in the construction of embankments, which material shall come from excavation on the Project or from approved sources furnished by the Contractor.

B. Any area upon which an embankment is to be constructed shall be plowed or scarified, all cleavage planes destroyed, and the area rolled thoroughly with a sheeps-foot roller before embankment construction is begun in the area. An area upon which an embankment is to be constructed having a slope steeper than 3 to 1 shall be benched with steps of not less than eight (8) inches rise before any embankment materials are placed thereon. Benching shall be of sufficient width to permit the operation of placing and compacting equipment. Each successive benching cut shall begin at the intersection of the original ground line and the vertical side of the previous cut. Material thus cut out shall be recompacted along with new material at the Contractor's expense.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02330 EMBANKMENT

C. Embankment construction will not be permitted within fifty (50) feet of any structure or proposed structure until such structure is cured sufficiently to permit embankment formation against it. This requirement will be waived when an embankment or portion thereof is to form the foundation of a structure or part thereof. Embankment to be placed on both sides of a concrete wall, manhole, or box type structure shall be so constructed that the embankment is always approximately the same elevation on both sides of the structure. Embankments on only one side of abutments, wingwalls, or piers shall not be constructed until the superstructure is in place or final concrete design strength has been obtained.

D. Where embankment is to be constructed across ground that will not support earth moving equipment, the fill shall be started with a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. In the construction of such a lift the density requirement will be waived but the moisture content of the material used shall not exceed the optimum moisture content for that material. Maximum thickness and minimum density requirements will apply to all succeeding layers of embankment construction. Each succeeding layer of embankment is to be constructed with a compacted thickness not to exceed six (6) inches and shall be approved before material for the next succeeding layer is placed.

E. Embankments shall be so constructed that adequate surface drainage will be provided at all times. Roadway embankment materials shall be placed in horizontal layers not to exceed a depth which will produce a six (6) inch compacted layer. Each layer shall be compacted for the entire embankment width to a density no less than ninety-five (95) percent of maximum density as determined in accordance with the standard specification of compaction and density of soils, AASHTO T 99. The moisture content of the embankment material shall be controlled in such a way that the material will be compacted with a moisture content ranging from two (2) percent below to two (2) percent above the optimum moisture content as determined from the above mentioned test and approved by the Owner. If the moisture content of the material in the embankment prior to compaction is greater than two (2) percent above the optimum moisture content, the material shall be aerated by disking, harrowing, plowing, or other means approved by the Owner, who shall be the sole judge as to when the required density has been obtained. For each layer of embankment material, the Contractor shall disk sufficiently to break down oversize clods, thoroughly mix any different materials, secure correct moisture content, ensure uniform density, and obtain proper compaction. Rolling with compacting equipment shall start longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half of the width of the tamping roller. Tamping equipment shall be operated at a speed of no more than three (3) miles per hour.

F. The Contractor shall be responsible until final acceptance for the stability of all embankments and shall replace at this own expense any portion which in the opinion of the Owner has become displaced or damaged due to carelessness, negligence, or by rainfall and weathering.

G. The slopes of all embankments, ditches, channels, and such other appurtenances as may be indicated on the Plans shall be shaped and trimmed to the lines, grades, and cross-sections shown or as directed by the Owner. This work shall also include the satisfactory shaping of spoil banks, waste deposits, and any other areas deemed necessary by the Owner to prepare the project for final inspection and acceptance.

H. Water for dust control when ordered by the Owner, whether to comply with local air pollution ordinances, safety, or good construction practices, shall be readily available along with adequate distribution equipment.

## PART 4 – MEASUREMENT

4.01 A. <u>Embankment (Unclassified</u>) Embankment construction will be computed by the cubic yard in place, compacted and ready for acceptance. Measurements for computations will be made by

cross-sections and the average-end-area method. Original cross-sections and final cross-sections will be taken from sections shown on the Plans

B. <u>Water.</u> Water for dust control will be measured by the 1,000 gallon unit. No payment will be made for any other water used on the project to maintain moisture control in embankment compaction or for stabilization.

C. <u>General.</u> It is the intent of these Specifications to pay only for quantities of Embankment as shown on the Plans or Proposal, and it shall be the Contractor's responsibility to ensure that excavation materials are suitable for embankment construction. Plan changes in grade or project limits may alter payment to the limits allowed in the General Conditions of Division 0.

### PART 5 – PAYMENT

#### 5.01 Embankment (Unclassified)

A. Payment will be made at the contract unit price per cubic yard in its final position, in place, compacted, and accepted by the Owner, which price shall be full compensation for the preparation of the area, furnishing, depositing and compacting the material, and the shaping and trimming of the embankments to the lines, grads, and cross-sections shown on the Plans.

5.02 <u>Water</u>

A. Water for dust control will be paid for at the contract unit price per 1,000 gallons (M.G.), which price will be full compensation for furnishing and distributing the water as directed by the Owner.

## 5.03 <u>General</u>

A. It is the Contractor's responsibility to ensure that adequate acceptable material is available to complete the project, and variations in shrinkage factors, undercut quantities, or unsuitable material quantities will not relieve him from that responsibility.

## 5.04 Payment will be made under:

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02330-01	Embankment (Unclassified)	Cubic Yard
02330-02	Water	M.G.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02335 SUBGRADE AND ROADBED

### PART 1 – SCOPE

1.01 This work consists of disposal of unsuitable material from roadbed excavations; construction and removal of temporary detours ordered by the Owner; sloping, shaping and dressing of all slopes; and the construction and preparation of the graded roadbed to receive the construction of a base or pavement.

1.02 Subgrade preparation shall consist of the final grading of the roadbed in both cuts and fills to the density specified, including gravel backfill, gravel stabilization, or cement stabilization when ordered by the Owner.

#### PART 2 – EQUIPMENT

- 2.01 All equipment for the satisfactory performance of subgrade preparation shall be on the project and approved by the Owner before the work will be permitted to begin.
- 2.02 Compacting equipment for final subgrade compaction shall include pneumatic tire rollers with a minimum contact pressure of eighty-five (85) pounds per square inch and a minimum single wheel load of 4,500 pounds. Each roller shall be a wobble-wheel type in which the rear set of wheels will not track the forward set and will be centered between the wheels of the forward set. The roller shall be capable of forward and backward propulsion on any grade encountered, and the Contractor shall furnish to the Owner charts or tabulations of the contact areas and pressure for the full range of tire loadings for each type of compactor tire to be used.

### PART 3 – CONSTRUCTION REQUIREMENTS

3.01 GENERAL

A. Prior to beginning subgrade operations all necessary Clearing and Grubbing and Removal of Structures and Obstructions shall have been completed in the area in accordance with Sections 02220 and 02230 of these Specifications. The removal of unsuitable material and/or undercutting ordered by the Owner will not be considered contract items and these two operations will be included in either excavation (unclassified) or embankment (unclassified) respectively.

B. Unsuitable material above subgrade or from undercutting in cuts shall be disposed of as directed by the Owner at no additional cost to the City. Any imbalance of material quantities caused by these operations or change in actual shrinkage factor shall be the Contractor's responsibility. The Owner's decision on the suitability of material or the need for undercutting shall be final.

C. When ordered by the Owner, water used for dust control will be paid for as a contract item.

D. The Contractor shall provide for proper drainage of the project area to protect from ponding and erosion.

#### 3.02 UNDERCUTTING

A. This work shall consist of the removal and disposal of unsatisfactory materials below grade in cut sections. Areas to be undercut may be designated on the Plans if sufficient information is available. However, the Owner may increase, decrease, or change such areas to be undercut if conditions dictate as construction progresses. Undercut areas shall be backfilled with suitable material from excavation quantities, gravel backfill, or material stabilized with gravel or Portland cement as ordered by the Owner.

### 3.03 SUBGRADE PREPARATION

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02335 SUBGRADE AND ROADBED

A. This work shall consist of the final preparation of the roadbed to receive the immediate construction of a base or pavement, curb and gutter, driveways, or sidewalks thereon.

B. Subgrade preparation in fill sections shall consist of the compaction of the top six (6) inches below subgrade elevation in paved areas only to a density of 100 percent as determined in accordance with the standard specification of compaction and density of soils as defined in Section 02330.

C. Areas in cut sections where required density cannot be obtained may be undercut and backfilled with suitable excavation material, stabilized with gravel or portland cement, or undercut and backfilled with gravel as directed by the Owner, who shall be the sole judge as to the method to be used. Special attention shall be given to areas such as utility trenches and manhole backfill areas. Payment will be made only for the gravel or portland cement used, and no additional compensation will be paid the Contractor for the work.

D. The Contractor shall be held responsible for the proper maintenance of subgrade acceptable to the Owner, and no additional compensation shall be paid to the Contractor to restore any subgrade after preliminary acceptance. The Contractor shall also take all precautions necessary to protect the acceptable subgrade from damage, and hauling over the finished subgrade shall be limited to that which is essential for construction purposes.

### PART 4 – MEASUREMENT

4.01 A. <u>Undercut Excavation</u> Undercut excavation will be measured by the inspector and a representative of the Contractor. They will agree on how much material, in cubic yards, was removed from the undercut area.

B. <u>Water.</u> Water for dust control will be measured by the 1,000 gallon unit. No payment will be made for any other water used on the project to maintain moisture control in embankment compaction or for stabilization.

#### PART 5 – PAYMENT

#### 5.01 UNDERCUT EXCAVATION

A. Payment for undercut excavation will be made at the contract unit price per cubic yard of excavation unclassified (Specification Section 02315 Part 5.01A), which shall be full compensation for hauling and disposal of the unsatisfactory material.

#### 5.02 UNDERCUT BACKFILL

A. Payment for earth material used as undercut backfill will be made at the contract unit price for Embankment (Unclassified) (Specification Section 02330 Part 5.01A), which price will be full compensation for undercutting and for furnishing, depositing, and compacting backfill material and dressing to subgrade or original ground line as directed by the Owner, complete in place.

#### 5.03 GRAVEL FOR UNDERCUT BACKFILL OR SUBGRADE STABILIZATION

A. Gravel for undercut backfill or subgrade stabilization in cut sections will be paid for at the contract unit price per ton, which price shall be full compensation for the excavation, placing and/or mixing gravel with in-place material, compaction, and dressing to plan elevation as directed by the Owner, complete in place.

## 5.04 PORTLAND CEMENT FOR UNDERCUT BACKFILL OR SUBGRADE STABILIZATION

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02335 SUBGRADE AND ROADBED

A. Portland cement for subgrade stabilization in cut sections or as backfill stabilization for undercut areas will be paid for at the contract unit price per pound in place, which price shall be full compensation for furnishing and placing cement, processing, compaction, and dressing to plan elevation as directed by the Owner, complete in place.

#### 5.05 WATER

A. Water for dust control will be paid for at the contract unit price per 1,000 gallons (M.G.), which price will be full compensation for furnishing and distributing the water as directed by the Owner.

#### 5.06 GENERAL

A. Subgrade preparation is not considered a pay item, and no work involved shall be paid for directly except gravel and/or portland cement as defined in Parts 5.03 and 5.04 above.

#### 5.07 Payment will be made under:

Item No.	Pay Item	<u>Pay Unit</u>
02335-01	Undercut Excavation	Cubic Yard
02335-02	Undercut Backfill	Cubic Yard
02335-03	Gravel for Undercut Backfill	Ton
02335-04	Portland Cement for Undercut Backfill	Pound
02335-05	Water	M.G.

CITY OF MEMPHIS-STANDARD CONSTRUCTION SPECIFICATIONS Modified by SARP10

#### SECTION 02447 EROSION CONTROL MEASURES

#### PART I - GENERAL

#### 1.01 DESCRIPTION

A. This item shall consist of temporary control measures as shown on the plans or as directed by TDEC, the Construction Manager, or the Engineer throughout the construction and post construction period to control water pollution, and siltation through the use filter bags, silt fences, rock silt screen, erosion control blanket, filter sock, and other erosion control devices or methods.

#### PART 2 - MATERIALS

#### 2.01 DEWATERING BAG

Dewatering bags for trench dewatering shall be a Dandy Products "Dandy Dewatering Bag" orapproved equal.

2.02 FILTER SOCK

Filter Sock shall be Erosion Tech "Excelsior Sediment Logs" 12 in. dia. or approved equal.

2.03 OTHER

All other materials shall meet commercial grade standards, meet the standards of the latest edition of the Tennessee Erosion & Sediment Control Handbook, and shall be approved by the Purchaser before being incorporated into the project.

#### PART 3 – CONSTRUCTION REQUIREMENTS

#### 3.01 EQUIPMENT

A. All equipment necessary for the satisfactory performance of this work shall be on the project and approved, before work will be permitted to begin.

#### 3.02 GENERAL

- A. Excavation, trenching, backfilling, and grading operations to elevations as needed to meet the requirements shown on the Contract Documents, shall be done in such a manner as to cause the least amount of soil erosion and siltation.
- B. The Contractor shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.
- C. If site earthwork is halted for more than 14 days on any disturbed areas, the Contractor shall temporarily stabilize the area until earthwork resumes at no extra cost to the Purchaser.

## 3.03 EXECUTION

- A. Excavation, trenching, backfilling, and grading operations to elevations as needed to meet the requirements shown on the Contract Documents, shall be done in such a manner as to cause the least amount of soil erosion and siltation.
- B. Appropriate erosion and sediment control measures shall be in place before any clearing of vegetation or other earth moving operations begin.

- C. Provisions required to maintain uninterrupted surface water flow shall be maintained during the work. Storm water flow in existing gutters, surface drains, and swales shall not be interrupted.
- D. The Purchaser shall be notified of any unexpected subsurface or other unforeseenconditions. Work shall be discontinued until the Purchaser provides notification to resumework.
- E. Erosion and sediment control shall be in accordance with the Tennessee Water Quality Control Act of 1977, as amended, and the Federal Act PI 92-59.
- F. The Tennessee Department of Conservation Publication, Tennessee Erosion & Sediment Control Handbook, latest revision, shall be used as a guide for construction of projects that require erosion and sediment controls to protect adjoining property and waters of the state.
- G. Whenever possible, a buffer strip of vegetation cover shall be kept adjacent to grading operations.
- H. All surface water flowing toward the construction area shall be diverted around the area as much as possible to reduce erosion potential by using beams, channels, and/or sediment traps as necessary.
- I. Erosion control measures shall be removed when they have served their useful purpose. The disturbed soil shall be fine graded, top soiled, and planted with permanent vegetationas soon as the construction sequence allows to prevent further potential erosion and sedimentation. Any seeded areas which are eroded shall be reworked as soon aspossible.
- **II.** A vegetation buffer strip shall be maintained between any stream and pipe trenching. Excavated material from the trench shall not be placed between the trench and stream.
- **III.** Erosion control measures shall be removed when they have served their useful purpose. The disturbed soil shall be fine graded, top soiled, and planted with permanent vegetationas soon as the construction sequence allows to prevent further potential erosion and sedimentation. Any seeded areas which are eroded shall be reworked as soon aspossible.
- **IV.** Outside of the work areas identified on the plans, the Contractor shall submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Purchaser.
- V. Regardless of the erosion control measures shown on the plans, it is the Contractor's sole responsibility to ensure that no water of objectionable color or quality leaves the construction site. Water from all sources shall have sediment removed before leaving the construction site. In the event of inadequate results from the erosion control measures being employed by the Contractor, additional measures above and beyond those shown on the plans will be employed until adequate results are reached.

### 3.04 CONSTRUCTION DETAILS

- A. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Purchaser, such work shall be performed by the Contractor at his/her own expense. No additional payment will be made for maintenance or reinstallation of erosion control features installed for this contract.
- B. Temporary pollution control may include work outside the construction limits such as haul roads, equipment and material storage sites and temporary plant sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.
- C. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.
- D. Sediment basins, if required, shall be treated by the use of flocculation. The contractor shall use Applied Polymer Systems (APS) APS 700 Floc Logs. Floc Logs must meet the requirements of the TN CGP as well as any and all TDEC requirements. Floc Logs shall be placed in drainage structures 8 and 33 at a minimum. Floc Logs shall be tethered within structure to allow for natural agitation within the drainage structure during a rain event. All flocculation shall be complete within 24 hours of a rain event. Sediment basin shall not be dewatered prior to the 24-hour flocculation period. Sediment basin shall be dewatered such as to restore the water level to the wet storage elevation as depicted on the plans. Contractor shall excavate flocculated sediment from the sediment basin regularly to ensure that basin maintains adequate storage for future rain events. Contractor shall coordinate with APS to determine the proper application rate based on the soils found on the project site. Application rates shall be approved by the Purchaser

#### PART 4 – NOT USED

#### PART 5 – METHOD OF MEASUREMENT

- 5.01 SILT FENCE WITH BACKING
  - A. Slit fence will be measured per linear foot placed in accordance with the plans and specifications and as directed by the Purchaser.
- 5.02 CONSTRUCTION EXITS
  - A. Construction exits will be measured per each placed in accordance with the plans and specifications and as directed by the Purchaser.
- 5.03 ROCK CHECK DAMS
  - A. Rock Check Dams will be measured per each placed in accordance with the plans and specifications and as directed by the Purchaser.
- 5.04 HIGH VISIBILITY FENCE
  - A. High visibility fence will be measured per linear foot placed in accordance with the plansand specifications and as directed by the Purchaser
#### 6.01 SILT FENCE WITH BACKING

A. Silt fence will be paid for at the contract unit price per foot, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, posts, fasteners, backing, trenching, backfill, compaction, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required

#### 6.02 CONSTRUCTION EXITS

A. Construction exits will be paid for at the contract unit price per each, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, rock, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required.

#### 6.03 ROCK CHECK DAMS

A. Rock check dams will be paid for at the contract unit price per each, which price shall be full compensation for furnishing, installing, maintaining and cleaning all fabric, rock, trenching, backfill, compaction, disposal of trapped sediment throughout the life of the project, removal at the conclusion of the project, and all other appurtenant work as required.

#### 6.04 HIGH VISIBILITY FENCE

A. High visibility fence will be paid for at the contract unit price per foot, which price shall be full compensation for furnishing, installing, and maintaining all fabric, posts, fasteners, removal at the conclusion of the project, and all other appurtenant work as required.

### 6.05 PAYMENT WILL BE MADE UNDER

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02447-6.01	SILT FENCE WITH BACKING	LF
02447-6.02	CONSTRUCTION EXITSROCK CHECK	EACH
02447-6.03	ROCK CEHCK DAMS	EACH
02447-6.04	HIGH VISIBILITY FENCE	LF

### END OF SECTION 02447



# CITY OF MEMPHIS

# STANDARD CONSTRUCTION SPECIFICATIONS FOR SANITARY SEWERS AND APPURTENANCES

Issued for State approval

Prepared by: City of Memphis Division of Engineering Sewer Design Department



City of	WPN 21.0259 Memphis Standard Specifications
APPR	OVED FOR CONSTRUCTION
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APPROVAL EXP	RES FIVE YEARS FROM ABOVE DATE

Faraedoon Qaladize Sewer Design Engineer

City of Memphis Division of Engineering 125 N. Main Street., Room 644 Memphis, TN 38103

### PART 1 - SCOPE

1.01 This Work will consist of the construction of sanitary sewers, siphons, and service connections of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished by these Specifications and in conformity with the lines, grades, and details shown on the Plans or established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Without specifications that state the quality of any work, the Contractor is required to perform such items using first-quality construction. Unless otherwise provided, the Contractor will furnish all material, equipment, tools, labor and incidentals necessary to complete the Work.

1.02 The Engineer may change the Plans, Specifications, character of work or quantity of work, provided the cost of the changes does not exceed 10% of the contract price.

### PART 2 - MATERIALS AND EQUIPMENT

#### 2.01 MATERIAL

A. Construction Material

1. All material furnished by the Contractor will be new, high quality and free from defects. Previously used material in acceptable condition may be used for bracing, forms, false work, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

B. Higher Strength Pipe

1. The Contractor may substitute a higher strength pipe of the same type as that specified subject to the approval of the Engineer.

### C Qualifications of Manufacturers

1. Pipe for sanitary sewers will be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Contractor will be subject to approval by the Engineer. No material will be delivered until the manufacturer and product have been approved by the Engineer. For any construction project, pipe and appurtenances for each pipe material shall be the product of a single manufacturer having a minimum of 10 years domestic experience producing the type of pipe supplied.

D. Material Inspection and Testing

1. Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested. All material to be used in the work will be sampled, inspected, and tested by current ASTM specifications, or other standard specifications. The Contractor will furnish the Engineer with three copies of certified reports from an accredited testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each length of pipe delivered to the project will show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Contractor

2. The Contractor will notify the Engineer before any deliveries of material and will make whatever provisions are necessary to aid the Engineer in the inspection and culling of the material before installation

### E. Storage

1. The Contractor will provide and maintain storage facilities and exercise such measures to maintain the specified quality and fitness of material to be incorporated in the work. The interior and sealing surfaces of the pipe, fittings and adapters will be kept free from dirt and foreign matter. PVC pipe, fittings, and adapters stored outside and exposed to sunlight will be covered with an opaque material with proper ventilation.

#### F. Prestressed Concrete Cylinder Pipe

1. All prestressed concrete cylinder pipe shall conform to the requirements of AWWA C 301 and C 304 and will be designed for a variable depth of cover as shown on the profile; the maximum trench loading that can occur on an empty pipe after backfill is in place; and a live load equal to the AASHTO HS20 loading or the minimum live load as specified in AWWA C 301, whichever is greater. The interior surface of the pipe will be a smooth, cylindrical surface. Cement will meet all the requirements ASTM C 150, Type II. Steel cylinder shall be made of steel sheets not lighter than No. 16 gauge with a minimum yield strength of 33,000 psi, and conforming to the requirements of "Standard Specification for Hot-Rolled Carbon Steel Sheets and Strip Structural Quality", Grade 33, ASTM designation A 1011. Steel used for the bell rings for pipe and fittings shall have a minimum yield strength of 30,000 psi and conform to the requirements of ASTM A 1011. Steel plate and special shapes for spigot joint rings shall conform to the requirements of ASTM A 36 or the other ASTM specifications listed in AWWA C 301. High tensile prestressing wire shall be a minimum of No. 6 gauge and maximum class shall be Class III. The wire shall conform to the requirements of "Standard Specification for Steel Wire, Hard-Drawn for Prestressing Concrete Pipe", ASTM A 648. No lifting holes will be allowed. The pipe will be furnished complete with gaskets, grout bands and lubricant as required for proper installation.

2. The interior of all 36 inch and larger diameter pipe will be fully lined with a PVC liner as specified in Section 02530 Paragraph 2.01.DD. The liner will be installed by the pipe manufacturer prior to pipe delivery.

3. The liner will be welded at each joint after installation and testing of the pipe. Exceptions to the welding requirement may be granted at the direction of the Engineer.

4. Fittings shall be composed of cut and welded steel plate with all welds inspected, and the completed cylinder shall be tested for tightness by the dye penetrant method. Fittings shall have wire reinforcement applied to the interior and exterior surfaces. Concrete and mortar linings shall be at least 3/8 inch thick and exterior mortar coating shall be 1 inch thick unless otherwise indicated. All materials and workmanship shall be as specified in AWWA C 301.

a. Curves of long radius may be formed by the use of pipe on which the spigot joint rings are placed on a bevel or by the use of bevel adapters. Special pipes shall be designed to provide the same strength as the adjacent pipe. Branch connection or openings, such as manholes and bypass pumping connections, shall be incorporated in straight pipe and shall be suitably reinforced. Special pipes shall be provided with joint rings corresponding to those on adjoining straight pipes. Special ends shall be provided on concrete pipe, where required to connect to pipe of other manufacturers and special structures.

#### G. Reinforced Concrete Pipe

1. All reinforced concrete pipe for gravity sewer applications will conform to the requirements of ASTM C 76 for circular pipe, Wall B for the specified diameter and strength class. If no class is specified, Class III pipe will be used. The interior surface of the pipe will be a smooth, cylindrical surface. Cement will meet all the requirements ASTM C 150, Type I. No lifting holes will be allowed. The pipe will be furnished complete with gaskets, grout bands and lubricant as required

for proper installation. Pipe will be designed for a 0.01 inch crack D-Load. The ultimate D-Load will be at least 1.5 times the 0.01 inch D-Load.

2. The interior of all 36 inch and larger diameter pipe will be fully lined with a PVC liner as specified in Section 02530 Paragraph 2.01 DD. The liner will be installed by the pipe manufacturer prior to pipe delivery.

3. The liner will be welded at each joint after installation and testing of the pipe. Exceptions to the welding requirement may be granted at the direction of the Engineer.

4. Joints in reinforced concrete pipe less than 30 inches in diameter will have compression gaskets or trapped O-ring gaskets. Pipes 30 inches in diameter or greater will have trapped O-ring gaskets meeting the requirements of ASTM C 443. When required, concrete pipe ends will be manufactured with steel bell and spigot end rings with a groove on the spigot for an O-ring rubber gasket. This joint will meet the joint requirements of ASTM C 443 and ASTM C 361. The shape, dimensions, and tolerances of the bell and spigot or tongue and groove ends of the pipe will meet the requirements of ASTM C 443. The ends of the rubber gasketed pipe will be accurately manufactured so that, when adjacent pipe sections are drawn together, the rubber gasket will be uniformly compressed around the periphery of the pipe to provide a watertight seal.

### H Ductile Iron Pipe and Fittings

1. Ductile iron pipe for gravity sewer and service connections will conform to ASTM A 746. Ductile iron pipe for force main applications will conform to ANSI A 21.51. The pipe thickness design will conform to ANSI A 21.50. If no thickness class is specified on the Plans or Contract Documents, Class 50 or approved equivalent will be used. All ductile iron pipe will be lined with either Protecto 401 Ceramic Epoxy, SewPer Coat Cement Mortar Lining, or Polyethylene Linings will be applied according to manufacturer's recommendations. Fittings will conform to the requirements of ANSI A 21.10. Unless otherwise specified, joints will be push-on gasket type conforming to the requirements of ANSI A 21.11. Hanged joints will conform to the requirements of ANSI A 21.11. Flanged joints will conform to the requirements of ANSI A 21.11. Flanged joints will conform to ASTM A 536 and will be Grade 70-50-05. Steel retainer rings will conform to ASTM A 148 for Grade 90-60

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# J.01 Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (8-15 inch Diameter)

1. All PVC gravity pipe and fittings 8-15 inches in diameter shall be solid wall PVC; no profile wall PVC pipe is allowed for pipes 15 inches or less in diameter. PVC solid wall pipe and fittings for gravity sewer applications will conform to the requirements of ASTM D 3034. The standard dimension ratio (SDR) will be SDR 26 (Type PSM). PVC resin will conform to ASTM D 1784 cell class 12454C. A different cell class will be allowed only if the material meets the requirements of a superior cell class than 12454C. Fittings for PVC gravity sewer pipe will be fabricated from PVC meeting the respective ASTM PVC pipe standard for molded or extruded PVC. The wall thicknesses of the waterway and bell of fittings will be no less than the respective minimum thicknesses for the equivalent pipe. All fittings will be compatible with the pipe to which they are attached.

2. All PVC gravity pipe joints will be gasketed bell and spigot push-on type conforming to ASTM D 3212, unless directed otherwise in these Specifications. Gaskets will be part of a complete plpe section and purchased as such. Lubricant will be as recommended by the pipe manufacturer.

3. Solvent welded PVC saddle wye's may only be used on existing PVC and truss gravity sewer mains. Collar joints for fittings will be either Type SC (solvent cement) or Type OR (flexible gasketed compression joint) and will conform to the requirements of ASTM D 2680.

# J.02 Polyvinyl Chloride (PVC) Gravity Pipe and Fittings (6 inch Diameter) Service Connection

6 Inches in diameter service connection may conform to either the SDR 26 Specification (ASTM D1784) or to ASTM D1785 and ASTM D 2665 (Schedule 40). All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and Shelby County, Tennessee code requirements. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656

### K. Polyvinyl Chloride (PVC) Pipe and Fittings (18-36 inch Diameter)

1. All 18-36 inch diameter PVC gravity sewer pipe and fittings shall be designed and manufactured in accordance with ASTM F 679, F 794, F 949, or F 1803. All PVC sewer pipe and fittings shall be manufactured from PVC resin with a cell classification of either 12454C or 12364C as defined in specification ASTM D 1784. The pipe shall be furnished complete with gaskets, fittings, lubricant, etc. as required for proper installation and completion of the line. The minimum pipe stiffness at 5% deflection shall be 46 psi when tested in accordance with ASTM D 2412 and as specified in ASTM F 679, F 794, F 949, or F 1803, as applicable. Samples of the type of pipe to be used shall be tested in accordance with ASTM D 2412. Impact tests shall be conducted in accordance with ASTM D 2444 and shall comply with ASTM F 679, F 794, F 949, or F 1803. Tests may be conducted by the manufacturer in the presence of the Engineer. The City shall have the right to make unannounced visits to the pipe manufacturer's facility to inspect the manufacturing process.

2. All joints shall be the bell and spigot type and conform to ASTM D 3212. Gaskets shall meet ASTM F 477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket which is positively retained. No solvent cement joints will be permitted in field construction.

3. The pipe manufacturer shall furnish to the Engineer a notarized certificate(s) of inspection stating that each piece of pipe used on this project was made and tested in accordance with these specifications.

4. All pipeline material shall be generically the same throughout the project with the permissible exception of utilizing different material for piping used for tie-ins of smaller lines, or as noted on the plans or as approved by the Engineer.

L Glass Fiber Reinforced Polymer Mortar Pipe and Fittings up to 72 inch Diameter

1. Pipe shall meet the requirements of ASTM D 3262 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe. The pipe shall be manufactured to form a dense, non-porous, corrosion-resistant, composite pipe that is resistant to corrosion from hydrogen sulfide and other corrosive materials normally found in sewerage systems, all without the use of special HDPE or PVC liners.

2. Minimum acceptable nominal length for joints of pipe shall be 20 feet except where field conditions require otherwise or approved by the Engineer.

3. Design: The design of the pipe shall comply with all requirements of the latest revision of ASTM D - 3262 for non-pressure (gravity) flow conditions. The pipe shall also be designed for a variable depth of cover as shown on the profile; the maximum trench loading that can occur on an empty pipe after backfill is in place; and a live load equal to the AASHTO HS20 loading or the minimum live load as specified in the latest revision of ASTM D - 3262, whichever gives the greater live load.

4. Resin Systems: These shall be only polyester resin systems with a proven history of satisfactory performance in sewage applications. Historical data shall have been acquired from a composite material of similar construction and composition.

5. Glass Reinforcements: Reinforcing glass fibers used in the manufacture of the pipe shall be of the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

6. Interior Lining: All interior surfaces of the pipe shall be lined with a fiberglass reinforced polyester lining as a part of the manufacturing process.

7. Joints: The pipe shall be field connected with fiberglass sleeve couplings that utilize full face elastomeric sealing gaskets of EPDM rubber compound, providing a zero leakage joint. The coupling shall be factory assembled to one end of the pipe. Each joint shall be tested after installation in accordance with Specification Section 02530 4.02.

8 Tests and Examinations: Tests, in-process and final examinations shall be performed by the manufacturer, or an independent testing laboratory approved by the Engineer, in accordance with the latest revision of ASTM D 3262, in order to assure conformance. All instruments, gauges, and other testing and measuring equipment shall be of the proper range, type and accuracy to verify conformance and test equipment shall be checked at least annually against calibrated and certified test gauges and instruments. The Engineer shall have access to all records of tests and inspections related to the manufacture of the pipe, and, without notice to the manufacturer, shall also have the right to witness the manufacture of the pipe and any tests being performed by the manufacturer or his suppliers relative to products, materials, or the pipe being produced. Copies of records of tests and inspections shall be submitted if requested by the Engineer.

a. Pipes: These shall be manufactured and tested in accordance with ASTM D 3262.

b. Joints: Coupling joints shall meet the requirements of ASTM D 4161 and/or produce a zero leakage joint.

c. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D 2412 shall be 46 psi.

9. Fittings and Special Pipe: Fittings shall be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays, all capable of withstanding all operating conditions when installed.

10. Curves of long radius shall be formed by the use of bevel end pipe or by the use of bevel adapters. Deflection of pipe joints to form the long radius curves will not be accepted. Special pipes shall be designed to provide the same strength as the adjacent pipe. Branch connections or openings, such as manholes and bypass pumping connections, shall be incorporated in straight pipe and shall be suitably reinforced. Special pipes shall be provided with joints corresponding to those on adjoining straight pipes. Special ends shall be provided on pipe, where required, to connect to pipe of other manufacturers and special structures.

11. Unloading Handling and Storage: All pipe shall be inspected at time of delivery, and damaged pieces rejected and removed from the site of the work. Unloading shall be done by mechanical equipment designed to properly handle the pipe, and dropping from delivery vehicles will not be permitted. Pipe shall be stored in an orderly manner to protect the pipe from injury, and from damage by freezing, all in accordance with the manufacturer's written instructions.

### M High Density Polyethylene (HDPE) Pipe and Fittings

1. High Density Polyethylene Pipe (HDPE) may be used in construction of inverted siphons. No HDPE will be allowed in any other gravity sewer application. All HDPE shall be manufactured from virgin, extra high molecular weight, high density PE4710 polyethylene pipe grade resin to a minimum cell classification of PE445574C as determined by ASTM D3350. No post-consumer recycled polyethylene materials shall be allowed.

2. All HDPE pipe and fittings shall conform to ASTM F714 and ASTM D3261, respectively, and have a Standard Dimension Ratio (SDR) of 17, maximum

3. Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of 75 psi and temperature of 400  $\square$  F. All such connections shall be performed in strict accordance with the manufacturer's instructions

# N. Polyvinyl Chloride (PVC) Pressure Pipe and Fittings

1. PVC pipe and couplings for force main applications will conform to the requirements of ASTM D 2241 and AWWA C 900 Standard for Polyvinyl Chloride (PVC) Pressure pipe 4 inches through 12 inches for Water. The minimum pressure class will be Class 100 or as specified and outside diameter base (IPS or CI) will be as specified in the Plans or Contract Documents.

2. Joints for pipe and couplings will be solid ring elastomeric gasket type. Gaskets must withstand internal pressures of not less than the minimum sustained pressure and burst pressure requirements specified for the pipe with which they are designed to be used. No solvent cement joints will be allowed. Joints will conform to the requirements of AWWA C 900 and/or ASTMD 2241.

### O High Density Polyethylene (HDPE) Pressure Pipe and Fitlings

1. All HDPE shall be manufactured from virgin, extra high molecular weight, high density PE4710 polyethylene pipe grade resin to a minimum cell classification of PE445574C as determined by ASTM D3350. No post-consumer recycled polyethylene materials shall be allowed

2. All HDPE pipe and fittings shall conform to ASTM F714 and ASTM D3261, respectively, and have a Standard Dimension Ratio (SDR) of 17, maximum.

3. Successive joints of HDPE pipe shall be joined by heat fusion at a fusion pressure of 75 psi and temperature of 400 F. All such connections shall be performed in strict accordance with the manufacturer's instructions.

### P Air/Vacuum Valves, Automatic Air Release Valves and Combination Valves

1. The Air/Vacuum Valves shall be single body, double orifice and shall automatically exhaust air from the force main while being initially filled with fluid. After the air has been exhausted from the line, the valve shall close tightly. The valve shall remain closed as long as the sewer line is under positive pressure. Should the force main pressure fall below atmospheric pressure, the valve shall reopen to allow air to enter the pipe thereby preventing a negative pipe pressure. The valve shall be designed to prevent clogging due to solids in the fluid. Each of these valves shall be designed to separate the liquid from the sealing mechanism. The Air/Vacuum Valves shall be as manufactured by A.R.I. or approved equal.

2. The Combination Air Valve shall consist of a combination of an air and vacuum large orifice and an automatic small orifice in a single body. The valve must be designed to operate with liquids carrying solid particles. The valve shall discharge air during the filling or charging of the system and admit air to the system while being emptied of liquid and discharge accumulated air from the system while it's under pressure and operating. Each of these valves shall be designed to separate the liquid from the sealing mechanism. The valve shall have a working pressure range up to 150 psi or as specified on the plans. Combination Valves shall be A.R.I. or approved equal.

3. The manufacturer shall certify venting capacity and provide three copies of installation and maintenance manuals for each type of Combination Air Valve and Air/Vacuum Valve supplied.

4. The Manufacturer shall guarantee all items specified to be free from defects in design, materials and workmanship for one year from the date of acceptance. During the guarantee period, the Manufacturer shall furnish and install replacement parts for any defective component at no additional cost.

## Q Check Valves, Gate Valves and Ball Valves

1. All check valves shall have external arms so that the valve may be opened and closed by hand. Check valves shall be controlled closing swing check valves and shall be Golden-Anderson Series 250, or Valve and Primer Series 6000, or as approved. Each check valve shall have a cast iron body, stainless steel plates, stainless steel springs, stainless steel hinge pins and stops, Teflon spring and hinge bearings and standard trim for IBBM construction. All wetted components shall be 316 stainless steel. Each check valve shall have Buna N seals.

2. All check valves shall be class 125 vertical or horizontal swing type with iron body and flanged ends

3. Knife gate valves will be manufactured by Red Valve Company, Inc, Pittsburgh, PA; and shall be their Standard Flexgate, or approved equal. Knife gate valves must conform to AWWA C-504 requirements. The shaft shall be constructed of Type 304 stainless steel. The knife gate shall be Type 316 stainless steel. The valve seat shall be a resilient, mechanically retained, field replaceable, polytetraflouroethylene elastomer. The upper and lower bearings shall be self-lubricating Teflon. The valve shall be equipped with a handwheel

4. Wedge gate valves will be resilient wedge gate valves as manufactured by Mueller Co., or approved equal. Wedge gate valves must conform to AWWA C 509 or AWWA C 515 and will be either series 2360 or series 2361.

5. All ball valves for 2 inch and 3 inch diameter fittings shall be full port, brass ball valves, shall be rated to 125 psi minimum, and shall meet the requirements of NSF/ANSI 61/8. Ball valves will have threaded connections and blowout proof stems. Ball valves will be Series FBV-3C as manufactured by Watts, or as approved.

6. Valve manufacturer shall furnish certification that each valve has been subjected to a hydrostatic water pressure twice the pressure class and that each valve is free of defects. The valve manufacturer shall guarantee all items specified to be free from defects in design, materials and workmanship for one year from the date of acceptance. The manufacturer shall, during the guarantee period, furnish and install replacement parts for any defective component at no additional cost

#### R. Steel Casing Pipe

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1. Casing pipe will conform to ASTM A 139. Minimum yield strength will be 35,000 psi. Wall thickness will meet the requirements of the latest revision of the American Railway Engineering Association Manual of Recommended Practice unless otherwise specified. Wall thickness will be:

ominal Thickness Inches	Nominal Diameter Inches	
0.188	Less than 14	
0.219	14 and 16	
0.250	18	
0.281	20	
0.312	22	
0.344	24	
0.375	26	
0.406	28 and 30	
0.438	32	
0.469	34 and 36	
0.500	38, 40, and 42	

2. When casing is installed without a protective coating and is not cathodically protected the wall thickness shown above will be increased to the nearest standard size that is a minimum of 0.063 inches greater than the thickness shown. This requirement does not apply to casing diameters less than 12 3/4 inches.

#### S. Lubricants for Prefabricated Pipe Gaskets

1. The lubricant used in jointing pipes fitted with flexible, rubber gaskets will be as recommended by the pipe manufacturer. Lubricants will be suitable for use at temperatures from 51 to 120. F(-15 C to 50 C). Containers will be labeled with the intended, compatible pipe material and the manufacturer's name.

#### T. Primers and Adhesives

1 All primers and solvents used with ABS Composite Sewer pipe will conform to ASTM D 2235 and will be applied as recommended by the manufacturer. For bonding PVC to PVC, solvent cement will conform to ASTM D 2564. For bonding PVC to ABS, solvent cement will conform to ASTM D 3138. Adhesives used to fasten flexible rubber or rubber gaskets will conform to the requirements of the gasket manufacturer

#### U. Adapters and Couplings

1. At the direction of the Engineer, a connection of sanitary sewer pipes, 6 inches through 16 inches, of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made by means of an approved compression or mechanical connector or adapter. The gaskets for compression connectors or adapters will be manufactured of an approved preformed elastomeric material conforming to applicable sections of ASTM Standards C 425, C 564, C1173, D 3212, and D 5926. Mechanical couplings or adapters will have tightening clamps or devices made of 300 series stainless steel with a stainless steel shear ring and stainless steel hardware, as specified in ASTM A 240. If a stainless steel shear band is not used a concrete collar is required. Each connector and adapter will bear the manufacturer's name and required markings. Installation will be by the manufacturer's recommendations.

2. At the direction of the Engineer, a connection of sanitary sewer pipes (18 inches in diameter and larger) of dissimilar material, different sizes or for the repair of sanitary sewer pipes of similar material may be made in accordance with Specification Section 02530 Paragraph 3.09.C. Mechanical connectors meeting the above requirements may be used at the direction of the Engineer

### V Portland Cement Concrete

1. Portland Cement Concrete will be of the class and dimensions shown on the Plans, or as directed by the Engineer. The classes of concrete are called Class A and Class C. Class A concrete is intended principally for concrete structures designed for high strength. Class C concrete is low strength concrete, intended principally for foundation stabilization, pipe cradles and encasement and other general-purpose uses. All portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures, their proportioning, mixing, delivery, minimum strength, sampling and testing will be as specified in Specification Section 03050.

### W. Crushed Limestone

1. Crushed limestone will be size No. 67 Coarse Aggregate meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction and the following gradation:

### Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)

Size No.	1"	3/4"	3/8"	No. 4	No.8
67	100	90-	20-	0-	0-
		100	55	10	5

2. Crushed limestone meeting the requirements of the Tennessee DOT Standard Specifications for Road and Bridge Construction, size No. 57 Coarse Aggregate will be used as directed by the Engineer or as shown on the plans Size No. 57 Coarse Aggregate will meet the following gradation:

### Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)

Size No	1-1/2"	1"	1/2"	No. 4	No.8
57	100	95-	25-	0-	0-
		100	60	10	5

- X Deleted
- V Mortar

1. Mortar will be composed of one-part portland cement, two parts masonry sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water All ingredients will be proportioned by measurements and not by estimating. All portland cement, sand, and water will be as specified in Specification Section 03050. All hydrated lime will be as specified by ASTM C 206.

2. The mortar will be hand mixed or machine mixed. In the preparation of hand mixed mortar, the sand, cement and hydrated lime will be thoroughly mixed in a clean, tight, mortar box until the mixture is of uniform color, after which water will be added. Machine mixed mortar will be prepared in an approved mixer and will be mixed not less than 1½ minutes. Mortar will be used within 30 minutes after mixing

#### Z. Bracing Lumber

1. Lumber for tunnel bracing will be a minimum of 3 inches thick and made of bridge oak. All timbers will be of good quality, straight grained, and free from weakening knots and other defects. Bracing will be placed to form a structurally sound timber tunnel. The timber tunnel lining will remain in place after laying the pipe and backfilling.

#### AA Pit Run Gravel

1 Pit run gravel will consist of one of the three gradations shown in the table below.

Total Percent by Dry Weight, Passing Each Sieve (U.S. Standard)							
Size No.	21/2"	2"	1½"	1"	3/8"	No.40	Clay*
1	100	95-100 100	95-100		35-65	10-30	1-12
3		100	100	90-100	45-65	10-35	2-12

\*Clay content will be determined by the Hydrometer Test-AASHTO T 88 Clay content up to 15 percent may be used with the approval of the Engineer

2 That portion passing the No. 40 sieve will be known as the binder. The binder aggregate will consist of hard durable particles of limestone or sound siliceous material. Shale aggregate or pipe clay binder will not be acceptable. The percent of silt will not exceed the percent of clay by more than 25 percent. If the binder material is insufficient to bond the aggregate a satisfactory binding material may be incorporated, as approved by the Engineer, so that the resultant mixture will comply with these Specifications. The mixing will be done uniformly, and blending of material on stockpiles or in the pits by bulldozers, clamshells, draglines, or similar equipment will not be permitted.

#### BB. Brick

1. All brick will conform to ASTM C 55 for Grade A. Unless otherwise approved by the Engineer, bricks will conform to the following dimensions: Depth Width Length

	(in)	(in)	(in)
Standard Size	2 1/4	3 3/4	8
Allowable Variation	+ 1/4	+ 1/4	+ 1/2

2 All brick will be new and whole, of uniform standard size and with straight and parallel edges and square corners. Bricks will be tough and strong and free from harmful cracks and flaws. Brick will be culled after delivery if required and all culls will be removed from the work site

3. The Contractor may be required to furnish the Engineer with at least five bricks of the character and make he proposes to use, at least one week before any bricks are delivered for use. All brick will be of the same quality as the accepted samples

### CC. Non-Shrinking Grout

1 Grout will be mixed in small quantities as needed and will not be re-tempered or used after it has begun to set. Unless otherwise specified, the grout will consist of one-part portland cement, two parts masonry sand by volume, a non-shrinking, nonmetallic admixture and sufficient water to form a grout of proper consistency. When non-shrinking or non-shrinking fast setting grout is specified it will be formulated by the incorporation of an admixture, or a premixed grout may be used.

2. The formulation, admixture or the premixed grout used will be subject to the approval of the Engineer and will be mixed and used according to the recommendations of the manufacturer. These special grouts will be classified as follows:

Type I – Non-shrinking Grout Type II – Non-shrinking, Fast Setting Grout

Portland cement, masonry sand, and water will conform to the requirements of Specification Section 03050.

# DD. Polyvinyl Chloride (PVC) Protective Lining for Concrete Pipe and Structures

1 Liner shall be Ameron T-Lock as manufactured by Ameron Protective Coatings Division. Brea, California or approved equivalent.

2 The material used in the liner and in all joint, corner, and welding strips shall be a combination of polyvinyl chloride resin, pigments, and plasticizers, specially compounded to remain flexible. Material color shall be white

3 Polyvinyl chloride resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted

4. Tensile specimens shall be prepared and tested in accordance with ASTM D412 using die B Weight change specimens shall be 1-inch by 3-inch samples of the sheet thickness Specimens may be taken from sheet and strip at any time prior to final acceptance of the work.

5. Liner plate locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature of 70-80 F inclusive.

6. All plastic liner plate sheets, including locking extensions, all joint, corner and welding strips shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material. The Engineer may authorize the repair of such defects by approved methods.

7. The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to 1/4-inch settling cracks, which may occur in the pipe or in the joint after installation, without damage to the lining.

8. The lining shall be repairable at any time during the life of the structure.

9. Liner shall be a minimum of 0.065 inches in thickness. Locking extensions (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2.5 inches apart and shall be at least 0.375 inches high.

10. Sheets shall have transverse strap channels cut in the locking extensions so that the strap can be placed into and perpendicular to the locking extensions.

11. These channels shall be not less than 3/4 inch wide and not more than 1 1/4 inch wide and shall be cut so that a maximum 3/16 inch of the base of the locking extension remains in the base of the strap channel. Strap channels shall be provided at intervals of not less than 15 inches and no more than 20 inches center-to-center. The strap channels will not be cut through the final two locking extensions on each edge of the sheet.

12: Transverse flaps shall be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that a maximum of 1/64 inch of the base of the locking extension is left on the sheet.

13. Weld strips shall be approximately 1 inch wide with a minimum width of 7/8 inch. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal 1/8 inch.

14. All sheets used shall be shop tested for pinholes using an electrical spark tester set at 20,000 volts minimum. Any holes shall be repaired and retested

### EE Tracer Wire for Sewer Line and Force Mains

- Tracer wire shall be installed along the length of all sewer pipes, service connections, manholes and stubs. All tracer wire shall have HDPE insulation intended for direct bury, green in color, and be suitable for wet or dry applications. All system components, including tracer wire, connectors, ground rods and access points, must be compatible.
- 2. Tracer wire shall be copper-clad steel 12-AWG, and must conform to ASTM B910/ B910M. Minimum brake load of tracer wire is 450 lb, in open cut and 1,150 lb, in directional drilling. Tracer wire for pipe bursting shall be copperhead with Extreme Strength 7x7 stranded 4,700 lb, break load. Conductor shall be annealed copper and meet or exceed all applicable ASTM standards, including ASTM B3 and ASTM B170.
- 3. Insulation shall be high density, high molecular weight, polyethylene (HDPE) with a minimum flexural strength of 120,000 psi and shall meet or exceed ASTM D790. Insulation shall be green in color with a minimum thickness for open cut, directional drilling, and pipe bursting of 30, 45, and 50 mils respectively.
- 4. Connector shall be specifically manufactured for use in underground tracer wire and shall be dielectric silicone filled to seal out moisture and corrosion, and shall be installed in a manner to prevent any uninsulated wire exposure. Non-locking, friction fit, twist on, or taped connectors are prohibited.
- Grounding of tracer wire shall be achieved by using a 1.5-lb, drive-in, magnesium ground rod with a minimum 20-feet HDPE insulated copper-clad steel wire connected to the rod specifically manufactured for this purpose.

6. All two-terminal tracer wire access points must include a manually interruptible conductive/ connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection. All at-grade access points shall include an encapsulated magnet molded into the top portion of the tube, to allow for detection by a ferrous metal detector. On both public and private properties, tracer wire shall terminate at an approved

at-grade, two-terminal access box near the sewer clean-out. For sewer lines over 500 linear feet without service laterals, tracer wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground tracer wire access box shall be delineated using a minimum 48" polyethylene marker post, green in color. All at-grade access points shall be supplied with anti-corrosion wax-gel to protect wires

#### FF. Reserved

#### GG New Material and Methods

1. The City encourages development of new products and technology and will consider the use of products or methods not previously specified. Product submittals will be reviewed by the City Engineer and a determination will be made as to the acceptability of the product. Consideration or review of a new product does not mean the City will accept its use on the Project.

### 2.02 EQUIPMENT

A. The Contractor will furnish and maintain in good condition all equipment and facilities as required for the proper execution and inspection of the Work. All equipment and facilities will be on site and approved by the Engineer before work will be permitted to begin.

### PART 3 - CONSTRUCTION REQUIREMENTS

### 3.01 SITE PREPARATION AND RESTORATION

#### A Rights-of-Way and Easements

1. Rights-of-way and/or easements as shown on the Plans and/or rights-of-way/easement plats are provided by the City to the Contractor for construction of sanitary sewer facilities. The Contractor will confine his construction activities to these areas. The Contractor will be responsible for obtaining written agreements for use of private property outside City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Contractor will immediately provide a copy of all such written agreements to the City upon obtaining the same.

#### B Clearing of Rights-of-Way and Easements

1. The Contractor will confine his clearing of rights-of-way and easements to the least area necessary for construction of facilities shown on the Plans. The Contractor will protect as many trees and shrubs within the area as possible. Where necessary for construction the Contractor will clear all live and dead vegetation and growth, pole stubs, logs, and other objectionable material. Cleared material will be removed to within 3 inches of existing ground. This work will be done well before excavation operations but only after erosion controls have been placed.

#### C. Location of Existing Obstructions

1 Locations of obstructions shown on the Plans are approximate and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Contractor will be removed and replaced in their original state or protected by the Contractor at no additional cost to the City.

#### D Removal of Obstructions

1. The Contractor will demolish and remove all structures and structure foundations, abandoned vehicles, appliances, and rubbish within the right-of-way/easement limits necessary for the performance of the work.

### E Protection of Obstructions Outside Easement Limits

1. The Contractor will protect and avoid damage to all trees, shrubs, plants, fences, structures, and all other objects outside the right-of-way/easement limits shown on the Plans and/or Plats due to construction operations. All damage will be repaired or restored at the Contractor's expense. Particular attention will be paid to avoid damage to trees, shrubs, bushes, and private property located next to rights-of-way/easements. No trees, plants, or other objects may be removed outside such limits without written permission of the property owner.

### F Special Protection of Obstructions Inside Easement Limits

1. Wherever the underground installation of sanitary sewer facilities will go through surface improvements previously made by the City, other governmental bodies, or property owners, the Contractor will be responsible for their protection and preservation. This responsibility includes the removal and storage of such improvements to allow replacement and restoration as close as possible to the undisturbed condition.

#### G. Disposal of Debris

1. All trees, brush, logs, snags, leaves, sawdust, bark, and refuse will be collected and disposed of according to the City Code of Ordinances at the expense of the Contractor. There will be no separate pay item for disposal of debris. Debris will be removed from the site when practical and will not be left until the completion of the contract. If burning of debris is allowed by the Engineer all precautions will be exercised to prevent the spread of fire and such burning will be according Specification Section 01740 Paragraph 1.06. Burning will be done only at approved locations and in conformity with the laws, ordinances and requirements of agencies and officials having jurisdiction. Besides obtaining the permission of the Engineer, the Contractor will obtain and pay for any permits required. When material is to be disposed of outside the easement, the Contractor will first obtain written permission from the property owner on whose property the disposal is to be made and will file a copy with the Engineer. Unless otherwise provided in the Contract Documents, the Contractor will arrange for disposing of such material outside the right-of-way/easement. No debris will be deposited in wetlands.

2. As approved by the Engineer, wood chips, mulch, etc. placed by the Contractor to prevent soil erosion are not considered debris. All erosion prevention materials will be placed and maintained in accordance with the Memphis and Shelby County *Storm Water Management Manual* and/or the Tennessee Department of Environment and Conservation *Erosion and Sediment Control Handbook*.

#### H Replacement of Fences

1. Any fences disturbed inside the right-of-way/easement limits will be replaced or restored to their original or better condition. Any fences removed will be replaced in their original location. Fences in such poor condition that they cannot be taken down and rebuilt with the same material will be replaced with new fence material similar in original quality, size, and appearance to the removed fence. Exceptions to this requirement will be allowed if written releases are obtained from the property owners by the Contractor and submitted to the Engineer. For chain link fence, new fence material and construction methods will conform to the requirements of Specification Section 02820.

### Restoration of Turfed Areas

1. All areas will be restored as nearly as practicable to their original condition. Finished lawn areas where soil has been deposited will be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled will be resodded. Areas where sod is only slightly damaged may be reseeded if so permitted by the Engineer. After final restoration of the settled trench surfaces, trench areas and areas regraded as part of the construction will be resodded, unless otherwise shown on the Plans or directed by the Engineer. Seeding and sodding material and construction methods will conform to the requirements of Specification Sections 02920 and 02921

### 3.02 EXCAVATION

A. All excavation performed under this Section including trench excavation, structure excavation, and channel excavation, but excluding undercut excavation, will be considered unclassified excavation despite the nature of the material and objects excavated and will not be measured or paid for separately except as specifically noted. Pavement removal and replacement will be accomplished as specified in Specification Section 02950.

#### B. Trench Excavation

1 All trenches will be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking may be allowed by written permission of the Engineer.

2. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material will be hand excavated so that the pipe is bedded on a firm, undisturbed subgrade.

3. No more than 300 feet of trench will be opened ahead of the completed sanitary sewer, nor will more than 100 feet be left unfilled except by written permission from the Engineer. In special cases the Engineer may limit the distance to which the trench may be opened by notifying the Contractor in writing.

4. The width of trenches below a level 1 foot above the outside top of pipe will be at least 6 inches but not more than 12 inches on each side of the outside of the pipe for all sizes up to and including 16 inches in diameter. A maximum trench width dimension for these pipe sizes will be 36 inches. For 18-inch diameter pipes, the width of trenches below a level 1 foot above the outside top of pipes will be at least 6 inches on each side of the pipe, with a maximum trench width of 42 inches. For pipe sizes more than 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe will be at least 12 inches but no more than 15 inches on each side of the outside of the pipe. If the trench width at or below 1 foot above the top of pipe exceeds the width specified, provisions will be made at the Contractor's expense to compensate for the additional load upon the pipe.

5. The sides of the trench will be as nearly vertical as possible. The bottom of the trench will be carefully graded, formed, and aligned according to City of Memphis Standard SST-3 and to the satisfaction of the Engineer before sanitary sewers are laid.

#### C Other Excavation

#### 1. Undercut Excavation:

Undercut excavation will consist of removing and disposing of unsatisfactory material below the grade established on the Plans for sanitary sewers, structures, and manholes. No undercut excavation will be done without prior authorization of the Engineer. The limits of undercut excavation will be determined by the Engineer who will be present during the undercut operations.

2. Undercut areas will be backfilled with No. 67 limestone or other aggregate approved by the Engineer to the grade established on the Plans. The backfill will be placed in 6 inch maximum lifts and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) or a minimum relative density of 0.75 Undercut backfill will be encapsulated in geotextile fabric conforming to Specification Section 02370 2.01.C.



3. Unauthorized Excavation Below Subgrade or Outside Limits:

Any unauthorized excavation and subsequent removal and backfilling beyond the lines and grades shown on the plans will be at the Contractor's expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Plans will be backfilled according to Specification Section 02530 Paragraph 3.02.C.2.

#### D Change in Location and Grade

1. If the Engineer orders in writing that the location or grade of a proposed sanitary sewer facility be changed from that shown on the Plans, the following provisions will apply. If the change is made before excavation work has begun and the item being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications, the appropriate pay item will apply. If the facility being constructed is not covered in the Proposal Sheet(s) and if the average excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work. If the average excavation per linear foot at the changed location varies more than 10 percent above or below original Plan quantities, a Change Order will be prepared to cover the new work. For purposes of comparing changed quantities with Plan quantities, a 1-foot long strip will be calculated from natural ground line to invert along both the revised and original locations. These calculations will then be multiplied by the proper lengths to determine the total cost.

2. If the change is made after excavation has already begun on the original Plan location, the procedures described above will apply to payment for work along the changed location. If abandonment of an existing excavation is required due to a change by the Engineer, a Change Order will be prepared covering the backfilling and restoration of the abandoned excavation. Backfilling and restoration of the abandoned excavation will be accomplished according to the appropriate section of these Specifications.

3. Filling a portion of existing excavation to meet changed grades will be accomplished according to Specification Section 02530 Paragraph 3.11.

4. If a change in a location and/or grade is authorized in writing by the Engineer at the written request of the Contractor, the Contractor will not receive any additional compensation for the changed work. Backfilling and restoration of abandoned excavation work will be accomplished totally at the Contractor's expense. If changes requested by the Contractor result in reduced lengths and/or depth of excavation, the revised quantities using Proposal unit prices or Change Orders as appropriate will be used to develop payment.

### E. Disposition of Excavated Material

1. Excavated material suitable for backfill will be stored no closer than 2 feet from the edge of the excavation. Excavated material will not obstruct crosswalks, sidewalks, driveways, street intersections, nor interfere unreasonably with travel on streets. Gutters or other surface drainage facilities will not be obstructed. The Contractor must provide access to fire hydrants, mail boxes, sewer and conduit manholes and similar utility or municipal service facility as required. Excavated material intended for backfill will be stored in a way that minimizes loss of excavated material due to erosion. The Contractor shall comply with all applicable OSHA regulations and City of Memphis Storm Water Ordinances.

2 Unless otherwise directed, all excavated material that will not be used for backfilling or restoration will be removed from the site and disposed of by the Contractor. If the Contractor proposes to store or place such excess excavated material upon any private property, written consent of the property owner or owners must be obtained by the Contractor in advance. A

certified copy will be given to the Engineer No surplus or excess material will be deposited in any stream channel nor anywhere that would change preconstruction surface drainage.

### Control of Water

1. The Contractor will keep all excavations free of water. If the trench subgrade consists of good soil in good condition at the time of excavation, it will be the Contractor's responsibility to maintain it in suitable condition. Dams, flumes, channels, sumps, or other work and equipment necessary to keep the excavation clear of water will be provided by the contractor. Dewatering of trenches, will be incidental to trench excavation. The Contractor will avoid producing mud in the trench bottom by his operations. If necessary or so ordered by the Engineer, the Contractor will remove any soil that becomes unacceptable and replace it with limestone or other approved aggregate at his own expense to maintain a firm, dry base.

2. Pipe bedding, laying, jointing, and the placing of concrete or masonry will be done in a water free trench or excavation. Trenches will be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water will be disposed of in a manner acceptable to the Engineer.

3. All gutters, pipes, drains, conduits, culverts, catch basins, storm water inlets, ditches, creeks, and other storm water facilities will be kept in operation, or their flows will be satisfactorily diverted and provided for during construction. Any facilities disturbed during construction will be restored to the satisfaction of the Engineer.

#### G Excavation Around Obstructions

1. The Contractor will perform all excavation by hand where excavation by machinery would endanger trees, structures, or utilities that otherwise might be saved by hand excavation.

2. The Contractor will cautiously excavate test holes to find the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, other sanitary sewer, storm drain, or similar utility comes within the limits of the trench such facilities will be properly supported.

#### H Excavation for Manholes and Special Structures

1. The Contractor will be responsible for performing the Work according to the lines and elevations shown on the Plans or as directed by the Engineer. The Contractor will excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.

2 The outside dimensions of excavations for manholes and special structure will be at least 12 inches greater than the outside of the masonry or concrete work to permit backfilling around the structure.

3. Where structures are to be built in street rights-of-way or paved areas, the excavation will not exceed 2 feet from the outside of the masonry or concrete work. If the excavation exceeds this limit, the Contractor will be required to backfill the entire space around the structure with pit run gravel compacted as specified in Specification Section 02530 Paragraph 3.11 B.

#### Special Protection

1. Treacherous Ground.

When running sand, quicksand, or other treacherous ground is encountered, the work will be

carried on with the utmost urgency and will continue day and night should the Engineer so direct

#### 2. Sheeting and Shoring:

The Contractor will furnish, place, and maintain sheeting and shoring as required to support the sides of any excavation to prevent earth movement that could endanger the workers or public and to prevent damage to the excavation, adjacent utilities or property. The Contractor will place the sheeting and shoring without the Engineer's instructions.

3. Sheeting will extend below structure invert a sufficient depth to assure adequate support. In the installation of sheeting, the use of vibratory type pile drivers (as opposed to impact type) will be limited to sheeting driven no greater than 5 feet below the invert. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, will not exceed the maximum width of a trench per Specification Section 02530 Paragraph 3.02,B. Walers and struts will be designed and installed to present no obstructions to proper placement of the pipe, bedding, cradle or encasement, and they will not interfere with the satisfactory installation of the pipe.

4. Sheeting, bracing, and shoring will be withdrawn and removed as the backfilling is being done, except where the Engineer permits the material to be left in place. The Contractor will cut off sheeting left in place at least 2 feet below the surface and will remove the cut off material from the excavation.

5. All sheeting, bracing, and shoring which is not left in place under this provision will be removed in a way that will not endanger the completed work or other structures, utilities, storm drains, sewers, or property. The Contractor will be careful to prevent the opening of voids during the extraction process.

6. If sheeting and shoring are not specifically required on the Plans or in the Specifications, steel drag shields or trench boxes may be used subject to the authorization of the Engineer. Voids left by the advancement of the shield will be carefully backfilled and compacted following trench backfill requirements.

#### 7 Excess Width of Trench:

If the Contractor is permitted to use equipment that results in wider trenches than specified, approved methods will be used around the pipe to resist the additional load caused by the extra width. The dimensions of the cradle or other methods will be specified by the Engineer. The contractor is responsible for meeting all applicable OSHA requirements. No extra compensation will be allowed for the additional material or work. Excess width trenches for semi-rigid and flexible pipe will be backfilled and compacted according to ASTM D 2321, and no concrete cradle will be used.

#### 8. Blasting:

Blasting will be undertaken only after the Contractor has received written authorization from the Engineer. With respect to the use of explosives in blasting, the Contractor will obtain all necessary permits and comply with all laws, rules, and regulations of the federal, state, City, and the insurer governing the keeping, storage, use, manufacture, sale, handling, transportation, or other disposition of explosives. The Contractor will obtain additional insurance covering the use of explosives with limits and coverage as specified by the Engineer. All operations involving the handling, storage, and use of explosives will be conducted with every precaution under the supervision of a properly licensed individual. The Contractor will take special precautions for the proper use of explosives to prevent harm to human life and damage to surface structures, utilities, storm drains, sewers, or other subsurface structures. The Contractor will advise the Engineer in advance when charges are to be detonated. Blasts will not be fired until all persons in the vicinity have had ample notice and have reached positions of safety.



9. Sanitary sewer construction will be carefully protected from all blasts, and all excavations

requiring blasting will be fully completed at least 30 feet ahead of the laying of the pipe. The mouth of the pipe will always be covered with a board or other plug carefully fitted to the pipe to prevent earth or other substances from entering.

10. After a blast is fired, the Contractor will thoroughly scale the excavation. All loose, shattered rock or other loose material that may be dangerous to the workers, pipe, or structure will be removed and the excavation made safe before proceeding with the work. The fact that the removal of loose, shattered rock or other loose material may enlarge the excavation beyond the required width will not relieve the Contractor from making such removal and filling the extra space. The Contractor will not be entitled to extra compensation therefore.

#### 11. Underpinning:

When excavations require underpinning of existing structures, the Contractor will submit shop drawings of underpinning details to the Engineer for review before commencement of excavation below the foundation of the structure. Review of underpinning details by the Engineer will not relieve the Contractor of his responsibility for protection of the structure and its contents.

#### J. Existing Utilities

#### 1 Location:

The Plans show the readily available record of location of existing structures and facilities both above and below the ground, but the City assumes no responsibility for the accuracy or completeness of this information. Utility service connections are not shown on the Plans, but can be expected in built-up areas, and if relocating them is necessary, it will be the Contractor's responsibility to arrange for the relocation with the owner or owners of the utilities.

#### 2. Protection

The Contractor will protect any storm drain, sewer, or utility within the limits of the construction. The Contractor will proceed with caution and will use every means to establish the exact location of underground structures and facilities before excavating in the vicinity. The City will not be responsible for the cost of protection or repair or replacement of any structure, pipe line, conduit, service connection, or similar facility broken or damaged by the Contractor's operations. All water and gas pipes and other conduits near or crossing the excavation will be properly supported and protected by the Contractor.

3. If the construction requires the removal and replacement of any overhead wires or poles, underground pipes, conduits, structures or other facilities, the Contractor will arrange for such work with the Owner or Owners of the facilities. No additional payment will be made by the City for this work.

#### 4. Service Connections:

Sewer and utility services between mains and buildings will be maintained and adjusted as necessary by the Contractor to provide as nearly a continuous operation as can be expected. This will be accomplished in any way that the Contractor chooses, provided the individual service is not interrupted for more than two consecutive hours. The occupants will be notified by the Contractor at least six hours before such service interruptions. When a break occurs, the Contractor will notify the affected occupant(s) of the probable length of time that the service will be interrupted.

5. If existing underground facilities or utilities require removal and replacement for the performance of this work, all replacements will be made with new material conforming to the requirements of these Specifications. If not specified, the material will be as approved by the Owner

6. The removal and replacement of water services to adapt to new construction will be the

Contractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade.

7. The removal and replacement of sewer house connections to adapt to new construction will be the Contractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched.

8. The Contractor will be responsible for any damage to the sewer house connection because of his operations. The Engineer does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

# 3.03 SEWER PIPE INSTALLATION

#### A General

1. Sewer pipe and bedding will be constructed as shown on the Plans. It will be the Contractor's responsibility to find all underground utilities before construction to insure there are no conflicts with the proposed line and grade. The Contractor's surveyor shall verify the base information on the City's plans prior to commencement of construction. Any discrepancies in the plans shall be reported to the Engineer immediately. If approved by the Engineer, minor changes in the alignment or grade will be permitted to avoid underground facilities, if straight alignment can be maintained between manholes. If minor changes in line or grade cannot avoid a conflict with the existing utility, the Contractor will arrange with the owner of said utility to have it adjusted as required to accommodate the proposed sewer at no additional expense to the City.

# B Modifications of Existing Sanitary Sewer Facilities

#### 1. Maintenance of Flow:

Where existing sewer lines are being modified, the Contractor will arrange his work so that sewage flow will be maintained during the construction period with no discharge of sewage into the open trench, and no back up of sewage in the existing line. The contractor will provide necessary bypass pumping capacity to carry flow downstream of the section to be modified.

# 2. Abandonment of Sewer Pipe:

Sewer pipe called for in the Specifications or Plans to be abandoned will be sealed at each end for a minimum distance of 18 inches, or one-half the diameter of the pipe, whichever is greater. Unless otherwise specified, the pipe will be sealed with a brick bulkhead and/or acceptable cement grout to form a solid watertight plug completely bonded to the pipe. Any sewer manholes to be abandoned will be abandoned per Specification Section 02531 Paragraph 3.03 B.

3. The Contractor will be allowed to remove pipe to be abandoned if wanted. If the Contractor elects the removal method, all associated costs will be included in the cost for other Pay items.

### 4. Connection to Existing Manholes:

The Contractor will core suitable openings into existing manholes or remove existing pipe to accommodate the sewer pipe at the proper elevation, location, and direction, as indicated on the Plans. Care will be used to avoid unnecessary damage to the existing manhole.

5. All loose material will be removed from the cut surfaces that will be completely coated with nonshrinking grout before setting the pipe. Before inserting the pipe, a sufficient thickness of grout will be placed at the bottom and sides of the opening for proper bedding of the pipe. For semi-rigid and flexible pipe installations a water stop as approved by the pipe supplier will be installed on the pipe according to the manufacturer's recommendations. After setting, all spaces around the pipe will be solidly filled with nonshrinking grout and neatly pointed up on the inside to present a smooth joint, flush with the inner wall surface. Any necessary revisions on the existing

manhole invert will be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. Plaster on the exterior of brick manholes will be repaired with nonshrinking grout. Particular care will be given to ensure that the earth sub-base and bedding next to the manhole will provide firm solid support to the pipe.

#### 6. Removal of Sewer Pipe:

Existing pipes and manholes to be removed and their locations will be shown on the Plans. Existing sewer pipe and manholes that must be removed to excavate for the proposed sewer will be included in the cost of the proposed sewer pipe and no additional compensation will be made to the Contractor. The City reserves the right to retain or reject salvage of any material encountered. All remaining material becomes the property of the Contractor who will be responsible for properly disposing of the same.

#### C Tracer Wire Installation

#### Tracer Wire

- 1. Tracer wire must be installed per manufacturer recommendations, and all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point. Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures. Tracer wire must be fastened on all pipe (mainline and service connections) with plastic zip ties at 5-foot intervals. Tracer wire on all sanitary service laterals must terminate at an approved at-grade, two-terminal access box color coded green and located directly above the service lateral at the road right of way.
- Service connection tracer wire shall be a single wire, connected to the mainline tracer wire using a lug connector, installed without cutting/splicing the mainline tracer wire.
- 2 New tracer wire being extended or tied into an existing tracer wire shall be connected using approved splice connectors, and shall be grounded at the splice location specified.
- 3 Tracer wire must be properly grounded at all dead-ends/stubs. Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 feet of HDPE copper clad wire connected to anode specifically manufactured for this purpose, and buried at the same elevation as the sewer line.
- 4 In case of occurring damage to the wire during installation, an immediate repair is required by removing the damaged wire and installing a new section of wire with approved connectors.

#### Connectors

1. All mainline trace wires shall be interconnected at intersections, at mainline tees, and mainline crosses. At tees Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground tracer installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner to prevent any uninsulated wire exposure. Non-locking, friction fit, twist on, or taped connectors are prohibited.

#### 3.04 PIPE BEDDING

A. Bedding will be defined as that material supporting, surrounding and extending to one foot above the top of the pipe. Bedding for sewer pipe will conform to the requirements given below for Class A, B.1, or B.2, whichever is shown on the Plans. If the class of bedding is not shown, a minimum of Class B.1 or B.2 bedding will be provided as specified below. At the direction of the engineer or as shown on the plans, sewer pipe and Class B.1 or B.2 bedding will be encapsulated in geotextile fabric as specified in Section 02370 2.01.C.

## B. Class A - Concrete Cradle

1. Class A bedding for sewer pipe will consist of a continuous concrete cradle constructed in conformity with the details shown on the plans or as directed by the Engineer. Class A bedding will only be used for rigid pipe.

C. Class B.1-Crushed Limestone

1. Class B.1 bedding will be number 67 crushed limestone. Pipe 4 inches to 24 inches in diameter will be bedded on 4 inches of bedding material. Pipe 27 inches to 48 inches in diameter will be bedded on 6 inches of bedding material. Bedding for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches continuing in layers not more than 6 inches in loose thickness around the pipe to the spring line. The remainder of the installation will be as outlined in Specification Section 02530 Paragraph 3.11. Unless otherwise instructed, concrete and ductile iron pipe will be bedded in Class B.1 bedding.

### D. Class B.2-Crushed Limestone

1. Class B.2 bedding will be number 67 crushed limestone. Pipe 4 inches to 24 inches in diameter will be bedded on 4 inches of number 67 crushed limestone Pipe 27 inches to 48 inches in diameter will be bedded on 6 inches of bedding material. Bedding for pipes larger than 48 inches in diameter will be by design based on anticipated soil conditions. After pipe installation, crushed limestone will then be tamped under the haunches and continued in layers not more than 6 inches in loose thickness around and above the pipe to a level 6 inches above the outside top of the pipe. The remainder of the installation will be as outlined in Specification 02530 Paragraph 3.11. Class B.2 bedding will be used for all flexible pipe including fiberglass reinforced polymer mortar pipe. PVC and HDPE.

E Deleted

#### 3.05 PIPE LAYING

A. Inspection Before Laying

1. All pipe will be inspected on delivery. Pipe that does not conform to the requirements of these Specifications or is not suitable for use will be rejected and immediately removed from the work site.

# B Preparation of Pipe Ends

1. All surfaces of the pipe to be joined will be clean and dry: All necessary lubricants, primer, adhesives, and similar material will be used as recommended by the pipe or joint manufacturer's specifications.

C Care During Hoisting, Placing, And Pushing Home

1. Equipment used to handle, lay, and join pipe will be equipped and used as to prevent damage to the pipe. All pipe and fittings will be carefully handled and lowered into the trench. Damaged pipe or jointing material will not be installed.

D. Direction of Work

1. The laying of pipe will be commenced at the lowest point. The bell or grooved end will be laid upgrade. All pipe will be laid with ends abutting and true to line and grade. They will be carefully centered so that when laid they will form a sewer with a uniform invert.

#### E. Uniform Pipe Bearing

1. Special care will be taken to insure that the pipe is solidly and uniformly bedded, cradled, or encased according to the Plans. For pipe with a bell that is larger than the barrel of the pipe the bedding material will be removed to a depth that will provide continuous support for the bell and

barrel. No pipe will be brought into position for joining until the preceding length has been bedded, joined, and secured in place. Where a concrete cradle is required, the pipe will be supported at no more than two places with masonry supports of minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete.

#### F Alignment and Grade

1. Each piece of pipe will be checked for vertical and horizontal alignment immediately after being laid. All adjustments to alignment and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe or striking the pipe to drive it down. Curved alignments will not be allowed except as directed by the Engineer.

#### G. Backfilling to Secure Pipe

When the joint is made, sufficient backfill material will be simultaneously placed along each side of the pipe to prevent moving the pipe off line and grade. Particular care will be used to prevent disturbance or damage to the pipe and the joints during backfilling.

#### H Flotation and Water in the Trench

1. The Contractor will take all necessary precautions to prevent flotation of the pipe in the trench. Water will not be allowed to rise in the trench. The Contractor will use well points, sump pumps, or another approved method of dewatering as required to lower the water table below the bottom of the excavation while minimizing the migration of fines from the surrounding area. The Contractor will make a request to the Engineer and receive approval prior to the use of special dewatering equipment other than well points or sump pumps. Dewatering operations are considered incidental to the work and no additional compensation will be made to the Contractor

#### Open Ends

1. Whenever pipe laying is stopped for any significant length of time, such as at the end of a workday, the unfinished end will be protected from damage and a temporary tight fitting plug or bulkhead will be placed in the exposed ends of the pipe to keep soil or other debris from entering the pipe.

#### J. Concrete Cradle Section next to Manhole

1 The pipe will be supported from the manhole wall to the limits of the manhole excavation in a normal sewer trench with a concrete cradle, structurally continuous with the manhole base slab or footing. Cost for this work is incidental to the cost of the pipe installation

#### K. Cutting Pipe

1. Cutting will be in a neat workmanlike manner at right angles to the pipe axis without damage to the pipe. Observe specifications regarding joint locations. Smooth the cut end by power grinding or filing to remove burrs and sharp edges. Repair lining of the pipe as required.

#### L. Wyes and Special Fittings

1. Wyes, stubs, reducers, fittings, or other special pipes will be installed as shown on the Plans or where ordered by the Engineer. The fittings and special pipes will be made of a compatible material, type, and class and/or strength designation as the pipe and installed as required by the Plans and Specifications. The cost for providing and installing the above items is incidental to the cost of the pipes.

M. Valves

1. Valves and appurtenant fittings will be installed as shown on the Plans or where directed by the Engineer.

2. Check valves and gate valves will be installed on either flanged or mechanical joint ductile iron pipe.

3. Air release, vacuum relief and combination air valves larger than 3 inches in diameter will be installed on either flanged or mechanical joint ductile iron pipe. A gate valve conforming to Specification Section 02530 2.01.Q shall be installed to isolate these air valves from the force main.

4. Air release, vacuum relief and combination air valves 3 inches in diameter and smaller will be installed on a ductile iron tap 'T' fitting. A ball valve conforming to Specification Section 02530 2.01 Q shall be installed on a 6" threaded nipple between the 'T' and the air valve

### 3.06 PIPE JOINTS

A. General

1. Pipe will be jointed immediately following the laying of each section. No pipe section will be left overnight which has not been completely jointed to the preceding pipe section in conformance with these Specifications.

2 The following provisions will apply to insure tight and sound joints:

a The joint will be placed with special care to avoid breaking joints and to leave gasket, if required, in proper position

b. All pipe 12 inches in diameter or larger will have dead weight held by crane while being lined up and pushed home.

c. Pipe will be pushed home with a constant and even force and not jarred home by the momentum of a moving force that will place an impact load on pipe.

d. Cement and lubricant will be used as recommended by the manufacturer and designated by the Engineer.

#### B. Compression Joints

1. The two ends to be joined will be thoroughly cleaned and a compression gasket compatible with the type of pipe to be joined will be at the position recommended by the pipe manufacturer.

2. Lubricant recommended by the gasket manufacturer will be liberally applied to the gasket and both ends immediately before pipe ends are joined. The upstream pipe will be positioned such that the spigot may enter the bell squarely. The pipe being laid will be pushed home and the gasket position checked with a feeler gauge before installation of the next section. Flat, unconfined gaskets on concrete pipe will be cemented to the spigot at the position recommended by the pipe manufacturer.

#### C. Mechanical Joints

1. The two ends to be joined will be thoroughly cleaned with a wire brush and the plain end, socket end, and gasket will be brushed with soapy water. The end will be centered in the socket and adequate anchorage will be provided to hold the pipe in position until the joint can be completed. When deflecting pipe from a straight line is necessary, the deflection will be made after joint assembly and before tightening bolts. Pipe deflection will not exceed that specified by ANSI C 600.

2. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. All bolts will be torqued to the required range recommended by the pipe manufacturer. Over stressing of bolts will be avoided. Gauge lines on the spigot end will be checked following assembly to ensure proper positioning of bell and spigot has been accomplished.

3 Any joints not properly positioned will be disassembled, cleaned, and reassembled as previously indicated.

#### D Flanged Joints

1. The two ends to be joined will be thoroughly cleaned with a wire brush. Bolt holes on each pipe flange to be joined will be aligned and bolts inserted. Bolts will be torqued evenly by alternating tightening of bolts opposite one another until all bolts are torqued to the recommended pressure.

#### E Solvent Cement Joints

1. The two ends to be joined will be thoroughly cleaned and primer liberally applied to the outside of the spigot within the joint insertion limits and inside the bell in conformance with the manufacturer's recommendations. Cement will be applied immediately to the same surfaces as the primer and the pipe joined within one minute. A sufficient quantity of cement will be applied to form a bead of excess cement around the full circumference of the joint when the spigot is fully inserted. The spigot end will be inserted to the insertion stop mark and rotated one-fourth turn. Avoid disturbing the joint until cement has had ample time to set.

#### F Restrained Joints

1. Restrained push-on joints are to be used as specified on the plans or by the Engineer. These special joints will be installed as specified by the manufacturer. The length of the pipe to be restrained will be determined by the Engineer based on pipe size, internal pressure, depth of cover, and soil characteristics around the pipe.

# 3.07 PIPE CAPS AND PLUGS

A. Wyes, stubs, or other fittings installed in the pipe for future connections will be closed at the open end. For pipes 21 inches in diameter or smaller, an approved cap or plug will be installed in the bell or socket using the same type joint or jointing material as required for the sewer. For pipes larger than 21 inches in diameter, temporary approved masonry bulkheads of the thickness required by the Plans and Specifications to close the open end may be substituted for stoppers. Care in backfilling will be used so that such closure and its seal will not be disturbed. This stopper will be jointed so that it may be removed later without injury to the pipe itself. Work and material is incidental to the cost of the pipe installation.

### 3.08 SERVICE CONNECTIONS

A All service connections on new pipe up to and including 12-inch diameter will be 6-inch diameter either Schedule 40 or SDR 26 in-line wye connections unless indicated otherwise on the Plans. Service connections on pipes larger than 12 inches in diameter will not be allowed. Saddles will not be used on new construction.

B. All service connections on existing pipe up to and including 12-inch diameter will be 6 inch diameter Inserta Tee, or approved equal, or saddle wye connections.

C. Although the general location of connections may be shown on the drawings, the actual location will be determined by the Contractor, subject to approval by the Engineer. Connections for

undeveloped property will generally be at the center of the lot. Connection locations for developed property will be coordinated with the property owner. The quantities shown on the proposal sheet are only approximate and are subject to change. The depth of connections at the property line will be determined by the Engineer. Service connections will be laid on no less than a 1 percent gradefor 6-inch diameter connections unless otherwise directed by the Engineer. Each building connection will be accurately recorded by station offset and depth on the as-built drawings and will be furnished to the Engineer. Unless authorized by the Engineer in writing, or shown on the drawings, building connections will not be tied into new or existing manholes. When service connections are tied into manholes at an elevation greater than 2 feet above the manhole invert, the service will be constructed as a drop construction as specified in Specification Section 02531 Paragraph 3.08.

D Service connections will be laid in open trenches except where tunneling may be necessary under existing curbs, sidewalks, or pavements. In all such instances, a shaft must be excavated at the end of the connection for inspection purposes and measurement of length and depth. All service connections will extend to the right-of-way or easement limits. The service connection will be installed in conformance to the City of Memphis Standard No. SST-16.

# 3.09 PIPE ENCASEMENT, COLLARS, AND THRUST BLOCKS

### A. General

1. Concrete will be Class "C" Concrete as specified in Specification Section 03050. All concrete will be placed, cured, and protected according to the applicable paragraphs of Specification Sections 03050 and 03310. Pipe alignment will be inspected immediately following concrete placement and any misalignment caused by the placement of concrete will be corrected before the initial set. Concrete will be protected against water until completely cured.

#### B. Pipe Encasement

1. Concrete encasement for pipes is to be used at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced as required. All pipe requiring encasement will be blocked at each joint using masonry supports of a minimum size sufficient to provide the required clearance and to prevent displacement during placing of concrete. Concrete will be placed on either side of the pipe in approximately equal amounts to prevent movement of the pipe. Concrete encasement is to be rectangular in section with a thickness of ½ the pipe diameter between the outside edge of pipe and the outside of encasement at the closest point unless shown otherwise on the Plans. The absolute minimum thickness for concrete encasement shall be 6 inches regardless of pipe size.

#### C. Pipe Collars

1. Concrete pipe collars are to be used to join pipe ends that cannot be joined with prefabricated joints. Concrete will be Class C and will be reinforced when shown on the Plans. Concrete pipe collars will be constructed at the locations and to the dimensions shown on the Plans or as directed by the Engineer. Pipes being joined will be blocked and supported laterally to prevent movement during placing or curing of concrete. Rubber water stops will be placed on each pipe before pouring the concrete collar. Fernco or equal mechanical coupling will be used for pipe connectors 16 inches and smaller.

#### D. Thrust Blocks

1. Concrete thrust blocks are to be used to resist internal thrust pressures at bends and fittings in force mains at the locations shown on the Plans or as directed by the Engineer. Concrete will be Class C and will be reinforced when shown on the Plans. Thrust blocks will conform to the dimensions shown on the Plans or City of Memphis Standard SST-12. Load distribution type

thrust blocks will be poured continuously from the force main to the undisturbed trench face. Backfill will not be placed as backing material for load distribution type thrust blocks.

2. All concrete will be poured in a way that leaves the pipe joint accessible for caulking or tightening of bolts. Care will be taken to permit the concrete to cure long enough to develop sufficient strength before the concrete is required to withstand the thrust. The area of the concrete bearing on the main or the restraining mass must be large enough to prevent over stressing the concrete.

3. If a concrete mass is used, a form may be necessary to contain the mass to provide access to joints or to insure the required bearing area. Generally, some form work is required for the mass of concrete necessary for blocking on mains sized 12 inches and larger. In poor soil, forming the concrete mass to construct the necessary bearing surface will be necessary. Instead of this construction, a restrained joint may be used.

Thrust blocks will be included in the linear foot price for the force main.

### 3.10 INVERTED SIPHONS

A. Each siphon will include inlet, outlet, and any intermediate manholes where shown on the Plans with all foundations, pipes, and pipe encasement and other appurtenances. Pipe to be included in the cost of the siphon is to be all pipe, fittings and specials between the center of the inlet manhole and the center of the outlet manhole.

B. The Contractor will construct cofferdams, temporary bulkheads, perform all pumping and other work necessary to protect the siphon during construction. The Contractor will be required to maintain a dry trench during construction, and will never be permitted to lay pipe or place concrete with water in the trench. Trenches will be kept free from water until the material in the joints and masonry has sufficiently hardened per Specification Section 02530 3.02 F Control of Water

C. Unless otherwise specified, inverted siphon pipe will be lined ductile iron Class 50 pipe and fittings as specified in Specification Section 02530 Paragraph 2.01.H fabricated for push-on type joints or HDPE conforming to Specification Section 02530 Paragraph 2.01.M. The siphon pipes will be encased in concrete at the locations and to the dimensions shown on the Plans or Details. The excavation, bedding, laying, jointing, pipe encasement, and backfill operations will conform to the applicable sections of this Specification.

D. When shown on the Plans, flexible joint ductile iron pipe will be used instead of push-on joint pipe as shown on Design Standards. Flexible joint pipe will be lald such that the maximum joint deflection as specified by the pipe manufacturer for each joint is not exceeded.

E. The inlet, outlet, and any intermediate manholes will be constructed according to the requirements of Specification Section 02531.

F. The inlet and outlet manhole inverts will be carefully shaped to conform to the inlet and outlet pipes and cause the least possible resistance to flow. The inlet manhole will have an invert weir constructed to contain low flows to a single siphon pipe. The invert weir will be level across the top and constructed to the elevation shown on the Plans. The outlet manhole invert will be formed to reduce backflow into the inactive siphon pipes.

#### 3.11 BACKFILLING

#### A. General

1. After sanitary sewer facilities have been bedded and installed according to these Specifications and upon permission of the Engineer, the backfill may be placed. Backfilling operations will continue following as closely behind pipe installation as practical. All backfill will be placed in uniform horizontal layers. Pushing backfill material down a ramp into excavated areas will not be permitted. No trash will be allowed to accumulate in the space to be backfilled. Particular care will be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.

2. The Contractor will be responsible for the condition of the trenches and filled areas during the contract and warranty period. The Contractor will maintain frequent inspection of the same. Anytime during the 12-month warranty period the trenches or filled areas settle and sunken places appear, the Contractor will be required to refill these sunken places when they are discovered with suitable material and will replace all damaged curb, gutter, and sidewalk. All soft or dangerous trenches will be marked, barricaded and caution lighted for the protection of the public.

3. Property with an existing dwelling located on it or lots within a developed subdivision or planned development are considered improved property.

- B. Street Right-of-Way and Improved Property
  - 1. Backfill Material:
  - a Backfill for manhole and pipe trench excavations through pavements in street or highway right-of-way or where the Engineer orders, will be made with pit run gravel or other acceptable material as approved by the Engineer. The backfill will be from the top of the bedding material or foundation to the subgrade elevation of the pavement. Pea gravel or similar granular material approximately uniform in size and without bonding properties will not be used.
  - b. Backfill for manhole and pipe trench excavations beyond pavements in street or highway right-of-way or outside public right-of-way will be made with select earth from the top level of the bedding material or foundation to the subgrade elevation in paved area, or within 1 inch of the surface in areas to be sodded, or to the surface in all other areas.
  - c. Select material will be free from debris, organic matter, perishable compressible material and contain no stones or lumps larger than 6 inches. Rocks and lumps smaller than 6 inches will not exceed an amount that will interfere with the consolidating properties of the fill material. Care will be taken that stones and lumps are kept separated and well distributed, and that all voids are completely filled with fine material. No rocks or lumps will come in direct contact with the pipe. The upper 3 feet of backfill in sodded or planted areas will be free of rocks or lumps larger than 1 inch in diameter.
  - 2 Placement and Compaction:
    - a Sanitary Sewer Trenches:

Backfill material will be placed by hand in 6 inch loose layers and tamped to a point 2 feet above the outside top of the pipe. Backfill will be compacted with suitable mechanical tamping equipment with special care being taken not to damage the pipe or joints. Use of compaction equipment directly above semi-rigid and flexible pipe should be avoided until sufficient backfill has been placed to ensure that the equipment will not damage the pipe. A minimum of 36 inches of compacted backfill above the top of semi-rigid and flexible pipe will

be in place before wheel loading and a minimum of 48 inches of compacted backfill before use of pneumatic tampers. From these elevations to the subgrade elevation of the pavement, bottom of the sod, or to the original ground surface, suitable backfill will be mechanically placed in 9 inch, maximum, loose layers. All backfill material will be compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).

b Manholes and Special Structures.

When the masonry or concrete work has set sufficiently to withstand compaction, and the Engineer authorizes, backfill material will be placed in 6 inch loose layers and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfill will be placed in this manner from the foundation of the structure to the subgrade elevation of the pavement, the bottom of the sod or to the original ground surface.

### C. Open Areas and Unimproved Property

1. Backfill Material:

Backfill of excavations on unimproved property will be made with select material from the top level of bedding material or foundation to the surface. Non-granular select material to be used for backfill will be free from debris, organic matter and perishable compressible material, and will contain no stones, lumps or rock fragments larger than 6 inches. Rocks or lumps smaller than 6 inches in diameter will not exceed an amount that will interfere with the consolidating properties of the fill material. No rocks or lumps will come in direct contact with the pipe. Stones and lumps will be kept separated and well distributed, and all voids will be completely filled with fine material.

#### 2. Placement of Backfill:

Backfill procedures specified in Specification Section 02530 Paragraph 3.11.B will apply from the trench bottom to a point 2 feet above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be placed by bulldozer or other mechanical means.

### D. Sanitary Sewer Facilities Placed on Fill

1. All sanitary sewer pipe laid on fill will be ductile iron pipe. Fill material placed in areas over which sanitary sewer facilities will be constructed will be select, job-excavated earth from the original ground to the subgrade elevation of the facility.

2. The fill material will be placed in 6 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) up to a point at least 2 feet above the outside top of the pipe or to the foundation of manholes or special structures. If compaction standards for the sanitary sewer exceed that of the adjoining fill, the width of compaction for a sanitary sewer will be not less than the outside diameter of pipe plus 10 feet. If compaction standards for the sanitary manhole or special structure exceed that of adjoining fill, the limits of compaction for the structure will be not less than 5 feet outside the structure base slab.

#### E Removal of Excess Material

1. After the trench or excavation has been properly backfilled, all excess dirt will be removed from the streets, roadways and improved private property so pavements or turfed areas may be replaced and properties cleaned.

2. In open areas and unimproved property, the excess material may be used to fill low spots on property next to the right-of-way/easement. Before spreading excess soil, the Contractor will obtain written permission from the property owner for the spreading of excess soil, and a copy of the written permission will be submitted to the Engineer. Such spreading or filling will not obstruct surface drainage and be to the satisfaction of the property owner. Excess material will be disposed of by the Contractor.

#### 3.12 TUNNELING, BORING, AND JACKING

#### A General

1. Sewer pipe will be constructed by tunneling, boring, or jacking only at those locations shown on the plans or directed by the Engineer. Carrier pipe for these applications will be of the type specified in the Plans and Specifications. Grade and alignment will be maintained through all liner pipes. The Contractor will submit shop drawings detailing the method, equipment and material to be used for tunneling, boring and jacking operations to the Engineer for review and approval. The approval by the Engineer of any drawings or plans will not in any way be deemed to release the Contractor from full responsibility for complete and accurate performance of the Work according to the Contract Drawings and Specifications.

2. When tunneling, boring, or jacking is required under railroads, highways, streets, or other facilities, construction will not interfere with the operation of the railroad, street, highway, or other facility and will not weaken or damage any embankment or structure. No water shall be introduced into any tunneling, boring or jacking excavation that lies within City, State or Rail Road right-of-way. A boring that uses a bentonite slurry may be allowed at the discretion of the Engineer and the owner of the right-of-way.

3. The Contractor will be responsible for protection of utilities and sewers against damage by his work. If any utility above or near the tunnel is endangered or has been damaged because of the construction operations, the utility owner will be notified immediately and will be given access to the area to carry out all necessary repairs to such utilities. If any sewers are damaged, it will be the responsibility of the Contractor to make the necessary repairs. If any public or private property is endangered or has been damaged due to tunneling, boring, or jacking operations, it will be repaired at the Contractor's expense. All cost and expense to the Contractor of carrying out the above requirements will be considered included in his bid prices for the completed sewer installation.

4. Access pits will be of sufficient size to provide ample working space for the jacking or boring equipment, reaction blocks, bracing, liner plates, spoil removal, and 2 sections of pipe. Provisions will be made for the erection of guide rails in the bottom of the pit where applicable. If drainage is to be discharged from the jacking pit, a collection sump will be provided. Wherever end trenches are cut in the sides of the embankment or beyond it, such work will be sheeted securely and braced satisfactorily to prevent earth caving.

5. The Contractor will furnish and operate all necessary pumping equipment of ample capacity and arrange to keep tunnels and shafts free of water during construction and to dispose of water satisfactorily. During placement of concrete, drainage and pumping will be arranged so concrete is placed in dry conditions. No water will flow over the concrete until it has set and will not be damaged.

#### B Tunneling

1. The Contractor will carry out the work of tunneling so there will be no cave-in or heaving of earth or other material into the tunnel excavation. If there should be any fall or movement of earth into the tunnel, the Contractor will proceed with the work with all necessary precautions to insure the safety of life and of sewers, utilities and public and private property above and near the tunnel.

2 The Contractor will furnish, place, and maintain all sheeting, bracing, lining or casing required to support the tunnel until the pipe and its bedding, jointing, encasement, and backfilling have been completed. All liners will remain in place.

3. Care will be used in trimming the surfaces of the excavated section and in placing the liners or sheeting and bracing so that the required minimum clearance between the outside of the pipe and the final position of the liners, sheeting and bracing in the tunnel will be attained without any deviation in sewer alignment. Sheeting or lining must be placed and held tightly against the trimmed earth surface of the excavated section so that there will be no voids between the earth and the lining or sheeting.

4. No part of the lining, bracing, or flanges of steel liner plates will project closer to the outside of the pipe or pipe bells than the clearance limits shown on the Plans, or a minimum of two inches, if not shown on the Plans.

5. If timber is used for lining and bracing instead of steel liner plates, invert struts will be placed at the required intervals but in such manner that the pipe and its bedding will be supported entirely by the original earth floor of the tunnel and not on timber lining or bracing. All timbers, when placed for the support of the roof and sides of the tunnel, will be properly fitted and wedged in place. Timber sets in tunnels will be abutting. All voids behind timbers will be filled with blocking or other suitable material.

6. Timbering will be designed and placed to allow the filling of voids. All excavated material not required for backfilling abandoned shafts will be removed from the site and disposed of by the Contractor at his expense

7 Shafts will be constructed at the location shown on the Plans. Temporary construction shafts will be of adequate size and properly constructed and equipped to meet all safety requirements. All shafts will be barricaded, lighted, fenced, and properly guarded from the beginning of the excavation until the completion of the construction requiring the shaft.

8. Provision will be made at all shafts so that plumb lines suspended on the centerline of the sewer at each end of the shaft will hang freely from the surface.

9 A ladder meeting OSHA requirements will be provided in each shaft and will be kept in safe, good repair, clean and clear of debris

10. Cavities between the surfaces of excavation and the tunnel liner plates or sheeting will be completely filled with a uniform sand cement grout consisting of 1 part portland cement and 7 parts sand and the minimum amount of water necessary for proper placement. Grout will be placed under pressure through grout holes in the steel liner plates or sheeting. The grout holes will be located and the grout placed in such sequence to insure the complete filling of all cavities and to transfer the load from the undisturbed material to the tunnel lining or sheeting uniformly.

11. After the tunnel section is excavated, lined, and braced, the pipe will be placed on and supported by steel rails or other approved supports. The supporting system will assure line and grade and will allow space below the pipe for concrete grout. Care will be used to avoid damage to the pipe and the liner plates.

12. The space between the pipe and the tunnel will be completely grouted with a mixture of sand and portland cement, mixed in the proportions of 1 part cement to 7 parts sand by volume and a minimum amount of water necessary for proper placement whether placed under pressure or by hand.

13. Temporary shafts will be completely abandoned. Unless otherwise specified in the Plans or Contract Documents all sheeting, bracing, and similar items may be removed unless the Contractor requests and receives authorization from the Engineer to leave it in place. No payment will be made for items left in place at the Contractor's option. If the Plans or the Engineer requires leaving the sheeting, bracing, and similar items in place, measurement will be made as provided in Specification Section 02530 Part 5 and payment will be made as provided in

Specification Section 02530 Part 6.

#### C Boring

1. When required by the Plans, sewers will be installed in bored holes. The holes will be bored from the downstream end, unless site conditions dictate otherwise and the Engineer approves.

2. The boring machine to be used will be in good condition and capable of drilling the bore hole within the required limits of accuracy. A smooth liner of sufficient strength will be forced into the bored hole to give a tight fit against the earth sides of the bore hole and still provide a uniform clearance of at least two inches around the pipe flange to permit pressure grouting. The liner pipe will be carefully inspected to insure that the carrier pipe can be properly placed.

3. All carrier pipe shall be mechanical joint or restrained joint pipe. Manholes at the ends of a section of bored pipe will not be constructed until the bored section is completed

4. The following procedures will be used for carrier pipe 18 inches and larger in diameter. The assembled pipe will be placed in the bored hole with approved, non-metallic, casing spacers attached. Casing spacers will be attached in accordance with the manufacturer's recommendations and with a casing spacer installed within 6 inches of each end of the bore. The assembled pipe will be placed in the bored hole only by such method that will keep the joints in compression. Any method that disjoints the pipe while being placed will not be permitted.

5. The ends of the bore shall be sealed with an approved, flexible end seal. The end seals shall be attached in accordance with the manufacturer's recommendations using stainless steel hardware

6 When unforeseen obstructions or conditions require abandonment of a partially completed bore hole, and the starting of a new hole, the Contractor will grout the abandoned bore hole solid. The Contractor will receive no compensation for any expenses incurred by any unsuccessful attempt.

#### D. Jacking

1. The Contractor will furnish for the Engineer's review, a plan showing his proposed method of jacking, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, and similar items in the assembled position. The review of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

2. Heavy duty jacks suitable for forcing the pipe through the embankment will be provided by the Contractor. In operating jacks even pressure will be applied to all jacks used. A suitable jacking

head and bracing between jacks and jacking head will be provided so that pressure will be applied to the pipe uniformly around the circumference of the pipe. A suitable jacking frame or backstop capable of resisting the jacking forces will be provided. The pipe to be jacked will be set on guides, properly braced together to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly will be placed to line up with the direction and grade of the pipe. The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with the inside angles or lugs to keep the cutting edge from slipping back onto pipe.

3. The pipe will be jacked from the downstream end. Manholes at the ends of a section of jacked pipe will not be constructed until jacked section is completed.
4. Any pipe damaged in jacking operations will be removed and replaced by the Contractor at his own expense. Embankment material will be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

5. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, will conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

6. The distance that the excavation will extend beyond the end of the pipe depends on the character of the material, but it will not exceed 2 feet in any case. This distance will be decreased if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

7. A cushion material will be placed in the joints between each pipe section adequate to distribute the jacking forces around the entire periphery of the pipe uniformly.

8. When jacking of pipe is begun, the operation will be carried on without interruption, as much as practicable, to prevent the pipe from becoming firmly set in the embankment.

9 The pits or trenches excavated to allow jacking operations will be backfilled immediately after the jacking of the pipe has been completed according to Specification Section 02530 Paragraph 3.11.

10. When unforeseen obstructions or conditions require abandonment of a partially completed pipe jack, the Contractor will grout the abandoned pipe solid. The Contractor will receive no compensation for any expenses incurred by any unsuccessful attempt.

E Sewer Pipe in Jacked Liner

1. When required by the Plans or Contract Documents, a sewer pipe will be installed by jacking a pipe as a liner and inserting a carrier pipe of required size, type, and class. When using jacking for liners, the steel liner will be welded steel, 35,000 psi yield strength, and of the diameter and wall thickness required on the Plans and Specifications. The Contractor will provide, at his own expense, thicker walled pipe if necessary to withstand the forces of jacking. In any case, the Contractor will retain full responsibility for the adequacy of this jacking operation, equipment and material.

F. Reserved.

3.13 DELETED

### 3.14 FINAL GRADING

A. Final grading around sanitary sewer facilities will conform to the elevation of adjacent undisturbed ground or as shown on the Plans. Sufficient grading will be done to provide adequate drainage.

### 3.15 CLEANING

A. All necessary precautions will be taken to prevent the entrance of mud, sand, or other obstructing material into the pipelines. As the work progresses, the interior of the sewer will be cleaned of all dirt, jointing material and extraneous material. On small pipe where cleaning after laying may be difficult, a squeegee will be kept in the pipeline and pulled forward past each joint immediately after its completion. Before final inspection the Contractor will remove all debris and foreignmaterial

## PART 4 - FINAL TESTING AND ACCEPTANCE

### 4.01 VISUAL INSPECTION

A. All work will be subject to visual inspection for faults or defects and any such deviation or omission will be corrected at once. All tests will be made by the Contractor who will provide necessary equipment for testing and lamping the system in the presence of and under the supervision and instructions of the Engineer. Lamp tests will be observed first hand by the Engineer. Each section of sewer line will show a full circle of light when lamped between manholes. All defects located will be corrected before conducting leakage tests.

### 4.02 LEAKAGE TESTS

A. Leakage tests will be performed on the full length of all sewer lines and manholes in the presence of the Engineer before acceptance. The cost of all testing will be included in the unit price for the item being tested

### B. Exfiltration Leakage Test

1. This section will only apply to pipe larger than 24 inches and smaller than 48 inches in diameter. All pipe over 48 inches in diameter will have individual joint testing according to Specification Section 02530 Paragraph 4.02.E. The method of testing used by the Contractor will be subject to approval by the Engineer. The Contractor will provide all required testing apparatus. The method adopted must exert a minimum internal water pressure of four feet. This hydrostatic head will be measured from the inside top of the pipe at the high end of the section being tested. The height of the water level at the beginning of the test must be high enough so that the 4-foot head will be standing at the end of the test. The maximum hydrostatic head is limited to 15 feet. The exfiltration test will be maintained for at least two hours on each reach between manholes as necessary to find all leaks. The trench and backfill are intended to be free of excess water.

2. In areas where groundwater is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches long will be installed through the manhole wall on top of the lowest sewer line entering the manhole. This will be done at the time the sewer line is installed. Immediately before the performance of the leakage test, the groundwater level will be determined by removing pipe cap, blowing air through pipe nipples into the ground to clear it, and then connecting a clear plastic tube to the nipple. The tube will be held vertically and a measurement of height in feet of water will be taken after the water stops rising in this plastic tube. The height in feet will be divided by 2.3 to establish the pounds of pressure that will be added to all readings. In the event there is water present in the trench or backfill at the time of the test, the required head producing the pressure inside the pipe must be raised to offset the counteracting pressure outside of the pipe. The test will not be considered satisfactory until an acceptable method of measurement shows that the exfiltration rate does not exceed 0 gallons per inch of internal diameter per mile of pipe per day for each reach tested.

3. An initial test must be arranged by the Contractor so that the first reach of each size laid by each crew at the beginning of the work day can be tested before the backfill has been completed, but the pipe will be backfilled to a point 2 feet above the outside top of the pipe. This test reach is intended to extend only to the next proposed manhole location. However, if conditions justify, the length of the test reach may be reduced but never will this reach be less than 100 feet. No further pipe laying will be permitted by this crew until the above described test has been satisfied. All remaining pipe will be subject to the exfiltration test after manholes have been constructed and backfill placed. Manholes are to be included in this test and will be considered as sections of pipe equal to the diameter of the manhole.

4. If anytime the exfiltration observed and measured by the Engineer exceeds 0 gallons per inch of internal diameter per mile of sewer per day, the Contractor will find the point(s) of leakage and will make necessary repairs and then retest the same reach. The Contractor will submit his plans for repair to the Engineer for his review.

5. Water used for testing will be removed from the test reach following acceptance and will be disposed of properly. Water used for testing will not be discharged in such a manner to damage other construction or public or private property. The cost of providing the test water will be borne by the Contractor.

## C. Air Leakage Test for 6-24 inch Diameter Pipe

1. Upon completion of construction, or earlier if the Engineer deems advisable, the Contractor will provide the necessary equipment and labor to perform low pressure air tests according to ASTM F1417. This test will be performed in the presence of the Engineer and will be for all types of gravity sewer pipe. This test will also include service lines from manholes.

The pressure test gauge will meet the following minimum specifications:

Size (diameter)	4 1/2 inches
Pressure Range	0-15 PSI
Figure Intervals	1 PSI Increments
Minor Subdivisions	0.05 PSI
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	Plus or minus 0,25% of Maximum scale readino
Dial	White coated aluminum with black lettering, 270 arc and mirror edges
Pipe Connection	Low male ½ inch NPT

3. Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are done.

4. Air leakage tests will be performed on each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trenches. The test time will be determined from the following table. If air tests fail to meet the following requirements, repeat tests as necessary after all leaks and defects have been repaired. Before acceptance, the same sewer reach will pass the low pressure air test.

Pipe Diameter (in )	Minimum Time (min:sec)	Test Time for Length of Sewer Tested (min)
6	5:40	.854 X L(ft)/60
8	7:34	1.52 X L(ft)/60
10	9:26	2.374 X L(ft)/60
12	11:20	3.418 X L(ft)/60
15	14:10	5.342 X L(ft)/60
18	17:00	7.692 X L(ft)/60
21	19:50	10.47 X L(ft)/60
24	22:47	13.674 X L(ft)/60

## Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated

1. Establish the test time for the sewer length from the formula or the minimum time, whichever is greater

### D Infiltration Test

1. Infiltration tests may be required for the complete line or any portion of it. Failure of any part of the line to pass an infiltration test will be sufficient reason to require additional work by the Contractor to reduce the infiltration in such portions of the line tested. The passing of an infiltration test will in no way relieve the Contractor of any responsibility to repair visible leaks found during the visual inspection.

2. Maximum allowable infiltration will be 0 gallons per mile per inch of diameter of sewer per 24-hour day at a time. The joints will be tight, and visible leakage in the joints of leakage greater than that specified above will be repaired at the Contractor's expense by any means necessary.

#### E Joint Acceptance Testing

1. Individual joints will be tested for pipe diameters of 48 inches and greater. Testing will be performed according to ASTM C 1103.

### 4.03 DEFLECTION TEST - SEMIRIGID AND FLEXIBLE PIPE

A. All polyvinyl chloride (PVC) pipe and glass fiber reinforced polymer mortar pipe will be tested for deflection. All testing will take place after backfill has been in place at least 30 days. All lines will be thoroughly cleaned before testing to assure accuracy.

B. Tests will be run using a rigid ball or nine arm mandrel having a diameter of 95% of the inside diameter of the pipe for PVC and 96% of the inside diameter of the pipe for glass fiber reinforced polymer mortar pipe. The mandrel will be pulled freely by hand through the pipe from manhole to manhole. No pipe deflection will exceed 5% for PVC and 4% for glass fiber reinforced polymer mortar pipe. Any section failing the test will be repaired by re-bedding or pipe replacement and retested to the satisfaction of the Engineer.

C. The cost of this service will be included in the unit price bid for the pipe.

### 4.04 SEWAGE FORCE MAINS

A. The Contractor will perform hydrostatic pressure and leakage tests concurrently conforming to AWWA C 600, AWWA C 605, ASTM D 2774 or ASTM F 2164 procedures as applicable and as modified herein. Tests will apply to all sewage force mains after backfilling

B. Force mains will be tested separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Select test segments such that adjustable seated valves are isolated for individual checking. The Contractor will furnish and install test plugs at no additional cost, including all anchors, braces and other devices to withstand hydrostatic pressure on plugs. The Contractor will be responsible for any damage to public or private property caused by failure of plugs. Limit water fill rates of line to available venting capacity.

C. Hydrostatic Pressure Test

Conduct tests at 1.5 times maximum operating pressure determined by following

P<sub>pl</sub> = test pressure in psi at gauge elevation OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line GE = elevation in feet at center line of gauge

D. Hydrostatic Leakage Test

Conduct tests conforming to AWWA C 600, AWWA C 605, ASTM D 2774 or ASTM F 2164 procedures, as applicable, at maximum operating pressure determined by following formula

 $P_{II} = 0.433$  (OP-GE), in which

Pti = test pressure in psi at gauge elevation OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line

GE = elevation in feet at center line of gauge

E. Satisfactorily complete previously defined pressure tests before determining the amount of leakage. Maximum allowable leakage will be determined by the following formula:

$$L = ND \frac{\sqrt{p}}{7400}$$

L = Allowable leakage in gallons/hour

N = Number of joints in length of pipeline tested

D = Nominal diameter of the pipe, in inches

P = Average test pressure during leakage test, in pounds per square inch, gauge

#### 4 05 FINAL ACCEPTANCE

A. When all work required by the Contract has been completed, the Contractor shall submit to the Engineer written certification from a registered land surveyor that the centerline of each structure is within 2.0 feet of the centerline of the sewer easement or the location designated on the plans. After receiving the surveyor's certification from the Contractor, the Engineer will make a final inspection of 02530-39

the Work, including any tests for operation. After completion of this inspection the Engineer will, if all things are satisfactory to him, issue to the Contractor a Certificate of Completion certifying that the Work required by the Contract has been completed according to the Contract Drawings and Specifications. However, the Certificate will not operate to release the Contractor or his sureties from any guarantees under the Contract or the Performance Bond. Upon receipt of the Certificate of Completion the Contractor will clean the premises and see that they are in an orderly condition.

#### 4.06 Tracer Wire

A. All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the contractor, and engineer, prior to acceptance of ownership. The verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

#### PART 5 - MEASUREMENT

### 5.01 SITE PREPARATION AND RESTORATION

A. The area to be considered for measurement will be the limit of the construction area in acres unless otherwise directed by the Engineer.

B. When the Proposal Sheet(s) do(es) not contain an item for Site Preparation and Restoration, this work will be required within the construction limits and will not be paid for directly but will be considered as a subsidiary obligation of the Contractor under other contract Items.

### 5.02 UNDERCUT BACKFILL

A. Undercut backfill will be measured by the ton of limestone in place.

### 5.03 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

A. Sheeting and shoring directed to remain in place will be measured by the 1,000 board feet, in place, after being cut off below grade. Sheeting and shoring placed and removed by the Contractor or left in place at the request of the Contractor will not be measured for payment.

### 5.04 PAVEMENT BACKFILL

A. Pit run gravel or other acceptable material used for backfill under pavements or other areas directed by the Engineer will be measured by the ton of material in place.

## 5.05 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Service connection removal and replacement for construction of sewer facilities will be measured per each, complete in place. Service connections damaged by the Contractor that do not require removal and replacement for construction of sewer facilities will not be measured for payment.

### 5.06 EXCAVATION

A. All work for excavation, blasting, drainage of trenches and dewatering, backfilling of excavation, compaction, grading, protection of existing utilities, disposal of excess material, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered obligations of the Contractor under other Pay Items of the Contract.

### 5 07 SEWER PIPE

A. Sewer pipe length will be measured per linear foot along the centerline of the pipe from center of

manhole to center of manhole. When there are special structures, sewer pipe will be measured from inside face to inside face for the various sizes, types, classes or wall thicknesses. No measurement of pipe depth will be made unless changed field conditions result in a change in the Plans by the Engineer

B. Sewer pipe length measurement will include the length of wyes as measured along the primary axis for all sizes of sewer pipe

### 5.08 PIPE WYES

A. Pipe wyes on sewer lines will not be measured for payment, but are incidental to the cost of furnishing and installing sewer pipe.

### 5.09 SEWAGE FORCE MAIN

A. Sewage force main length will be measured per linear foot along the centerline of the pipe from the point of measurement at the pumping station or valve box shown on the Plans to the end of the force main at its discharge location. Shut-off and relief valves, valve boxes, and thrust blocks are incidental to the construction of the force main and/or pump station and will not be measured for payment.

## 5.10 DUCTILE IRON PIPE FITTINGS

A. Ductile iron pipe fittings will not be measured for payment, but are incidental to the cost of furnishing and installing ductile iron sewer pipe or inverted siphons.

### 5.11 SERVICE CONNECTIONS

A. Service connections between sewer main and right-of-way or easement line will be measured per linear foot to the nearest whole foot, along the centerline of the pipe from the outside face of the wye to the end of the reducer, for the various sizes and types constructed.

B. Service connections between a manhole and the right-of-way or easement line will be measured per linear foot horizontally from the inside face of the manhole to the end of the reducer. Drop service connections will be measured per vertical foot from the flow line of the service connection in the manhole wall to the end of the building connection inside the manhole to the nearest whole foot, along the centerline of the pipe for the various sizes constructed. No measurement of service connection depth will be made. Service connection length will include the length of fitting, reducers, and specials as measured along their centerline.

### 5.12 NON-SHRINKING GROUT

A. Non-shrinking grout for general use as indicated on the plans or as directed by the Engineer will be measured by the cubic yard, complete in place for each type used

### 5.13 PLAIN CONCRETE FOR GENERAL USE

A. Concrete for general use including but not limited to pipe bedding, encasement and collars at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place for each class used.

### 5.14 REINFORCED CONCRETE

A. Reinforced concrete including but not limited to pipe encasement and collars at the locations shown on the Plans or directed by the Engineer will be measured per cubic yard, complete in place.

### 5.15 Tracer Wire

A. Tracer wire and/or appurtenances will not be measured for payment.

### 5.16 INVERTED SIPHON

A Inverted siphons constructed according to Plans and Specifications will be measured per lump sum, for each siphon complete in place.

### 5.17 SEWER IN EARTH TUNNEL

A. Sewers constructed in earth tunnels will be measured by the centerline length for tunnels with liner plate or without liner plate.

B. Measurements will be from the face of the pit to the face of the pit.

### 5.18 SEWER IN BORED HOLE

A. Sewers constructed in a bored hole will be measured by the centerline length for bored holes with or without liner pipe.

B. If Contractor has requested and has obtained approval to use a bored hole instead of the construction required by the Plans, no measurement of sewers in bored holes will be made

C. Reserved.

#### 5.19 JACKED SEWER

A. Jacked sewers will be measured by the centerline length from the face of the pit to the face of the pit. If the Contractor has requested and has obtained approval to jack a sewer instead of the construction required by the Plans, no measurement of jacked sewers will be made.

### 5.20 SEWER IN JACKED LINER

A. Sewers in jacked liner will be measured by the centerline length from the face of the pit to the face of the pit. If the Contractor has requested and has obtained approval to construct a sewer in a jacked liner instead of the construction required by the Plans, no measurement of sewers in jacked liner will be made.

### 5.21 DELETED

### 5.22 ABANDONMENT OF EXISTING PIPE

A. Abandonment of existing pipe will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

#### 5.23 REMOVAL OF EXISTING PIPE

A. Removal of existing pipe will be measured per linear foot, to the nearest whole foot, along the centerline of the pipe to be removed regardless of size, type, or depth. No measurement of existing pipe removal within the limits of excavation for new sewers will be made

### PART 6 - PAYMENT

### 6.01 SITE PREPARATION AND RESTORATION

Payment will be made for Site Preparation and Restoration at the contract lump sum price, which will be full compensation for removal of trees, shrubs, plants, brush, rubbish, fences, manmade obstructions including but not limited to structures, abandoned cars and appliances, building foundations, and all other obstructions as may be directed by the Engineer; the disposal of debris, removing of obstructions, and the restoration of fences, turfed areas, and all other items will be as specified in the Plans and Contract Documents or as directed by the Engineer.

### 6.02 UNDERCUT BACKFILL

A. Accepted quantities of undercut backfill will be paid for at the contract unit price per ton of limestone furnished and placed, which will be full compensation for undercut excavation, special protection, protection of existing utilities, and backfilling to bottom of facility subgrade elevations, complete in place.

## 6.03 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

A. Accepted quantities of sheeting and shoring directed by the Engineer to remain in place will be paid for at the contract unit price per 1,000 board feet in place after being cut off below grade, which will be full compensation for material only. The cost of placing sheeting and shoring to remain in place will be included in the unit cost of other items. No payment will be made for sheeting and shoring placed and removed by the Contractor or left in place upon request of the Contractor.

### 6.04 PAVEMENT BACKFILL

A. Accepted quantities of pit run gravel or other acceptable material used for backfill under pavements or other areas designated by the Engineer will be paid for at the contract unit price per ton furnished and placed, which will be full compensation for furnishing, placing and compacting the selected material.

### 6.05 SERVICE CONNECTION REMOVAL AND REPLACEMENT

A. Accepted quantities of service connections removed and replaced will be paid for at the contract unit price per each for various types of service connections, which will be full compensation for excavation, removal of old service line and appurtenances, furnishing and construction of new service lines, connections to existing service line and appurtenances to remain, and backfilling, complete in place.

B. All pipeline material will be generically the same throughout the project except solid wall PVC pipe service connected to truss pipe mainlines.

### 6.06 OMITTED

#### 6.07 SEWER PIPE

A. The accepted quantities of all sewer pipe will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types, classes, or wall thicknesses of pipe, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, maintenance of sewage flow, bedding, laying, jointing, cleaning and inspection, conducting acceptance tests, installation of pipe wyes, connection to manholes, adapters and couplings, stoppers, and removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside pavement areas. All pipeline material will be generically the same throughout the project except connecting solid wall PVC pipe service connections to truss pipe mainlines.

### 6.08 OMITTED

### 6.09 SEWAGE FORCE MAIN

A. The accepted quantities of sewage force main will be paid for at the contract unit price per linear foot furnished and laid for the various sizes, types and classes or wall thicknesses, which will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, bedding, laying, jointing, fittings, shut-off valves, relief valves, valve pits, thrust blocks, cleaning and inspection, conducting acceptance tests, connection to existing sewer manholes or structures, removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside pavement areas.

### 6.10 OMITTED

#### 6.11 SERVICE CONNECTIONS

A. The accepted quantities of service connections will be paid for at the contract unit price per linear foot furnished and laid for the various sizes and types. The accepted quantities of drop service connection will be paid for at the contract unit price per vertical foot furnished and installed. The contract unit price will be full compensation for material and material testing, excavation, special protection, protection of existing utilities, bedding, laying, jointing, adapters and couplings, stoppers, reducers, marking reducer, removal and/or abandonment of existing pipe within the limits of excavation and backfilling outside of pavement areas.

### 6.12 NON-SHRINKING GROUT

A. The accepted quantities of non-shrinking grout for general use will be paid for at the contract unit price per cubic yard, complete in place for each type used, which will be full compensation for material, testing, etc. necessary for the satisfactory completion of the work.

### 6.13 PLAIN CONCRETE FOR GENERAL USE

A. The accepted quantities of plain concrete for general use including but not limited to pipe bedding, encasement and collars will be paid for at the contract unit price per cubic yard complete in place, which will be full compensation for material, testing, excavation, pipe support, form work, removal of forms, and curing and protection of concrete.

#### 6.14 REINFORCED CONCRETE

A. The accepted quantities of reinforced concrete including but not limited to pipe encasement and collars will be paid for at the contract unit price per cubic yard, complete in place that will be full compensation for material, testing, excavation, pipe support, form work, reinforcing steel, removal of forms, and curing and protection of concrete.

### 6.15 INVERTED SIPHON

A. Payment will be made for Inverted Siphon at the contract lump sum price, which price will be full compensation for material and material testing, excavation, special protection, cofferdams, temporary bulkheads, maintenance of sewage flow during construction, protection of existing utilities, inlet manhole and outlet manhole with rims and covers, intermediate manholes, siphon pipe and fittings, concrete encasement, conducting acceptance test, removal and/or abandonment of existing pipe within the limits of excavation and backfilling.

## 6 16 SEWER IN EARTH TUNNEL

A. The accepted quantities of sewers in earth tunnels will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes, which price will be full compensation for material and material testing, pit excavation, sheeting, timber bracing, liner if required, excavation,

temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance tests and backfilling of pits and shafts.

## 6.17 SEWER IN BORED HOLE

A. The accepted quantities of sewers in a bored hole will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes, which will be full compensation for material and material testing, pit excavation, sheeting, timber bracing, liner if required, excavation, boring temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, casing spacers, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance test, and backfilling of pits and shafts.

#### B Reserved

### 6 18 JACKED SEWER

A. The accepted quantities of jacked sewers will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes; the price will be full compensation for material and material testing, pit excavation, jacking equipment and concrete slab foundation, jacking back stop, temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe, jacking pipe, making pipe joint cushions, cleaning and inspection, conducting acceptance tests, and backfilling of pits and shafts.

### 6.19 SEWER IN JACKED LINER

A. The accepted quantities of sewers in jacked liner will be paid for at the contract unit price per linear foot furnished and constructed for the various sizes; the price will be full compensation for material and material testing, pit excavation, jacking equipment and concrete slab foundation, jacking back stop, temporary shafts, pumping, protection of existing utilities, maintenance of sewage flow, pipe liner, laying pipe, making pipe joints, grouting, cleaning and inspection, conducting acceptance tests, and backfilling of pits and shafts.

#### 6.20 DELETED

### 6.21 OMITTED

### 6.22 REMOVAL OF EXISTING PIPE

A. The accepted quantities of existing pipe removal will be paid for at the contract unit price per linear foot regardless of pipe size or type which price will be full compensation for excavation, special protection, protection of existing utilities, pipe removal, salvage or disposal, backfilling and site restoration.

### 6.23 Tracer Wire

No separate payment shall be made for tracer wire or appurtenances. Tracer wire and appurtenances shall be considered incidental to the sewer and/or service connection installation.

## 6.24 PAYMENT WILL BE MADE UNDER:

	Item No	PayItem	Pay Unit
	02530-6.01	SITE PREPARATION AND RESTORATION	Lump Sum
	02530-6.02	UNDERCUT BACKELL	Ton
	02530-6.03 5	SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE	1 000 Board East
	02530-6.04	PAVEMENT BACKFILL	Top
	02530-6.04.0	1 DELETED	10(1
	02530-6.04.0	2 Pit Run Gravel Backfill	Top
	02530-6.05	SERVICE CONNECTION REMOVAL AND REPLACEMENT	EA
	02530-6.05	Type Service Connection	EA
	02530-6.07	SEWER PIPE	EA Linner Fret
	02530-6.07 0	1 Prestressed Concrete Cylinder Dise	Linear Foot
	02530-6.07.0	Presilessed Concrete Dino Close II	
	02530-6.07.0	Reinforced Concrete Pipe, Glass II	LF
	02000-0.07.0	No Neinidiced Concrete Fipe, Glass III	LF
	02530-6.07.0	04 Reinforced Concrete Pipe, Class IV	LF
	02530-6 07 0	05 " Reinforced Concrete Pipe, Class V	LF
	02530-6.07.0	06 " Ductile Iron Pipe, Class 50	LF
	02530-6.07.0	07 Ductile Iron Pipe, Class 51	LF
	02530-6.07.0	08 " Ductile Iron Pipe, Class 52	LF
	02530-6.07.0	09 " Ductile Iron Pipe, Class 53	LF
	02530-6.07.1	10 " Ductile Iron Pipe, Class 54	LF
	02530-6.07 1	11 " Ductile Iron Pipe, Class 55	LF
	02530-6.07.1	<ol><li>"Ductile Iron Pipe, Class 56</li></ol>	LE
	02530-6.07 1	13 DELETED	21
	02530-6.07.1	14 DELETED	
	02530-6.07.1	<ol> <li>Polyvinyl Chloride (PVC) Pipe</li> </ol>	LE
	02530-6.07 1	16. Glass Fiber Reinforced Polymer Mortar Pipe	LE
	02530-6.09	FORCE MAIN	LE
	02530-6.09.0	01. "Ductile Iron Force Main, Class 50	LE
	02530-6.09.0	2. "Ductile Iron Force Main Class 51	I.E.
	02530-6.09.0	3. "Ductile Iron Force Main Class 52	LE
	02530-6.09.0	)4. "Ductile Iron Force Main, Class 53	LE
	02530-6.09.0	)5. "Ductile Iron Force Main, Class 54	1 E
	02530-6.09.0	06 "Ductile Iron Force Main, Class 55	1E
	02530-6.09.0	7 "Ductile Iron Force Main, Class 55	LE
	02530-6.09.0	18 Polyainyl Chloride (PVC) Force Main, Class 30	LF
	02530-6.09.0	High Depsity Polyathylong Force Main, Glass 200	LF
	02530-6.11	SERVICE CONNECTION	LF
	02530-6 12 1	NON-SHRINKING GROUT	LF
	02530-6 12 0	1 Non-shrinking grout Type I	CY
	02530-6 12 0	2 Non-shrinking fool acting grout Type I	CY CV
	02530-6 13	PLAIN CONCRETE FOR CENERAL LICE	GY
	02530-6.13	11. Plain concrete for general use Close A	CY
	02530 6 13 0	12 Plain concrete for general use, class A	GY
	02530-0.13.0		GY
	02530-6 15		CY
	02530-6.16		Lump Sum
	02530-0.10	SEWER IN EARTH FUNNEL	LF
	02530-0.10.0	12 Sewer in Earth Turnel With Liner Plate	LF
	02530-0.10.0	Sewer in Earth Tunnel Without Liner Plate	LF
	02030-0.17	SEWER IN BURED HULE	LF
	02030-0.17.0	Sewer in Bored Hole With Liner Pipe"	LF
	02030-0.17.0	Sewer in Bored Hole Without Liner Pipe"	LF
	02530-0.17.0		12
100	02530-0.18	JAGRED SEWER	LF
200	02030-0 18.0	Jacked Sewer	LF

02530-46

02530-6.19 SEWER IN JACKED LINER	1 F
02530-6.19.01 "Sewer in Jacked Liner"	LE
02530-6.22 REMOVAL OF EXISTING PIPE	LF

# Examples of Pay Item Numbering System for Sewer Pipes

20

02530-6 07 03.48	Pay Item Number
02530-6	Section of Specification
.07	Last digit(s) of applicable paragraphs for payment
.03	Type of Pipe: e.g., Reinforced Concrete, Class III
.48	Size of Pipe; e.g., 48" diameter

END OF SECTION 0253

### PART 1 - SCOPE

1.01 This work consists of the construction of manholes and special structures for sanitary sewers of the type and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Engineer. The construction will be accomplished according to these Specifications and Plans or as established by the Engineer. The Contractor will perform all work necessary to complete the Contract with the best modern practice. Unless otherwise provided, the Contractor is required to furnish all labor, material, equipment and other items necessary to complete the manholes and structures as shown on the Plans.

### PART 2 - MATERIALS AND EQUIPMENT

### 2 01 MATERIAL

### A Construction Material

1. All material furnished by the Contractor will be new, high quality and free from defects. Previously used material in acceptable condition is allowed for bracing, forms, false work, and similar uses. Material not conforming to the requirements of the Specifications will be considered defective and will be removed immediately from the site.

## B. Qualifications of Manufacturers.

1. Manholes for sanitary sewers will be the standard product of an established, reputable manufacturer made in a permanent plant. Suppliers for each material to be used by the Contractor are subject to the approval of the Engineer. No material will be delivered until the manufacturer and product have been approved by the Engineer.

### C Material Inspection and Testing

1. Representative samples of material intended for incorporation in the work will be submitted for examination when so specified or requested. All material to be used in the work will be sampled, inspected, and tested by current ASTM specifications, or other standard specifications. The Contractor will furnish the Engineer with three copies of certified reports from an accredited testing laboratory showing the results of the tests carried out on representative samples of material to be used on the Project. Each structure delivered to the project will show the laboratory's stamp. The performance or cost of all testing is the responsibility of the Contractor.

2. The Contractor will notify the Engineer before any deliveries of material and will make whatever provisions are necessary to aid the Engineer in the inspection and culling of the material before installation.

#### D. Storage

1. The contractor will provide storage facilities and exercise measures that will maintain the specified quality and fitness of materials to be incorporated in the work.

### E Portland Cement Concrete

1. Portland cement concrete will be as designated in Specification Section 02530 Paragraph 2.01 V.

### F. Steel Reinforcement

1 Deformed steel reinforcing bars and welded wire fabric will be as shown on the Plans or as directed by the Engineer. All steel reinforcement will be as specified in Specification Section 03310.

### G Mortar

1. Mortar will be as designated in Specification Section 02530 Paragraph 2.01.Y.

### H Brick

1. All brick will be as designated in Specification Section 02530 Paragraph 2.01 BB.

2. No new brick manholes are to be allowed in the City of Memphis system. This specification is included for repair of existing brick manholes and incidental use of brick for leveling courses in new construction.

### Gray Iron Castings

1. Castings will be of the standard Memphis type as detailed on the Plans and Design Standards. Castings will be made of good quality, even grained cast iron and will be smooth and free from scale, lumps, blisters, sand-holes, and defects of any nature that would render them unfit for the service for which they are intended. They will be thoroughly cleaned and subjected to a careful hammer inspection

2. Castings will meet the requirements of ASTM A 48, Class No. 35, or Grade 65-45-12 ductile iron meeting the requirements of ASTM A 536. Manhole rims and covers will be designed to withstand HS-20-44 loading defined in the AASHTO Specifications. Rims and covers will be machined or ground at touching surfaces to seat firmly and prevent rocking. Any set not matching will be removed and replaced at no additional cost.

- J Manhole Steps
  - 1. Steps are not allowed in sewer structures.
- K. Precast Concrete Manhole Sections, Bases and Other Structures

1. All precast reinforced concrete manhole risers, cones, grade rings, and flat slab tops will conform to the requirements of ASTM C 478 for the specified diameter and strength class. All cone sections and transition sections will be eccentric. Barrel sections will be custom made with openings to meet indicated pipe alignment and invert elevations. The Contractor will submit shop drawings for each typical structure shown on the Plans for approval by the Engineer. After approval by the Engineer, the Contractor can place the order for structures. The bottom manhole section and pipe(s) will be in place (supported by concrete blocks) before pouring the cast-in-place manhole base. The bottom of all precast base slabs 4 feet in diameter will extend a minimum of 6 inches beyond the outside wall of the manhole riser. The bottom of all precast base slabs 5 feet in diameter will extend a minimum of 7 inches beyond the outside wall of the manhole riser. All poured in place bases will extend a minimum of 8 inches beyond the outside wall of the manhole riser. All poured in place bases will extend a 12 inches beyond the outside wall of the manhole riser.

2. For sewer manholes four (4) to six (6) feet in diameter and less than twenty (20) feet deep, precast reinforced concrete manhole base sections shall be a minimum of 8 inches thick. For sewer manholes greater than six (6) feet in diameter or more than twenty (20) feet deep, precast reinforced concrete manhole base sections shall be a minimum of 12 inches thick. All precast manhole base sections shall be reinforced with Number 4 steel reinforcing bars placed 6 inches on center each way and at mid depth of the slab, unless shown otherwise on the plans. Steel reinforcement shall conform to Specification Section 03310.

3. The interior of the manhole sections will be a smooth, cylindrical surface. Lifting holes, when provided, will be filled with expanding grout, or other approved material.

4. Gaskets between manhole sections will be a flexible material meeting the requirements of Federal Specification SS-S-00219 for Type I gaskets and AASHTO M 198 for Type B gaskets unless otherwise specified on the Plans. Joint contact surfaces will be formed with machined castings. Joints between a manhole section and precast concrete flat tops will be mortar joints conforming to the requirements of this Specification. All sewer manholes must pass the Negative Air Pressure (Vacuum) Test as required in Specification Section 02531 Paragraph 4.02.A.

5. All pump station wet wells and siphon structures shall be lined or coated with a material conforming to either Section 02530 paragraph 2.01.DD or Section 02531 paragraph 2.01.R.

6. All manholes and structures on pipe 36 inches in diameter and larger shall be lined or coated with a material conforming to either Section 02530 paragraph 2.01.DD or Section 02531 paragraph 2.01.R.

7. Manhole manufacturer shall install plastic liner as recommended by lining manufacturer.

### L Sand

1. Sand for structure abandonment will consist of sand or a natural sandy soil, all of which passes a 3/8 inch sieve and not more than 10 percent passes a No. 200 sieve.

M. Pit Run Gravel

1. Pit run gravel will be as designated in Specification Section 02530 Paragraph 2 01 AA

### N Non-Shrinking Grout

1 Non-shrinking grout will be as designated in Specification Section 02530 Paragraph 2.01 CC

### O Waterproofing

1. Waterproofing for manhole exteriors will consist of two coats of asphalt or coal tar pitch Asphalt will conform to the requirements of ASTM D 449. Coal tar pitch will conform to the requirements of ASTM D 450.

### P Vent Stack

1. Vent stack pipe will be a 4-inch diameter galvanized steel pipe conforming to the requirements of ASTM A 53 with a minimum wall thickness of standard weight pipe. One end of the vent stack pipe will have a 180-degree bend fabricated by either shop welding a manufactured 180 degree elbow or fitting the pipe with a manufactured 180 degree threaded elbow and coupling. The opposite end of the pipe will be plain end. The maximum height for vent stacks for this specification shall be 20 vertical feet

2. Vent stack supports will be fabricated from steel shapes conforming to ASTM A 36, and to the dimensions and details shown on the Plans. The vent stack supports will be welded to the vent stack pipe and to the vent stack support bottom ring around the entire contact surface.

3. The vent stack support bottom ring will be shop fabricated with bolt holes at the spacing shown on the plans for anchorage to the manhole top. All welding will be according to the American Welding Society Structural Welding Code.

4 A vent stack support ring with threaded coupling may be cast in the flat top for installation of the vent stack

5. All surfaces of the completed vent stack and welds will be cleaned and painted. The color of the finish coat will be silver.

### Q. Flexible Pipe Connectors to Manholes

1. All connections of pipe to manhole sidewalls will be made with flexible connectors. Openings in the manhole sidewall for the pipe will be precast or cored to provide required size and location. The hole will be manufactured to allow for lateral and vertical movement, and angular adjustments through 20 . A connector between manholes and pipes such as Press-Seal, Kor-N-Seal, or Z-LOK will be installed in the precast or cored opening. The connector will meet the requirements set forth in the latest revision of ASTM C 923. A corrosion resistant, stainless steel external band will be used around the flexible connector to create the external seal around the pipe.

2. Any void between the pipe and connector will be filled with an approved flexible gasket material.

3. Flexible connectors will be considered an integral part of the manhole sidewall, and no separate payment will be allowed

### R. Protective Linings and Coatings

1. All poly vinyl chloride (PVC) protective lining for concrete structures shall conform to Section 02530 Paragraph 2.01 DD.

2. Protective coating properties:

Product Type	Polymer based Polyurethane or Solid Epoxy
Color	Light
Compressive Strength	4,000 psi (minimum)
Tensile Strength	1,500 psi (minimum)
Hardness Type D	60
Bond Strength-Concrete	> than 750 psi
Dry Film Thickness	125 mils
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3. Warranty: The COATINGS MANUFACTURER shall warranty the entire project to include any and all aspects of the surface preparation, base material installation and protective coating applications for a period of TEN (10) YEARS from the date of acceptance by the City of Memphis. The warranty shall make no distinction between installation practices and material performance and shall not be prorated with respect to elapsed time for the entire warranty period. Manufacturer shall, within a reasonable period of time after receipt of written notice thereof by the City of Memphis [period not to exceed sixty (60) calendar days], repair defects in materials or workmanship during said TEN (10) year period, and any damage to other work caused by such defects or repairing of same at his own expense and without cost to the City of Memphis

4. Protective coatings for concrete structures will be SpectraShield® Liner System Products, Structure-Guard as manufactured by Quadex Rehabilitation Products, or as approved.

### S Grade Adapter Rings

1. Grade adapter rings shall be the standard Memphis type, compatible with City of Memphis standard rings and covers. Grade adapter rings shall be gray iron castings conforming to paragraph 2.01. I in these specifications.

### T Repair Materials

1. Repair materials are to be used in the rehabilitation of existing sewer manholes and structures. Repair materials shall be used to fill voids and to structurally reinforce and/or rebuild substrate surfaces as deemed necessary by the Engineer.

2. Quick blending, rapid setting, high early strength, fiber-reinforced, non-shrink repair mortar that can be trowelled or spray applied must be compatible with the specified protective coating.

3 Material properties:

Product Type	Fused Calcium Aluminate or Cementitious Fiberalass
Cure Time	<48 hours
Curing Gasses	Non-Toxic
Compressive Strength	5.000 psi (minimum)
Tensile Strength	500 psi (minimum)
Flexural Strength	600 psi (minimum)
Shrinkage	0% at 90% Relative Humidity

4. Repair materials for concrete structures will be QM-1s Restore as manufactured by Quadex. Rehabilitation Products, or as approved.

### 2.02 EQUIPMENT

A. The Contractor will furnish and maintain in good condition all equipment and facilities as required for the proper execution and inspection of the Work. All equipment and facilities will be on site and approved by the Engineer before work will be permitted to begin.

## PART 3 - CONSTRUCTION REQUIREMENTS

3.01 SITE PREPARATION AND RESTORATION

A. Site preparation and restoration for sewer manhole and structure construction will be performed per Specification Section 02530 Paragraph 3.01.

3.02 EARTHWORK

A. Earthwork for sewer manholes and structures will be performed per Specification Section 02530 Paragraph 3.02.

# 3.03 REMOVAL OR ABANDONMENT OF EXISTING MANHOLES AND STRUCTURES

A Removal

1. Existing manholes and structures to be removed will be shown on the Plans or as directed by the Engineer. The City reserves the right to retain or reject salvage of any materials encountered. Unless otherwise specified, salvaged rims and covers remain the property of the City and will be delivered by the Contractor to a City yard as directed by the Engineer. All remaining materials become the property of the Contractor who will be responsible for disposal.

- 2. The excavation will be backfilled per Specification Section 02530 Paragraph 3.11
- B Abandonment

1. Existing manholes and structures to be abandoned in place will be shown on the Plans or as identified by the Engineer.

2. After removing manhole and structure rims, covers, and similar items, all pipes will be bulkheaded. The walls will be lowered to 2 feet below final grade if in earth or to 12 inches below subgrade if in a proposed pavement area. The remaining manhole or structure will be filled with sand to the limits previously mentioned.

3. The sand will be placed in approximately 12 inch layers and each layer compacted to 75 percent relative density or 95 percent of maximum density (standard proctor) as applicable. A 12 inch thick plain concrete slab will be installed over the manhole top extending 12 inches beyond the outside face of the manhole.

4. The City reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for disposing of same.

5. All manholes that must be removed to perform excavation for the proposed sewer pipe and/or structures will be removed as part of the sewer excavation and no additional payment will be due the Contractor.

### 3.04 GENERAL CONSTRUCTION REQUIREMENTS

A. New manholes and structures will be constructed of plain or reinforced concrete. Work may include the repairing of brick masonry manholes or structures. Where the top elevation is not shown on the Plans, the manhole or structure will be built to conform to the elevation ordered by the Engineer. Standard depth manholes are those having a depth of 6'-0" from rim to invert of the sewer. Manholes and special structures will be built as the pipe laying progresses. The Engineer, at his discretion may stop the laying of pipe or the building of other manholes until the manhole just passed has been completed. Completion of the manhole will include the installation of fittings, connections to pipes, placing of castings, testing, and other construction as shown on the Plans.

B. Inlet and outlet pipes will extend through the walls of manholes and special structures to allow for water tight connections with the manhole walls. The ends will be cut off flush with the inside surface of the wall as shown on the Plans, Details, or otherwise directed. The pipes will intersect at the structures so the inlet pipe will be aligned in the direction of outlet pipe such that counterflow is prevented. Water stops will be installed around pipes as they pass through the sanitary manhole wall.

C. Inverts will be of Class A concrete poured to conform to the shapes shown on the Plans or otherwise directed. The inverts will be so constructed as to cause the least possible resistance to flow. The shape of the inverts will conform uniformly to inlet and outlet pipes. A smooth and uniform finish will be required.

D. All castings, rims, covers and fittings will be placed in the positions shown in the Plans or as directed by the Engineer. Rims on manhole cones will be set concentrically with the top of the cone in a full bed of mortar so that the space between the top of the manhole cone and the bottom flanges of the rim will be filled and made watertight. A ring of mortar at least 1 inch thick and pitched to shed water away from the rim will be placed around the outside of the bottom flange. Mortar will extend to the outer edge of the cone and will be finished smooth and flush with the top of the flange. If rim fittings are to be bolted or anchored in concrete or brick masonry, all anchors or bolts will be set and held in place before the concrete or mortar is placed. The unit will not be disturbed until the mortar or concrete has hardened to adequate strength. Bolt-down manhole covers will be installed at the locations shown on the Plans and all bolts securely tightened following acceptance of the manhole to provide a watertight seal.

E Vent stacks will be installed on manholes at locations and to the elevations shown on the Plans or as directed by the Engineer. Vent stacks will be installed on flat top manholes only The vent stack pipe will be positioned in the hole provided in the manhole top and the vent stack support bottom ring

will be attached to the concrete manhole top with anchor bolts in drilled holes with expansion sleeves. A vent stack support ring with threaded coupling may be cast in the flat top for installation of the vent stack.

## F Protective Linings and Coatings

1. The contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.

2. Wherever a pipe lateral (not of plastic lined concrete) is installed through a lined concrete manhole, the lining shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches. This protecting cap may be molded or fabricated from the lining material but needs not be locked into the pipe.

3. All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer.

4. Welding shall fuse both sheets and weld strip together to provide a continuous joint equal in corrosion resistance and impermeability to the liner plate

5. Hot-air welding guns shall provide effluent air to the sheets to be joined at a temperature between 500 and 600 F. Welding guns shall be held approximately 0.5 inch from and moved back and forth over the junction of the two materials to be joined. The gun shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip. All welders shall be certified by the manufacturer.

6. Protective coatings shall be installed in strict conformance with the manufacturer's recommendations

## 3.05 REPAIRING OF BRICK MANHOLES AND STRUCTURES

A. Where shown on the Plans or directed by the Engineer, the Contractor will repair brick manholes or structures. The work will conform to the applicable portions of Specification Section 02640 Paragraph 3.02.B 1.

## 3.06 PRECAST CONCRETE CONSTRUCTION

A. Precast concrete manholes will be neatly and accurately built according to the Plans or as directed by the Engineer. All precast manholes will use either a concrete slab constructed of Class A concrete on a 12 inch thick crushed stone foundation and which will be cast integrally with the base section and the inlet and outlet pipes as shown on the Plans or the precast manhole will use a precast base section conforming to Specification Section 02531 Paragraph 2.01.K.

1. Precast concrete manhole base sections shall be placed on a 12 inch minimum thickness No. 67 crushed limestone base. The stone base will be fully encapsulated in a geotextile fabric as indicated on the plans or as directed by the Engineer. Geotextile fabric shall conform to Section 02370 paragraph 2.01 C, and grade No. 67 stone shall conform to Section 02530 paragraph 2.01 W.

B Precast concrete sections will be set so the structure will be vertical and with sections in true alignment. Joint surfaces of the base or previously installed section will have a flexible rubber gasket installed in the recess after being primed with an asphaltic cement material recommended by the manufacturer. Flexible rubber gaskets and primers will not be applied to wet or damp surfaces. Each joint will be completely filled with nonshrinking grout on the inside and outside of the manhole after sections have been placed.

C. All holes in precast sections used for their handling will be thoroughly plugged with nonshrinking grout. The grout will be finished smooth and flush with the interior and exterior manhole wall surfaces.

D All precast concrete manhole cones will be of eccentric construction as shown on the Plans or Details.

E. If brick masonry is used to adjust manhole rims to grade, the masonry work will be performed according to Specification Section 02640 Paragraph 3.02.B.1.

F. All flat top manhole slabs will be steel reinforced with a minimum thickness of 6 inches. The manhole rim and cover will be placed eccentrically in the slab as shown on the Plans or Details. Waterproofing will be applied per Specification Section 02531 Paragraph 3.09.

## 3.07 CAST-IN-PLACE CONCRETE CONSTRUCTION

A. All cast-in-place manholes and structures will be built of Class A concrete as shown on the Plans. The manholes and structures will be built on an undisturbed earth foundation and conform to the dimensions, shapes and details shown on the Plans. Concrete construction will conform to the methods, forms, mixture, placement, protection, and curing for concrete per Specification Section 03310.

B. Cast-in-place manholes will be neatly and accurately built according to the Plans or as directed by the Engineer. Wall thicknesses will be as detailed on the Plans but not less than 6 inches thick

C. All cast-in-place manholes will be of eccentric construction as shown on the Plans. Any required reinforcement will be of the kind, type, and size and will be spaced, bent, and fastened as shown on the Plans.

D. Connection of inlet and outlet pipes will conform to the sizes, alignments, and elevations shown on the Plans. Concrete reinforcement and inlet and outlet pipes will be in place and approved by the Engineer before any concrete is placed. If concrete placement is not continuous, a rubber water stop gasket will be required at each construction joint.

E. The inside and outside surfaces of the manhole or structure walls will receive a Class 1, Ordinary Surface Finish as defined by Specification Section 03310 Paragraph 3.11. Waterproofing will be applied per Specification Section 02531 Paragraph 3.09.

### 3.08 MANHOLE DROP CONSTRUCTION

### A. Drop Construction for New Manholes

1. Drop construction will be installed for new manholes at the locations shown on the plans and/or as directed by the Engineer. Drop construction will conform to the details shown on the plans and Details SST-2 for outside drop construction. If precast manhole construction is used, the manhole sections will be custom made with openings for both the upper and lower inlet pipes. The pipe connections to the manhole sidewalls shall be made with flexible connectors conforming to Specification Section 02531 Paragraph 2.01.Q. Water stops will be installed around pipes as they pass through the sanitary manhole wall. Grout will be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces. If cast-in-place manhole construction is used, the upper and lower inlet pipes will be in place and approved by the Engineer before any concrete being placed. All drop construction will be constructed of either ductile iron pipe with push-on or mechanical joints or PVC pipe conforming to the appropriate section of these Specifications. PVC pipe for drop construction at new manholes will be used only on improved property as defined in Specification Section 02530 Paragraph 3.11.A. On unimproved property the section of inlet pipe making the connection to the manhole at the higher

elevation and all fittings and drop pipe shall be ductile iron pipe. Solvent cement joints may be used on PVC for drop construction. Encasement of the outside drop pipe will be constructed of Class C concrete.

## B. Drop Construction for Existing Manholes

1. Drop construction will be installed in existing manholes at the locations shown on the plans and/or as directed by the Engineer. Drop construction will conform to the details shown on the plans and Detail SST-2 for inside drop construction. The Contractor will core a hole in the manhole wall to permit installation of a flexible connector as specified in Specification Section 02531 2.01 Q Flexible Pipe Connectors to Manholes and the inlet pipe at the required flow line elevation, horizontal angle, and slope. Care will be used to avoid unnecessary damage to the existing masonry or concrete.

2. All loose material will be removed from the cut surfaces, which will be completely coated with grout before setting the pipe. Before inserting the pipe and flexible connector, a sufficient thickness of grout will be placed at the bottom and sides of the opening for proper bedding of the pipe. After setting, all spaces around the pipe will be solidly filled with grout and neatly pointed up on the inside to present a smooth joint, flush with the inner and outer wall surface. Any necessary modifications to the existing invert will be made to provide a smooth, plastered surface for properly channeled sewage flow from the new connection. All drop construction will be constructed of either ductile iron pipe with push-on or mechanical joints or PVC pipe conforming to the appropriate section of these Specifications. Solvent cement joints may be used on PVC for drop construction. The vertical drop construction will have the dead weight held by suitable means until the steel support straps are secured in place and tightened. The pipe mechanical joint bolts, if used, will not be positioned against the manhole wall. The steel support straps will be fastened to the manhole wall with two bolts per strap set in expansion sleeves in drilled holes.

### 3.09 WATERPROOFING

A. After the manhole masonry and concrete construction are complete, the exterior surface of each manhole wall within the limits shown on the Plans will be given two coats of approved waterproofing material. Total minimum dry film thickness will be 12 mils. Each coat will be applied at a rate not to exceed one gallon per 100 square feet. The waterproofing materials will be applied by brush or low pressure sprayer and according to the instructions of the manufacturer. Time will be allowed between coats to permit sufficient drying so that the application of the second coat does not affect the first coat.

B. Care will be exercised during backfilling to prevent damage to the waterproofing. Any waterproof coating damaged during backfill operations will be cleaned of all dirt and two coats of waterproofing reapplied as previously specified.

### 3 10 DEWATERING

A. Contractor shall furnish, install and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to remove any groundwater encountered in the excavation. Contractor shall conduct said groundwater away from the construction site in an approved manner. Generally, dewatering is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, dewatering may be measured and paid for as defined in Specification Section 02531 Parts 5 and 6.

### 3.11 BYPASS PUMPING

Contractor shall furnish, install and operate pumps, pipes, appurtenances, and all equipment of sufficient capacity required to maintain sewage flow around the work area. Contractor shall conduct

said bypass pumping in an approved manner. Generally, bypass pumping is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, bypass pumping may be measured and paid for as defined in Specification Section 02531 Parts 5 and 6.

### 3.11. ADJUSTMENT OF RIMS AND COVERS

### A. Standard adjustment method:

1. Any manhole covers not adjusted and set at final grade by others shall be adjusted by the Contractor. If the cover requires lowering, the manhole rim shall be removed, sufficient upper courses of brick removed, and the rim reset at proper grade by use of cement mortar over the top course of brick remaining.

2. If the cover requires raising, all defective courses of brick shall be removed and the manhole rebuilt to proper grade and the rim reset as described above. The maximum finished collar height as measured from the top of the manhole rim to the beginning of the conical section shall be 18 inches. If the adjustment would require a collar of greater than 18 inches in height, then the existing collar and conical section of the manhole shall be removed, the riser section raised the required amount, the conical section and collar rebuilt and the rim reset at the proper grade.

3. Any changes in grade for manhole covers of precast or poured-in-place manholes shall be as shown on the plans or as directed by the Engineer.

#### B Manhole adjustment with adapter rings:

1. For manhole covers to be raised less than or equal to 5 inches and where the total collar height would not exceed 18 inches, manhole adapter rings may be used if approved by the Engineer. Adapter rings may be up to a maximum of 5 inches utilizing no more than one ring. Adapter rings shall be tack welded to the existing rim at a minimum of 4 locations.

### C Alternate adjustment method:

1. For manhole covers requiring adjustment where Cernent Stabilized Aggregate Base (Specification Section 02710.1) or Soil Cernent Base (Specification Section 02710.2) is being placed, the Contractor may, at his option, remove manhole rims and covers and adequately seal off the top of the existing manholes below the bottom of the base course prior to the aggregate or soil cernenting operations. If this option is exercised, the Contractor shall reference the location of all manholes so sealed off and aggregate or soil cernenting operations shall then continue over the entire street. Within 24 hours after the final compaction of a section of roadway or paved area, all manholes located within this section shall be raised to grade by removing a section of the soil or aggregate base a minimum 3 feet square directly over each manhole. The manhole rims and covers shall then be replaced with Class A concrete to the subgrade. If, in the process of adjusting the manhole rims, the Contractor removed a larger section than specified, he shall replace the entire area so removed with Class A concrete at this expense

### 3.13 PUMPING STATIONS

A. Pumping stations and force mains will conform to the latest edition of the State of Tennessee Department of Environment and Conservation Division of Water Pollution Control Specification "Design Criteria for Sewage Works." The City will be responsible for providing the secondary electrical service to the top of the utility pole installed by the contractor. The City will also be responsible for any necessary extension of MLG&W water mains necessary to serve the pump stations. The Contractor will be responsible for providing the water service connection from the MLG&W main or meter box to the pump station.

## PART 4 - ACCEPTANCE TEST FOR MANHOLES AND STRUCTURES

### 4.01 VISUAL INSPECTION

A. All work constructed will be subject to visual inspection for faults, defects, or deviations from the Plans and any such deviation or omission will be corrected at once. All tests will be made by the Contractor who will provide necessary equipment for testing and lamping the manhole or structure in the presence of and under the supervision and instructions of the Engineer. Lamp tests will be observed first hand by the Engineer. All defects found will be corrected before conducting leakage tests. Repair methods must be approved by the Engineer.

### 4.02 MANHOLE LEAKAGE TEST

A. All manholes and special structures will be subjected to a vacuum test as outlined in ASTM C 1244 or as specified. The manhole, including the frame, will be placed under a vacuum of 10 inches Hg (4.9 psig). The manhole will be considered acceptable if the time measured for the vacuum to drop to 9 inches Hg (4.4 psig) is greater than that shown in the table on the following page. Manholes not meeting the vacuum test requirements will be repaired and retested or replaced

## Minimum Test Times for Various Manhole Diameters

		Manh	ole Diameter (ft)		
	4	5	6	7	8
Depth (ft)			Test Time (sec)		
8	20	26	33	42	55
10	25	33	41	51	64
12	30	39	49	66	86
14	35	46	57	74	96
16	40	52	67	87	113
18	45	59	73	95	123
20	50	65	81	105	137
22	55	72	89	116	150
24	59	78	97	126	164
26	64	85	105	137	177
28	69	91	113	147	191
30	74	98	121	157	205

B. The Contractor will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs and operating personnel. The cost of this work is to be included in the unit bid price for manholes.

### 4.03 PROTECTIVE LININGS AND COATINGS

A. After the manhole or other structure is installed, all surfaces covered with lining, including welds, shall be tested with an approved electrical hole detector (Tinker & Rasor Model No. AP-W with power pack) with the instrument set at 20,000 volts minimum. All welds shall be physically tested by a nondestructive probing method. All patches over holes, or repairs to the liner or coating wherever damage has occurred, shall be accomplished in accordance with manufacturer's recommendations.

B Defective welds will be retested after repairs have been made. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection. Inspection shall be made within 2 days after joint has been completed in order to prevent tearing the projecting weld strip and consequent damage to the liner from equipment and materials used in or taken through the work

### PART 5 - MEASUREMENT

### 5.01 STANDARD DEPTH SEWER MANHOLE

A. Standard depth manholes will be measured per each, for the various diameters and types less manhole rim and cover. Standard depth is a manhole depth less than or equal to 6 feet as measured vertically from the top of the manhole cone or slab to the invert of the manhole. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of sewer manholes. No measurement shall be made for any transition slab to switch to 4 feet diameter riser sections from larger diameter bases. No measurement shall be made for flat tops. Transition slabs and flat tops, if used, shall be incidental to the construction of the sewer manhole.

### 5.02 EXTRA DEPTH SEWER MANHOLE

A Extra depth manholes will be measured per vertical foot along the vertical centerline of the manhole from a point 6.0 feet above the invert of the manhole to the top of the manhole cone or slab for the various diameters and types. Only manholes deeper than 6.0 feet will be considered for extra depth measurement. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of extra depth sewer manholes. No measurement shall be made for switch to 4 feet diameter riser sections from larger diameter bases. No measurement shall be made for flat tops. Transition slabs and flat tops, if used, shall be incidental to the construction of the extra depth sewer manhole.

### 5 03 SEWER MANHOLE DROP CONSTRUCTION

A. Drop construction in new or existing manholes will be measured per vertical foot as measured from the upper inlet pipe flowline to the flowline of drop pipe elbows at the bottom of the drop construction. Payment for drop construction for new manholes will be in addition to payment for standard depth manhole and extra depth construction (if required).

### 5.04 REPAIR BRICK SEWER MANHOLE AND STRUCTURE

A. Repair of brick manholes and structures will be measured per each

### 5.05 SPECIAL SEWER STRUCTURE

A. Special structures will be measured per each including access shafts, but less manhole rim and cover. No measurement of depth will be made. No measurement shall be made for protective linings or coatings. Linings and coatings shall be considered incidental to the construction of the special structure.

## 5.06 SEWER MANHOLE RIM AND COVER

A Manhole rims and covers will be measured per each set consisting of one rim and one cover for the various types.

### 5 07 VENT STACK

A. Vent stacks will be measured per each set consisting of stack pipe, 180' bend and support. No measurement of height will be made.

## 5.08 SEWER MANHOLE AND STRUCTURE REMOVAL

A. Removal of existing manholes and structures will be measured per each. Removal of existing manholes and structures within the limits of excavation for new sewer facilities will not be measured or paid for separately but will be included in the price of the new sewerfacility.

## 5.09 SEWER MANHOLE AND STRUCTURE ABANDONMENT

A. Manholes and other sewer structures to be abandoned will be measured for payment per each. Material for backfilling abandoned structures will not be measured.

### 5.10 DEWATERING

A. Generally, dewatering is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, dewatering may be measured for payment. If measured for payment, dewatering will be measured by the day, each day that the pumps are in operation and that the contractor is actively working within the excavation being dewatered. If the contractor is not actively working within the excavation, no measurement will be made for dewatering. The actual quantities used will be jointly agreed upon between the City and the Contractor.

### 5.11 BYPASS PUMPING

A. Generally, bypass pumping is considered to be an incidental to the construction of sewer manholes, special structures, pipeline, etc. In some cases, at the City's discretion, bypass pumping may be measured for payment. If measured for payment, bypass pumping will be measured by the day, each day that the pumps are in operation and the contractor is working on the sewer downstream of the bypass. If the contractor is not actively working on the sewer downstream of the bypass, no measurement will be made for bypass pumping. The actual quantities used will be jointly agreed upon between the City and the Contractor.

## 5.12 ADJUSTMENT OF RIMS AND COVERS

### A. Standard adjustment method:

- 1 Standard manhole adjustments will be measured per each manhole rim adjusted to grade
- B Manhole adjustment with adapter rings.

1. Manhole adjustment with adapter rings will be measured per each manhole rim adjusted to grade.

### 5.13 PUMPING STATION

A. Pumping station(s) constructed according to Plans and Specifications will be measured per lump sum for each pumping station, complete in place and operational. Included as a part of the pumping

station is the water service connection from the MLG&W main shown on the Plans to the pump station(s). The power pole set by the Contractor to receive MLG&W secondary service and all electrical service from the top of the pole to pumping station equipment are included in the lump sum measurement

### 5.14 PROTECTIVE COATINGS

A. Generally, protective coatings are considered to be an incidental to the construction of sewer manholes and special structures. In some cases, at the City's discretion, protective coatings may be measured for payment. If measured for payment, protective coatings will be measured by square foot of surface area covered. No measurement shall be made for repair materials.

### PART 6 - PAYMENT

### 6.01 STANDARD DEPTH SEWER MANHOLE

A. The accepted quantities of standard depth sewer manholes will be paid for at the contract unit price per each, complete in place for the various diameters and types less rim and cover, which will be full compensation for materials and materials testing, excavation, special protection, and curing of concrete, placing and jointing precast sections, transition slabs, flat tops, construction of base slabs, inverts, connection of inlet and outlet pipes, waterproofing, linings or coatings, cleaning and inspection, conducting acceptance tests, removal and/or abandonment of existing pipe, manholes, or structures within the limits of manhole excavation, and backfilling outside of pavement areas.

### 6.02 EXTRA DEPTH SEWER MANHOLE

A. The accepted quantities of extra depth sewer manholes will be paid for at the contract unit price per vertical foot, complete in place for the various diameters and types, which will be full compensation for materials and materials testing, excavation, special protection, placing, protection, and curing of concrete, placing and jointing precast sections, construction and installation of base slab, transition slab, flat top, invert, connection of inlet and outlet pipes, waterproofing, lining or coating, cleaning and inspection, conducting acceptance tests, removal and/or abandonment of existing pipe, manholes or structures within the limits of excavation, and backfilling outside of pavement areas.

### 6.03 SEWER MANHOLE DROP CONSTRUCTION

A. The accepted quantities of sewer manhole drop construction will be paid for at the contract unit price per vertical foot, complete in place for drop construction in new manholes or drop construction in existing manholes, which will be full compensation for materials and materials testing, excavation, special protection, maintenance of sewage flow during construction, construction of drop pipe, pipe fitting and connections, installation of steel support straps, placement, curing, and protection, and backfilling outside of pavement areas. Payment for drop construction for new manholes will be in addition to payment for standard depth manhole and extra depth construction (ifrequired).

### 6 04 REPAIR BRICK SEWER MANHOLE AND STRUCTURE

A. The accepted quantities of repair brick sewer manholes and structures will be paid for at the contract unit price per each, complete according to detail, which will be full compensation for materials and materials testing, excavation, special protection, maintenance of sewage flow during construction, masonry work, plastering, waterproofing, cleaning and inspection, conducting acceptance test, and backfilling outside of pavement areas

## 6.05 SPECIAL SEWER STRUCTURE

A. The accepted quantities of special sewer structures will be paid for at the contract unit price per each, complete in place according to detail, which will be full compensation for materials and materials' testing, excavation, special protection, maintenance of sewage flow during construction, placement, curing, and protection of concrete, cleaning and inspection, waterproofing, linings or coatings, conducting acceptance test, and backfilling outside pavement areas.

## 6.06 SEWER MANHOLE RIM AND COVER

A. The accepted quantities of sewer manhole rim and cover set will be paid for at the contract unit price per each set complete in place for various types which price will be full compensation for materials and materials' testing, setting rim and cover, placing gaskets and bolts, protection and curing of mortar, cleaning and inspection.

### 6.07 VENT STACK

A. The accepted quantities of vent stacks will be paid for at the contract unit price per each complete in place, which will be full compensation for materials and materials' testing, fabrication, painting, and installation of vent stacks.

## 6.08 SEWER MANHOLE AND STRUCTURE REMOVAL

A. The accepted quantities of sewer manhole and structure removal will be paid for at the contract unit price per each, which price will be full compensation for excavation, special protection, protection of existing utilities, structure removal, disposal of debris, and backfill.

## 6.09 SEWER MANHOLE AND STRUCTURE ABANDONMENT

A. Sewer structures to be abandoned will be paid for at the contract unit price per each, which price will be full compensation for preparing the structure for abandonment, sealing connecting pipes, furnishing and placing backfill material, compaction, handling of salvageable material, and disposal of debris.

### 6.10 DEWATERING

A. If measured for payment, the accepted quantities shall be paid for at the contract unit price per day, which shall be full compensation for material, installation, and operation of pumps, pipes, appurtenances, and all equipment of sufficient capacity required to conduct the groundwater away form the construction site and to satisfactorily complete the work.

### 6.11 BYPASS PUMPING

A. If measured for payment, the accepted quantities of bypass pumping shall be paid for at the contract unit price per day, which shall be full compensation for material, installation, and operation of pumps, pipes, appurtenances, and all equipment of sufficient capacity required to maintain sewage flow around the work area and to satisfactorily complete the work.

## 6 12 ADJUSTMENT OF RIMS AND COVERS

### A Standard adjustment method

1 The accepted quantities of manholes adjusted will be paid for at the contract unit price per each for raising or lowering the manhole cover to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the covers to the satisfaction of the Engineer.

### B Manhole adjustment with adapter rings:

1. The accepted quantities of manholes adjusted by the adapter ring method will be paid for at the contract unit price per each for raising the manhole to final grade, which price will be full compensation for furnishing all labor and materials necessary for the complete adjustment of the cover to the satisfaction of the Engineer.

### 6.13 PUMPING STATION

A. Payment will be made for pumping station at the contract lump sum price, which will be full compensation for material, structures (i.e., wet and dry wells), equipment and controls, excavation, special protection, maintenance of sewage flow, protection of existing utilities, provision of the water service connection from the MLG&W water main (valve box) to the pumping station, connection to the source of power on the site, connecting a power supply to the pumping station from top of the pole set by the Contractor at pump site, conducting acceptance tests, backfilling, and all items incidental to the construction of a complete, operational pumping station.

### 6.14 PROTECTIVE COATINGS

A. If measured for payment, the accepted quantities of protective coatings shall be paid for atthe contract unit price square foot, which shall be full compensation for material, surface preparation, installation, testing, and all equipment required to satisfactorily complete the work. No separate payment shall be made for repair materials.

### 6.15 PAYMENT WILL BE MADE UNDER:

Item No.

#### Pay Item Pay Unit

02531-6.01		STANDARD DEPTH SEWER MANHOLE	FA
02531-6.01.01	Ft.	Diameter Standard Depth Precast Concrete Manhole	FA
02531-6.01.02	Ft	Diameter Standard Depth Poured-in-Place Concrete Manhole	FA
02531-6 02		EXTRA DEPTH SEWER MANHOLE	VE
02531-6.02.01	Ft.	Diameter Extra Depth Precast Concrete Manhole Vertical Foot	VE
02531-6.02.02	Ft	Diameter Extra Depth Poured-In-Place Concrete Manhole	VE
02531-6.03		SEWER MANHOLE DROP CONSTRUCTION	VE
02531-6.03.01	ln.	Diameter Drop Construction in New Manhole	VE
02531-6.03.02	In.	Diameter Drop Construction in Existing Manhole	VE
02531-6.04		REPAIR BRICK SEWER MANHOLE AND STRUCTURES	FA
02531-6.05		SPECIAL STRUCTURE	FA
02531-6.06		SEWER MANHOLE RIM AND COVER	FA
02531-6.06.01		No. 7 Manhole Rim and Cover	FA
02531-6.06.02		Bolted Down Manhole Rim and Cover	FA
02531-6.06.03		No. 6 Manhole Rim and Cover	EA
02531-6.07		VENT STACK	FA
02531-6.08		SEWER MANHOLE AND STRUCTURE REMOVAL	FA
02531-6.09		SEWER MANHOLE AND STRUCTURE ABANDONMENT	FA
02531-6.10		DEWATERING	DAY
02531-6.11		BYPASS PUMPING	DAY
02531-6.12		ADJUSTMENT OF RIMS AND COVERS	EA

02531-6.12.01	Adjustment of rim and cover by standard method	FΔ
02531-6.12.02	Adjustment of rim and cover with adapter rings	EA
02531-6.13	PUMPING STATION	LA
02531-6.14	PROTECTIVE CONTING	LS
	THOTEOTIVE COATING	SF

## END OF SECTION 02531

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02630 SITE PREPARATION AND RESTORATION

### PART 1 – SCOPE

1.01 This Work shall consist of the removal of brush, rubbish, fences, structures, abandoned appliances, building foundations, all trees, shrubs and plants not to be protected, and all other obstacles within the right-of-way / easement limits shown on the Plans and/or in the Special Instructions; the disposal of debris; and the restoration and/or protection of trees, shrubs, plants, fences, turfed areas, and structures after construction of drainage facilities is completed.

### PART 2 – EQUIPMENT

2.01 All equipment for the satisfactory performance of the work shall be on the project and approved before the work will be permitted to begin.

### PART 3 – CONSTRUCTION REQUIREMENTS

### 3.01 RIGHT-OF-WAY AND EASEMENT.

Rights-of-way and/or easements as shown on the Plans and easement/rights-of-way plats are provided by the City for construction of storm drainage facilities. The Contractor shall confine his construction activities within these areas. The Contractor shall be responsible for obtaining written agreements for use of private property outside of City acquired rights-of-way/easements for such purposes as storage of material and equipment and access to the construction site. The Contractor shall provide a copy of all such written agreements to the City immediately upon obtaining same.

### 3.02 EXISTING OBSTRUCTIONS.

Locations of obstructions shown on the Plans are approximate and are shown only for information purposes and are not intended as an accurate location of such obstructions. Obstructions not shown on the Plans but encountered by the Contractor shall be removed as necessary and, if directed by the Owner, replaced in their original state or protected by the Contractor at no additional cost to the City.

### 3.03 REMOVAL OF VEGETATION.

A. The rights-of-way/permanent easements shown on the Plans and right-of-way/easement plats shall be cleared of all dead trees, living trees, stumps, brush, projecting roots, hedge, weeds, pole stubs, logs, and other objectionable material, vegetation and growth. This work shall include the removal of all trees, shrubs, and plants not suitable for moving and replanting as determined by the Owner. All trees, stumps, roots, pole stubs, brush, hedge, and other protruding obstructions within the rights-of-way/easements shall be removed to within 3 inches of existing ground. This work shall be done well in advance of excavation operations. Trees and shrubs to be replanted shall be extracted with an ample ball of earth around roots so that transplanting may be successful. The root ball shall be wrapped in burlap. Vegetation stored for replanting shall be watered sufficiently to protect the root system from dehydration.

B. Low hanging branches and unsound branches on trees or shrubs designated to remain, shall be removed. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

### 3.04 REMOVAL OF OBSTRUCTIONS.

Existing fence material and posts within the rights-of-way/easement limits shown on the Plans and rightof-way/easement plats shall be moved from the construction area and stored in such a manner as to protect them against damage. The Contractor shall be responsible for the condition of the removed fence material and posts. The Contractor shall demolish and remove all structures and structure foundations within the rights-of-way/easement limits unless otherwise instructed by the Owner. Such structures and foundations shall be removed to 12 inches below the subgrade elevation or as directed by the Owner. If permitted by the Owner, the Contractor shall backfill basements, cisterns, and the like in an approved manner. The Contractor shall remove all abandoned vehicles, appliances and rubbish within the rightsof-way/easement limits.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02630 SITE PREPARATION AND RESTORATION

### 3.05 PROTECTION OF OBSTRUCTIONS OUTSIDE RIGHT-OF-WAY/EASEMENT LIMITS.

The Contractor shall protect and avoid damage to all trees, shrubs, plants, fences, turfed areas, structures, and all other objects outside of the right-of-way/easement limits shown on the Plans and right-of-way/easement plats from damage due to construction operations. Damage caused by the Contractor shall be repaired or restored at no cost to the City. Particular care shall be used to avoid damage to trees, shrubs, bushes, turfed areas, and private property located adjacent to rights-of-way/easements on private property. No trees, plants, turfed areas, or other objects outside such limits shall be disturbed or damaged without the written permission of the property owner.

### 3.06 SPECIAL PROTECTION OF OBSTRUCTIONS INSIDE EASEMENT LIMITS.

Wherever the underground installation of drainage facilities conflicts with other improvements previously made by the City, other governmental bodies, or adjacent property owners, the Contractor shall be responsible for their protection and preservation, including necessary removal and storage of such improvements, and subsequent replacement to obtain, to the fullest extent possible, the undisturbed condition.

### 3.07 DISPOSAL OF DEBRIS.

All trees, brush, logs, snags, leaves, sawdust, bark, construction debris, and refuse shall be collected and disposed of in accordance with all applicable City codes and ordinances. Debris shall be removed from the site as soon as practical and shall not be left until the completion of the contract. If burning of debris is allowed by the Owner, the Contractor must obtain and pay for a permit from the City of Memphis Department of Fire Prevention and all precautions necessary shall be exercised to prevent the spread of fire and such burning shall be in accordance with Division 1, "General Requirements" of these Specifications. Burning shall be done only at approved locations and in conformity with the laws, ordinances, and requirements of agencies and officials having jurisdiction. When materials are to be disposed of, the Contractor shall obtain written permission before hand from the property owner on whose property the disposal is to be made and shall file a copy of such permit with the Owner. Unless otherwise provided in the Contract Documents, the Contractor shall make his own arrangements for disposing of such materials off site.

### 3.08 REPLACEMENT OF VEGETATION.

As soon as backfill operations permit, the Contractor shall replace transplanted trees, shrubs, and plants. The Contractor shall properly water the transplanted vegetation immediately upon replanting and at suitable intervals thereafter. If shrubs, plants, or trees die after transplanting and before final acceptance of the Work, the Contractor shall at his expensed replace same with equal shrubbery, plants, or trees.

### 3.09 REPLACEMENT OF FENCES.

Any fences disturbed within the rights-of-way/easement limits shall be replaced to the satisfaction of the Owner. Fences in such poor condition that they cannot be removed and replaced shall be replaced with new fence material similar in original quality, size, and appearance to the removed fence or a written release shall be obtained from the property owners. For chain link fence, new fence materials and construction methods shall conform to the requirements of Specification Section 02820. For box culvert or pipe construction, any fences removed shall be replaced in their original location. Any fence damaged during construction shall be restored to original or better condition. For channel lining construction, removal of fences shall be performed with care and the fence rolled up or stacked and stored on the owner's property. All side yard fences within the easement shall be replaced or extended to the new channel with in-kind fence material.

### 3.10 ESTABLISHMENT OF TURFED AREAS.

After final restoration of settled trench surfaces, all areas within the right-of-way or permanent easement limits which were established turfed areas prior to construction will be sodded in accordance with Specification Section 02920. All cut or fill slopes constructed for new drainage facilities will be sodded in accordance with Specification Section 02920 and in conformity with City cross-sections.

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02630 SITE PREPARATION AND RESTORATION

## 3.11 RESTORATION OF OTHER TURFED AREAS.

All areas outside the right-of-way, permanent easement, or cut and fill slopes shall be restored as nearly as practical to their original condition at the Contractor's expense. Finished lawn areas upon which earth has been deposited shall be cleared to the level of the existing sod and then raked and watered. Areas where sod has been damaged, destroyed, or ruts have been filled in shall be resodded. Areas where sod is only slightly damaged may be lightly reseeded, if so permitted by the Owner. Sodding and seeding materials and construction methods shall conform to the requirements of Specification Section 02920.

### PART 4 – MEASUREMENT

### 4.01 SITE PREPARATION AND RESTORATION.

A. No measurement of area will be made. When changes in the Contract Documents affect the rights-of-way/easement area, a proportionate adjustment for the increased or decreased area will be made.

B. When the Proposal Sheet(s) does not contain an item for Site Preparation and Restoration, this work will be required within the construction limits and will not be paid for directly but will be considered as a subsidiary obligation of the Contractor under other contract items.

### PART 5 – PAYMENT

### 5.01 SITE PREPARATION AND RESTORATION.

Payment will be made for Site Preparation and Restoration at the contract lump sum price, which price will be full compensation for removal and/or protection of trees, shrubs, plants, brush, rubbish, fences, man-made obstructions including but not limited to structures, abandoned appliances, building foundations, and all other obstructions as may directed by the Owner; the disposal of debris and obstructions removed; and the restoration of trees, shrubs, plants, fences; restoration of turfed areas outside of right-of-way, permanent easement and cut and fill slopes, and all other items as shall be specified in the Plans and Contract Documents or directed by the Owner.

5.06 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02630-01	SITE PREPARATION AND RESTORATION	Lump Sum

END OF SECTION 02630

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02631 EARTHWORK

### PART 1 - SCOPE

1.01 This work shall consist of all types of excavation, special protection, protection of existing utilities, backfilling, and grading for all types of drainage facilities including such labor, material and equipment, and all other items as may be necessary to complete the earthwork as shown on the Plans, stipulated in the Contract Documents, or directed by the Owner.

### PART 2 – MATERIALS AND EQUIPMENT

### 2.01 MATERIAL

### A. Lumber.

Lumber to be used for bracing trenches shall be no less than 2 inch thick rough cut oak.

### B. Pit Run Gravel.

Pit run gravel shall consist of one of the three gradations shown in the table below.

1. Total Percent, by Dry Weight, Passing Each Sieve (U.S. Standard)

<u>Size No.</u>	<u>2 ½ "</u>	<u>2"</u>	<u>1 ½ "</u>	<u>1"</u>	<u>3/8"</u>	<u>No. 40</u>	<u>Clay*</u>
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

\* Clay content shall be determined by the Hydrometer Test – AASHTO T 88. Clay content up to 15 percent may be used with the approval of the Owner.

2. That portion passing the No. 40 sieve shall be known as the binder. The binder aggregate shall consist of hard durable particles of limestone or a sound silicious material. Shale aggregate or pipe clay binder will not be acceptable, and in no case shall the percent of silt exceed the percent of clay by more than 25 percent.

3. If the binder material is insufficient to properly bond the aggregate, a satisfactory binding material may be incorporated, as approved by the Owner, so that the resultant mixture will comply with these Specifications. The mixing shall be done uniformly, and blending of materials on stockpiles or in the pits by bulldozers, clamshells, draglines, or similar equipment will not be permitted.

### C. Backfill Material.

Material for backfill shall be fine compactible soil selected from site excavation if approved by the owner as being suitable. Additional material needed shall be obtained from borrow excavation.

### 2.02 EQUIPMENT

All equipment necessary for the satisfactory performance of this work shall be on the Project and approved before work will be permitted to begin.

### PART 3 – CONSTRUCTION REQUIREMENTS

### 3.01 EXCAVATION

### A. General.

All excavation performed under this Section including trench excavation, structure excavation, and channel excavation but excluding undercut will be considered unclassified excavation regardless of the nature of the material and objects excavated and will not be measured or paid for separately except as specifically noted herein. Pavement removal and replacement shall be accomplished as specified in Specification Section 02950.

### 1. <u>Undercut Excavation</u>.

a. Undercut excavation shall consist of removing and disposing of soft, spongy earth, muck, mud, unconsolidated fill, organic matter, and any other unsatisfactory materials below the grade established on the Plans for storm drains, structures, and channels where determined necessary by the Owner. No undercut excavation shall be performed without prior authorization of the Owner in writing. The limits of undercut excavation will be determined by the Owner, who will be present during the undercut operations.

b. Undercut areas shall be backfilled with suitable material to the grade established on the Plans. The backfill shall be placed in 6 inch maximum lifts and compacted by use of a bulldozer.

### 2. Unauthorized Excavation Below Subgrade or Outside of Limits.

All unauthorized excavation carried beyond or below the lines and grades given by the Plans or Contract Documents, together with the removal of such excess excavated materials, and the cost of refilling the space of such over dig or unauthorized excavation, shall be at the Contractor's expense. The excess space between the undisturbed bottom and sides of the excavation and subgrade limits shown on the Plans for storm drain pipe shall be refilled with suitable material and compacted per Specification Section 02631, Paragraph 3.01.A.1a unless otherwise directed by the Owner. The excess space between the undisturbed bottom of the excavation and subgrade elevations shown on the Plans for box culverts and concrete channel lining shall be refilled with suitable material and compacted per Specification outside of side excavation limits shall be backfilled with select material unless otherwise directed by the Owner. The backfill shall be compacted in accordance with Specification Section 02631, Paragraph 3.01.A.1a.

### 3. <u>Change in Excavation Location or Grade</u>.

If the Owner orders in writing that the location or grade of a proposed drainage facility be changed from that shown on the Plans, the following provisions will apply.

a. If the change is made before excavation work has begun and the facility being constructed is covered in the Proposal Sheet(s) by pay items with appropriate depth classifications (pipes, manholes, and similar items), the appropriate pay item will apply to the new depth measurements along the changed centerline. If the changed location or grade introduces a new depth classification not included in the Proposal Sheet(s), a Change Order or Construction Change Order will be prepared in accordance with Specification Section 00710 Article 9 "Changes". If the facility being constructed is not covered in the Proposal Sheet(s) by pay items with depths classifications (box culverts, concrete channel lining, unlined channel, inlets, junction structures, etc.) and if the average depth of excavation per linear foot at the changed location or grade is within 10 percent of the original Plan quantity, there will be no change in the unit price for this work and no additional compensation (or reduced compensation) will be allowed for the change. If the average depth of excavation per linear foot at the changed location is more than 10 percent above or below original Plan guantities, a new unit price for the actual excavation depth will be established. For purposes of comparing changed quantities to Plan quantities, a 1 foot wide strip will be assumed from natural ground line to invert along both the revised and original locations; quantities will then be calculated for the 1 foot wide strip along both conditions and then divided by the proper lengths.

b. If the change is made after excavation has already begun on the original Plan location, the procedures described above will apply to payment for work along the changed location. If abandonment of an existing excavation or a portion of an existing excavation is required due to a change by the Owner, the Contractor will be compensated for the backfilling and restoration of the abandoned excavation. Backfilling

## CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02631 EARTHWORK

and restoration of the abandoned excavation will be accomplished in accordance with the appropriate section of these Specifications.

c. Filling a portion of existing excavation to meet changed grades will be accomplished in accordance with Specification Section 02631 Paragraph 3.01.A.1a.

d. If a change in location and/or grade is authorized in writing by the Owner at the written request of the Contractor; whether before or after excavation work has begun; the Contractor will not receive and additional compensation whatsoever for the changed work even though lengths and/or depth of excavation may be greater than original Plan quantities. Backfilling and restoration of abandoned excavation work will be accomplished totally at the Contractor's expense. If changes requested by the Contractor result in reduced lengths and/or depth of excavation, the revised quantities using Proposal unit prices or Change Orders/Construction Change Orders as appropriate will be used to develop payment.

### 4. Disposition of Excavated Material.

a. Excavated materials suitable for backfill shall be stored no closer than 2 feet from the edge of the excavation to allow free passage of the Owner and permit the Owner to perform his work in an expeditious and safe manner. Excavated material shall not obstruct crosswalks, sidewalks, street intersections, nor interfere unreasonably with travel on streets by occupants of adjoining property. Gutters or other surface drainage facilities shall not be obstructed. When clear access to fire hydrants, mail boxes, sewer and conduit manholes, and similar utility or municipal service facilities is required, the Contractor must provide such access. Excavated material intended for backfill shall be stored in such a manner as to minimize loss of excavated material due to erosion.

b. All materials excavated, disturbed, damaged, or removed by the Contractor and not to be used for refilling trenches, channels, or structure excavations or to be used in restoration of subsurface or surface facilities or conditions, shall be removed from the site and disposed of by the Contractor, unless otherwise directed. The City reserves the right to retain excess excavation material and direct the Contractor to deliver it to a site specified by the Owner at the Contractor's expense. If the Contractor proposes to store or place such excess excavated material upon any property, written consent of the property owner or owners must be secured in advance and a certified copy thereof be filed with the Owner. No surplus or excess materials shall be deposited in any stream channel nor in any place where preconstruction surface drainage would be changed, without written permission of the Owner.

### 5. <u>Control of Storm Water.</u>

a. The Contractor shall keep all excavations free of water. He shall provide all dams, flumes, channels, sumps, or other works necessary to keep the excavation entirely clear of water and shall provide and operate pumps or other suitable equipment of adequate capacity for dewatering the excavations. He shall avoid producing mud in the trench or channel bottom by his operations. If necessary or so ordered by the Owner, the Contractor shall place pit run gravel at his own expense to maintain a firm, dry excavation bottom and base. Pipe bedding, laying, jointing, and the placing of concrete or masonry shall be done in a water free trench or excavation, which shall be kept clear of water until pipe joints, concrete and masonry have set and are resistant to water damage. The water shall be disposed of at the Contractor's expense.

b. All gutters, pipes, drains, conduits, culverts, catch basins, inlets, ditches, creeks, and other storm water facilities shall be kept in operation, or their flows shall be satisfactorily
diverted and provided for during construction. Any facilities disturbed during construction shall be restored to the satisfaction of the Owner.

6. Excavation Around Obstructions.

a. The Contractor shall perform all excavation by hand where excavation by machinery would endanger trees, structures, or utilities which otherwise might be saved by the use of hand excavation.

b. The Contractor shall cautiously excavate test holes to locate the limits of underground obstructions anticipated within the excavation. When a water pipe, gas pipe, sewer, or similar utility comes within the limits of the trench, such facilities shall be properly supported.

### B. <u>Trench Excavation</u>.

1. All trenches shall be open cut unless otherwise shown on the Plans. Tunneling, boring, or jacking will be allowed only on permission of the Owner, unless otherwise shown on the Plans, and a complete record thereof shall be kept in the Contractor's project diary.

2. The Contractor shall be responsible for prosecuting the work in accordance with the grades and lines shown on the Plans or as directed by the Owner. Trenches may be excavated by machinery to a depth that will not disturb the finished subgrade. The remaining material shall be hand excavated so that the pipe may be laid on a firm, undisturbed subgrade.

3. No more than 300 feet of trench shall be opened at any time in advance of the completed storm drain, nor shall more than 100 feet be left unfilled except by written permission from the Owner. In special cases the Owner may limit the distance to which the trench may be opened by notifying the Contractor in writing.

4. The width of trenches below a level 1 foot above the outside top of pipe shall be such as to leave not less than 6 inches on each side of the outside of the pipe for all sizes up to and including 15 inch diameter pipe. Maximum trench width dimension for these pipe sizes shall be 36 inches. For 18 inch diameter pipe, the width of trenches below a level 1 foot above the outside top of pipes shall be such as to allow not less than 6 inches one each side of the pipe, with a maximum trench width of 42 inches. For pipes sizes over 18 inches, the width of trenches below a level 1 foot above the outside top of the pipe at level 1 foot above the outside top of the pipe. If the trench width at or below that level 1 foot above the outside top of pipe exceeds the widths specified, provision shall be made for the additional load upon the pipe at the Contractor's expense. For pipes other than circular, trench width shall be adjusted to provide for the additional pipe width along the along the horizontal axis.

5. The sides of the trench shall be as nearly vertical as possible. The bottom of the trench shall be carefully graded, formed, and aligned according to the Plans and to the satisfaction of the Owner before storm drains are laid thereon.

6. The bottom of the trench shall be excavated at each joint of bell and spigot pipe to allow the body of the pipe a uniform contact and support throughout its entire length. When mortar joints are specified, bell holes shall be excavated at each joint in the pipe line to provide space underneath the pipe in which to properly build up mortar joints.

C. Excavation For Drainage Structures.

1. The Contractor shall be responsible for prosecuting the Work in accordance with the lines and elevations shown on the Plans or as directed by the Owner. The Contractor shall excavate as required for all structures with foundations carried to firm, undisturbed earth at the elevation of the underside of the structure.

2. The outside dimensions of all manholes, inlets, box culverts, channel lining, and other drainage structure excavations shall be at least 12 inches greater than the outside of the masonry or concrete work to permit backfilling around structure.

3. Where structures are to be built in street right-of-way or paved areas, the excavation shall not exceed 2 feet from the outside of the masonry or concrete work. In the event that the excavation exceeds this limit, the Contractor will be required, at his expense, to backfill the entire space around the structure with suitable material compacted as specified in Specification Section 02631 Paragraph 4.0.

4. For drainage facilities to be constructed in fill areas, the fill shall first be placed and compacted in accordance with these Specifications. The excavation for the drainage facilities shall then commence following the placement of fill.

### D. Unlined Channel Excavation.

The Contractor shall be responsible for prosecuting the Work in accordance with the grades and lines shown on the Plans or as directed by the Owner. The sides and bottom of the channel shall be excavated and shaped so as to conform with the cross-sections shown on the Plans or as directed by the Owner.

### 3.02 SPECIAL PROTECTION

### A. <u>Treacherous Ground.</u>

When running sand, quicksand, or other treacherous ground is encountered, the work shall be carried on with the utmost vigor and shall be prosecuted day and night should the Owner so direct.

### B. Sheeting and Shoring.

1. The Contractor shall furnish, place, and maintain such sheeting and shoring as may be required to support the sides of any excavation to prevent earth movement that could endanger the work or workmen; or to prevent any earth movement which might in any way delay the Work, change the required width of the excavation, or endanger adjacent pavement, utilities, sewers, buildings, or other structures above or below the ground surface; or to contain the construction within a specified area such as an easement or street right-of-way. The Contractor shall place this sheeting and shoring for such protective purposes without the Owner's instructions.

2. During the extraction of sheeting, care shall be exercised to prevent damage due to settlement or movement of new drainage facilities. The sheeted trench width, as measured between those faces of the sheeting in contact with the earth trench wall, shall not exceed the maximum width of trench specified in Specification Section 02631 paragraph 3.01.B. below an elevation 1 foot above the top of the pipe. Walers and struts shall be designed and installed to present no obstructions to proper placement of the pipe, bedding, cradle or encasement, nor shall they interfere with the satisfactory laying and jointing of the pipe.

3. Sheeting, bracing, and shoring shall be withdrawn and removed as the backfilling is being done, except where and to such extent as the Owner shall order that sheeting, bracing, and shoring be left in place, or where the Owner will permit the same to be left in place at the Contractor's request. The Contractor shall cut off any such sheeting at least 2 feet below the surface and shall remove the cutoff material from the excavation.

4. All sheeting, bracing, and shoring which is not left in place under the foregoing provisions shall be removed in a manner which will not endanger the completed work or other structures, utilities, sewers, or property whether public or private. The Contractor shall exercise care to prevent the opening of voids during the extraction process.

5. Steel drag shields or trench boxes may be used in lieu of sheeting, shoring, and bracing unless the Owner directs otherwise.

### C. Excess Width Of Trench.

If the Contractor is permitted to use equipment that results in wider trenches than hereinbefore specified, concrete cradle or additional concrete cradle shall be used around pipe if required to resist the additional load caused by the extra width. The dimensions of this cradle will be specified by the Owner, and no extra compensation will be allowed for the additional material or work.

### D. Blasting.

1. Blasting shall be under taken only after the Contractor has received written authorization from the Owner. With respect to the use of explosives in blasting, the Contractor shall apply for and receive all necessary permits and comply with all federal and state laws, rules, ordinances and regulations and requirements of the insurer governing the keeping, storage, use, manufacture, sale, handling, transportation, or other disposition of explosives. The Contractor shall provide additional liability insurance to the City, with limits and coverages as specified by the Owner, covering blasting operations in advance of any blasting. All operations involving the handling, storage, and use of explosives shall be conducted with every precaution under the supervision of a properly licensed individual. The Contractor shall take special precautions for the proper use of explosives both at or near the top of the excavation and in the excavation in order to prevent harm to human life and damage to surface structures, utilities, sewers, or other subsurface structures. The Contractor shall advise the Owner in advance when charges are to be set off. Blasts shall not be fired until all persons in the vicinity have had ample notice and have reached positions of safety.

2. Storm drains shall be carefully protected from all blasts, and all excavations requiring blasting shall be fully completed at least 30 feet in advance of the laying of the pipe. In all cases, the mouth of the pipe shall be provided with a board or other stopper carefully fitted to the pipe to prevent all earth or other substances from entering.

3. After a blast is fired, the Contractor shall thoroughly scale the excavation. All loose shattered rock or other loose material which may be dangerous to the workmen, pipe, or structure shall be removed and the excavation made safe before proceeding with the Work. The fact that the removal of loose, shattered rock or other loose material may enlarge the excavation beyond the required width will not relieve the Contractor from making such removal and filling the extra space. The Contractor shall not be entitled to extra compensation therefore.

### E. Wellpoints.

The Contractor shall use wellpoints, sump pumps, or any other method of dewatering as required to lower the water table below the bottom of the excavation. He shall make a request to the Owner and receive approval of the use of special dewatering equipment other than well points or sum pumps. Dewatering operations are considered incidental to the Work and no additional compensation shall be made to the Contractor.

### F. <u>Underpinning.</u>

When excavations require underpinning of existing structures, the Contractor shall submit shop drawings of underpinning details to the Owner prior to commencement of excavation below the

foundation of the structure. Review of underpinning details by the Owner shall not relieve the Contractor of his responsibility for protection of the structure and its contents.

### 3.03 EXISTING UTILITIES

### A. Location.

The Plans indicate the available records of location of existing structures and facilities, both above and below the ground, but the City assumes no responsibility for the accuracy or completeness of this information. Utility service connections are not shown on the Plans, but can be encountered at any location on the Project. If it is necessary to adjust or relocate any utility, it shall be the Contractor's responsibility to coordinate the work with the appropriate utility. Any cost or delays incurred by the Contractor in this activity shall be incidental and no additional compensation will be made.

#### B. Protection.

1. If the construction of the storm drains, structures, or channel requires the removal and replacement or protection of any overhead wires or poles, the Contractor shall make satisfactory arrangements for such work with the owner or owners of such wires and poles and no additional payment will be made by the City.

2. The Contractor shall protect any sewer or utility within the limits of the construction. The Contractor shall proceed with caution in any excavation and shall use every means to determine the exact location of underground structures, pipe lines, conduits, and similar obstructions prior to excavation in the vicinity thereof. The City will not be responsible for the cost of protection or repair or replacement of any structure, pipe line, conduit, service connection, or similar facility above and below ground which may be broken or otherwise damaged by the Contractor's operations. All water and gas pipes and other conduits adjacent to or crossing the excavation shall be properly supported and protected by the Contractor.

### C. Service Connections.

1. Sewer and utility services between mains and buildings shall be maintained and adjusted as necessary by the Contractor so as to provide as nearly a continuous operation as reasonably can be expected. This shall be accomplished in any way that the Contractor may desire, provided that the individual service not be inoperative more than two consecutive hours. The occupants shall be notified by the Contractor at least six hours in advance of such service interruptions. When a break occurs, the Contractor shall notify the affected occupant(s) of the probable length of time that the service will be interrupted.

2. If existing underground facilities or utilities require removal and replacement for the prosecution of this Work, all replacements of such underground construction or parts thereof shall be made with new materials conforming to the requirements of these Specifications or, if not specified, as approved by the Owner.

3. The removal and replacement of water services to accommodate new construction shall be the Contractor's responsibility within the limits where the new service line grade blends smoothly with the existing service line grade. This work will be incidental to the construction of the drainage facility and no additional compensation will be made.

4. The removal and replacement of sewer services to accommodate new construction shall be the Contractor's responsibility from the sewer main to a point where the new grade and existing grade can be matched. Payment will be made in accordance with Specification Section 02631 Paragraph 5.05.

5. The Contractor shall be responsible for any damage to the service as a result of his operations. The City does not guarantee the number, size, condition, nor length of adjustment necessary to bring a service to a new grade.

### 3.04 BACKFILLING

A. <u>General.</u>

1. Bedding for drainage facilities shall be constructed in accordance with the following specifications for the various type facilities:

- a. Storm Drain Pipe: Specification Section 02632 Paragraph 3.02.B
- b. Manholes, Inlets and Special Structures: Specification Section 02640 Paragraph 3.02
- c. Reinforced Concrete Box Culverts: Specification Section 02641 Paragraphs 3.02.B and 3.01.B

After drainage facilities have been bedded and installed in accordance with appropriate specifications and upon permission of the Owner, the backfill may be placed. No trash will be allowed to accumulate in the space to be backfilled. Particular care shall be taken to avoid allowing wood to be included in the backfill, other than sheeting and shoring that has been approved to be left in place.

2. The Contractor shall at all times be responsible for the condition of the trenches and filled areas. He shall maintain frequent inspection of same and at any time before the final acceptance of the work by the City the trenches or filled areas settle and sunken places appear, he shall be required to refill these sunken places with suitable material as soon as they are discovered. All trenches shall be barricaded and caution lighted at all times for the protection of the public.

3. Backfilling shall be accomplished as soon as practicable after underground work is completed and inspected. Backfilling operations shall proceed in an orderly fashion following as closely behind construction operations as practical.

4. All backfill shall be placed in uniform horizontal layer. "Ramping," that is pushing backfill material down a ramp into excavated areas, will not be permitted unless authorized in writing by the Owner.

### B. Backfill in Street Right-Of-Way and Improved Property

### 1. <u>Backfill Material in Pavement Areas.</u>

Backfill in excavations through pavement in street right-of-way or wherever prevention of backfill settlement is considered essential such as driveways and paved parking areas on private property, and where the Plans require or the Owner orders, shall be made with pit run gravel or other acceptable material from the top of the bedding material or foundation to the subgrade elevation of the pavement. Pea gravel, sand or similar granular materials approximately uniform in size and without bonding properties shall not be used.

### 2. Backfill Material Outside of Pavement Areas.

a. Backfill in excavations outside of pavement in street right-of-way or outside of public right-of-way shall be made with select, job-excavated earth from the top level of the bedding material or foundation to the subgrade elevation in paved area, or to within 1 inch of the surface in areas to be sodded, or to the surface in all other areas.

b. Nongranular, job-excavated material shall be free from debris, organic matter, perishable compressible materials, and shall contain no stones or lumps or rock fragments larger than 6 inches in dimension, nor be in such amount that will interfere with

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the consolidating properties of the fill material. Care shall be taken that stones and lumps are kept separated and will distributed, and that all voids are completely filled with fine materials. The upper 3 feet of backfill in sodded or planted areas shall be free of such rocks or lumps larger than 1 inch in diameter.

3. Placement and Compaction.

a. Storm Drain Trenches.

As soon as the pipe has been bedded, laid, jointed, and inspected by the Owner, backfilling shall continue in the following manner. Backfill shall be placed by hand in 6 inch loose layers above the bedding and tamped with heavy tampers or pneumatic tampers, special care being taken not to damage the pipe or joints, to a point 2 feet above the outside top of the pipe. From this point to the subgrade elevation of the pavement, or to the bottom of the sod, or to the original ground surface in all other areas, suitable backfill shall be placed in 12 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698).

### b. Structure and Box Culvert Excavations.

As soon as the masonry or concrete work has set sufficiently to withstand compaction, and the Owner has inspected it, suitable backfill shall be placed in 6 inch loose layers concurrently and uniformly on all sides and compacted with heavy tampers or pneumatic tampers to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698). Suitable backfill shall be placed in this manner concurrently on all sides from the foundation of the structure or culvert to the subgrade elevation of the pavement, or to the bottom of the sod or to the original ground surface in all other areas.

### c. Concrete Channel Lining Excavations.

As soon as concrete work has set sufficiently to withstand backfilling and has been inspected by the Owner, select backfill material shall be placed by methods other than ramping and compacted by jetting or flooding from the foundation of the channel lining to 3 inches above the top of the wall. Backfill will be rounded slightly adjacent to the top of wall to an elevation 1 inch above the top of the wall to assure positive surface drainage over the top of the wall. Backfill operations shall be coordinated with placement of the weep hole drainage system behind the channel lining wall. Special care shall be exercised during backfilling operations to prevent settlement behind channel lining walls.

### C. Backfill in Open Areas and Unimproved Property

1. <u>Backfill Material.</u> Backfill for storm drain pipe excavations in open areas and unimproved property shall be made with select earth material from the top level of the bedding material or foundation to the surface. Backfilling for structures, box culverts, and concrete channel lining excavations in open areas and unimproved property shall be performed in accordance with Specification Section 02631 Paragraph 3.04.B. Nongranular, job-excavated material to be used for backfill shall be free from debris, organic matter and perishable compressible materials, and shall contain no stones or lumps or rock fragments larger than 6 inches in dimension or in such amount that will interfere with the consolidating properties of the fill material. Stones and lumps shall be kept separated and well distributed, and all voids shall be completely filled with fine materials.

2. <u>Placement of Backfill.</u> Backfill procedures specified for improved areas shall apply from the trench bottom to a point 2 feet above the outside of the pipe. From this point to slightly above the surrounding surface elevation, suitable backfill may be placed by bulldozer or other mechanical means.

### D. Drainage Facilities Placed on Fill

1. Fill material placed in areas over which drainage facilities will be constructed shall be select earth material from the elevation of suitable subgrade to the bottom elevation for bedding or foundation of the drainage facility.

2. <u>Placement and Compaction.</u> If drainage facilities are constructed on filled areas, the fill material shall be placed in 6 inch loose layers and compacted to 95 percent of maximum density at plus or minus 2 percent of optimum moisture content as determined by Laboratory Standard Proctor Test (ASTM D 698) up to a point at least 2 feet above the outside top of the pipe or to the foundation of manholes, inlets, special structures, box culverts, concrete channel lining and concrete ditch paving. If compaction standards for storm drain pipe exceed that of the adjoining fill, the width of compaction for the storm drain shall be not less than the outside diameter of pipe plus 10 feet. If compaction standards for the manhole, inlets, special structure, box culverts, concrete channel lining and concrete ditch paving exceed that of adjoining fill, the limits of compaction for the facility shall be not less than 5 feet outside of the facility base slab.

### 3.05 FINAL GRADING

A. Final grading around and above drainage facilities shall be shaped to the slope of adjacent undisturbed ground. Sufficient grading operations shall be performed to provide natural surface drainage from adjacent properties into drainage facilities.

B. Grading above the top of concrete channel lining walls shall be accomplished in accordance with proposed cross-sections supplied by the City at the preconstruction conference or as directed by the Owner. Grading shall provide adequate drainage over the top of channel walls. Side slopes shall be graded to provide a minimum slope of  $\frac{1}{2}$  inch per foot beginning 3 inches above the top of channel walls. Side slopes shall be rounded off near the channel wall to an elevation of 1 inch above the top of wall. The addition of sod will provide a final side slope elevation 2 inches above the top of wall.

## PART 4 – MEASUREMENT

### 4.01 UNDERCUT BACKFILL

Undercut backfill will be measured by the ton of suitable material.

### 4.02 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

Sheeting and shoring directed to remain in place will be measured by the 1,000 board feet, in place prior to being cut off below grade. Sheeting and shoring placed and removed by the Contractor will not be measured for payment.

### 4.03 PAVEMENT BACKFILL

Pit run gravel or other suitable materials used for backfill as determined by Specification Section 02631 Paragraph 3.04.B will be measured by the ton and will be paid for at the contract unit price per ton furnished and placed, which price will be full compensation for furnishing, placing and compacting the selected fill.

### 4.04 UNLINED CHANNEL

Unlined channel will be measured per linear foot along the centerline for various channel cross-sections, complete in place.

### 4.05 SEWER BUILDING (HOUSE) CONNECTION REMOVAL AND REPLACEMENT

Sewer building connection removal and replacement for construction of drainage facilities shall be measured per each, complete in place. Sewer building connections damaged by the Contractor which do not require removal and replacement for construction of drainage facilities will not be measured for payment.

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### 4.06 GENERAL

All work for excavation, blasting, drainage of trench and dewatering, backfilling of excavation, compaction, grading, protection of existing utilities, water service connection adjustments, disposal of excess materials, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered as a subsidiary obligation of the Contractor under other Pay Items of the Contract.

### 4.07 COMPACTION TESTING

Soil test as required by the Owner will be paid for by the test as performed by a testing agency which meets the approval of the Owner.

### PART 5 – PAYMENT

### 5.01 UNDERCUT BACKFILL

Accepted quantities of undercut backfill will be paid for at the contract unit price per ton of backfill material furnished and placed, which price will be full compensation for undercut excavation, special protection, protection of existing utilities, and backfilling to bottom of facility subgrade elevations, complete in place.

### 5.02 SHEETING AND SHORING DIRECTED TO REMAIN IN PLACE

Accepted quantities of sheeting and shoring directed by the Owner to remain in place will be paid for at the contract unit price per 1,000 board feet in place prior to being cut off below grade, which will be full compensation for material only. The cost of placing sheeting and shoring to remain in place shall be incidental to the work. No payment will be made for sheeting and shoring placed and removed by the Contractor.

### 5.03 COMPACTION TESTING

Accepted quantities of compaction tests as required by the Owner will be paid for at the contract unit price per test.

### 5.04 UNLINED CHANNEL

Accepted quantities of unlined channel will be paid for at the contract unit price per linear foot for various channel cross-sections, which price will be full compensation for excavation, removal, and disposal of excavated material and grading, complete in place.

### 5.05 SEWER BUILDING (HOUSE) CONNECTION REMOVAL AND REPLACEMENT

Accepted quantities of sanitary sewer building connections removed and replaced will be paid for at the contract unit price per each connection, which price will be full compensation for excavation, removal of old connection line and appurtenances, materials and construction of new connection, joining to existing connection line, and backfilling, complete in place.

### 5.06 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02631-01	Undercut Backfill	Ton
02631-02	Sheeting and Shoring Directed to Remain In Place	1,000 Board Feet
02631-03	Soil Compaction Test	Each
02631-04 02631-04	Unlined Channel Description	Linear Foot Linear Foot

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<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02631-05	Sewer Building (House) Connection	Each
02631-06	Pavement Backfill	Ton

# END OF SECTION 02631

### PART 1 - SCOPE

This work shall consist of the construction of manholes, inlets, junction boxes, headwalls, wingwalls, skirts, brick radius, poured-in-place radius and other special drainage structures of the kinds and dimensions shown on the Plans, stipulated in the Contract Documents, or as directed by the Owner. The construction shall be accomplished in accordance with these Specifications and in conformity with the lines, grades, cross-sections, and details shown on the Plans or established by the Owner. The work shall include such labor, material, equipment, removal and abandonment of structures, brick masonry, cast-in-place concrete construction, precast concrete construction, rims and covers, frames and grates, miscellaneous iron castings, and all other items as may be necessary to complete the structures as shown on the Plans.

### PART 2 – MATERIALS AND EQUIPMENT

### 2.01 MATERIAL

### A. New Material.

All materials shall be subject to sampling, testing, and approval or rejection by the Owner. Unless otherwise specified, all materials incorporated into the work shall be new and unused in previous construction. Used materials, acceptable to the Owner, may be used for bracing, forms, falsework, and similar uses.

### B. Manufacturer's Qualifications.

The source of supply for each material to be supplied by the Contractor shall be subject to approval by the Owner before delivery. Precast concrete manhole sections, steel reinforcement, and iron castings shall be the standard product of a manufacturer of established reputation in the industry and manufactured in a permanent plant adapted to meet the specified design requirements of the material being supplied.

### C. Inspection and Testing.

1. Representative samples of materials intended for incorporation in the work shall be submitted for examination when so specified or requested by the Owner. All materials to be used in the work shall be sampled, inspected, and tested in accordance with current ASTM specifications, or other specified standard specifications. The Contractor shall furnish the Owner with three copies of certified reports from a reputable testing laboratory showing the results of the tests carried out on representative samples of materials delivered and to be used in the project. The performance or cost of all testing is incidental to the work and shall be done at no cost to the City.

2. The Contractor shall notify the Owner in advance of any deliveries of the materials and shall make whatever provisions are necessary, including the furnishing of such labor as may be required to aid the Owner in the examination, inspection and culling of the materials on the site prior to installation in the work.

3. All materials not conforming to the requirements of these Specifications shall be considered as defective and rejected for use and shall be removed from the site of the work.

### D. Storage.

The Contractor shall provide such storage facilities and exercise such measures as will insure the preservation of the specified quality and fitness of materials to be incorporated in the work.

### E. Portland Cement Concrete.

Portland cement concrete shall be of the class and dimensions, and at the designated locations shown on the Plans, or as directed by the Owner. The classes of concrete are referred to as Class A and Class C. Class A concrete is intended principally for concrete structures designed for high strength. Class C concrete is intended principally for low strength concrete used for

foundation stabilization, pipe cradles, and encasement and other general purpose uses. All portland cement, coarse aggregate, fine aggregate, water, air entraining agents and chemical admixtures; their proportioning, mixing, and delivery shall be as specified in Specification Section 03050.

### F. <u>Steel Reinforcement.</u>

Deformed steel reinforcing bar shall conform to ASTM A 615 for Grade 40 or Grade 60 and shall be of the grades, sizes, and dimensions and at the designated spacings and locations shown on the Plans or as directed by the Owner. Welded wire fabric conforming to ASTM A 185 shall have a minimum yield strength of 65,000 psi and fabric conforming to ASTM A 497 shall have a minimum yield strength of 70,000 psi and shall be of the size, design, and weight and at the locations shown on the Plans or as directed by the Owner. All steel reinforcement and its storage shall be as specified in Specification Section 03310.

### G. Mortar.

1. Mortar shall be composed of the following mixture by volume: 1 part portland cement, 2 parts sand, hydrated lime not to exceed 10 percent of the cement used, and 4 parts water. All ingredients shall be proportioned by measurement and not by estimation. All portland cement, sand, and water shall be as specified in Specification Section 03050. All hydrated lime shall be as specified by ASTM C 6.

2. The mortar shall be hand mixed or machine mixed. In the preparation of hand-mixed mortar, the sand, cement and hydrated lime shall be thoroughly mixed together in a clean, tight, mortar box until the mixture is of uniform color, after which water shall be added. Machine-mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 1  $\frac{1}{2}$  minutes. Mortar shall be used within 30 minutes after mixing.

### H. Brick.

1. All brick shall conform to the Specifications for Concrete Building Brick, ASTM C 55 for Grade A. Bricks shall conform to the following dimensions, unless otherwise approved by the Owner.

	Depth Inches	Width Inches	Length Inches
Standard Size	2 ¼	3 3⁄4	8
Allowable Variation	+ 1/4	+ 1/4	+ 1/2

All brick shall be new and whole, of uniform standard size and with substantially straight and parallel edges and square corners. Bricks shall be tough and strong and free from injurious cracks and flaws. Brick shall be culled after delivery, if required, and all culls shall be removed from the work site.

2. The Contractor may be required to furnish the Owner with at least five bricks of the character and make he proposes to use, at least one week before any bricks are delivered for use. All brick shall be of the same quality as the accepted samples.

### I. Gray Iron Castings

Castings shall be of the standard Memphis type as detailed on the Plans and Design Standards. Castings shall be made of good quality, strong, tough, even grained cast iron and shall be smooth, free from scale, lumps, blisters, sand holes, and defects of any nature which would render them unfit for the service for which they are intended. They shall be thoroughly cleaned and subjected to a careful hammer inspection. Castings shall meet the requirements of ASTM A 48, Specifications for Gray Iron Castings, Class No. 30, or ASTM A 536, Standard Specification for Ductile Iron Castings, Grade 65-45-12. In either case, manhole rims and covers and inlet

frames and grates shall be designed to withstand HS 20-44 loading as defined by AASHTO Specifications. Before being shipped from the foundry, castings shall be given one coat of coal tar pitch varnish applied in a satisfactory manner so as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off. Frames and covers shall be machined or ground at touching surfaces so as to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced at no additional cost to the City. The Contractor shall provide the Owner with invoices, bills of lading or other necessary documentation as proof of purchase of all castings. Documentation shall be submitted along with each request for payment.

### J. Manhole Steps.

Cast iron steps shall be of the standard Memphis type as detailed on the Plans and Design Standards. Cast iron shall conform to the requirements of Paragraph I above. Rubber or plastic coated steel manhole steps shall meet the requirements of ASTM C 478. The steel shall be completely encapsulated in corrosion resistant rubber or plastic. All steps shall be cast integral with manhole walls or grouted into manhole walls. Manhole steps can be driven in the manhole wall while concrete is still green and grouted around.

### K. Structural Steel.

Structural steel for sidewalk drains, inlets, and other structures shall be of the grades, thickness, shapes, and dimensions shown on the Plans and Design Standards or as directed by the Owner. Top plates for sidewalk drains shall be JAL-TREAD floor plate or equal. All surfaces of sidewalk drains shall be given one coat of coal tar varnish applied in a satisfactory manner as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off.

### L. Precast Concrete Manhole Sections.

1. All precast reinforced concrete manhole risers, cones, grade rings, flat slabtops, and bases shall conform to the requirements of ASTM C 478 for the specified diameter and strength class. All cone sections and transition sections shall be eccentric in shape. Rings shall be custom made with openings to meet indicated pipe alignment conditions and invert elevations. The Contractor shall submit shop drawings for each individual structure on the Plans for review by the Owner before placing his order for structures.

2. The interior surfaces of the sections shall be a smooth, true cylindrical surface free from undulations or corrugations. Lifting holes when provided shall be cast in the wall of the pipe to receive a precast truncated conical concrete plug of such size as will allow 1/8 inch cementing material on the sides of the joining surfaces of the plug and will fill at least 50 percent of the lifting hole depth. Cement shall meet all requirements of the Specifications for Portland Cement, ASTM C 150, Type II.

3. Joints between manhole sections shall be installed using rope type flexible plastic gasket material meeting the requirements for Type B gaskets or rope type flexible butyl gasket material meeting the requirements the requirements for Type A gaskets, as defined by AASHTO M-198 unless otherwise specified on the Plans or Design Standards. Joint contact surfaces shall be formed with machined castings; they shall be exactly parallel with a 2° slope and nominal 1/16 inch clearance. Joints between a manhole section and precast concrete flat tops shall be mortar joints conforming to the requirements of this Specification.

### M. <u>Sand.</u>

Sand for structure abandonment shall consist of sand, all of which passes a 3/8 sieve and not more than 10 percent passes a no. 200 sieve.

### N. Crushed Limestone.

Crushed limestone for precast manhole base bedding shall meet the requirements of Specification Section 02632.

### O. Nonshrinking Grout.

Grout shall be mixed in small quantities as needed and shall not be retempered or used after it has begun to set. Unless otherwise specified or directed, the grout shall consist of one part portland cement and two parts sand by volume and a nonshrinking admixture mixed with sufficient water to form a grout of proper consistency. When nonshrinking or nonshrinking, fast setting grout is specified, it shall be formulated by the incorporation of an admixture or a premixed grout may be used. The formulation and the admixture of the premixed grout used will be subject to the review of the Owner and shall be mixed and used in accordance with the recommendations of the manufacturer. These special grouts will be classified as follows:

Type I - Nonshrinking Grout Type II - Nonshrinking, Fast Setting Grout Portland cement, sand, and water shall conform to the requirements of Specification Section 03050

### 2.02 EQUIPMENT

A. The equipment provided by the Contractor shall include hoisting equipment capable of handling and placing precast items in final position without damage. Mechanical tamps shall also be provided.

B. All of the above equipment, as well as any additional equipment necessary for the satisfactory performance of this construction, shall be on the project and inspected by the Owner before work will be permitted to begin.

### PART 3 – CONSTRUCTION REQUIREMENTS

### 3.01 MODIFICATION OF EXISTING STRUCTURES.

### A. <u>Removal</u>

Existing structures to be removed shall be as indicated on the Plans or directed by the Owner. The City reserves the right to retain or reject salvage of any materials encountered. Unless otherwise directed by the Owner, all castings shall be retained by the City. All salvage materials retained by the City shall be delivered to the appropriate City storage yard as directed by the Owner. All remaining materials become the property of the Contractor who will be responsible for disposing of same. The excavation shall be backfilled in accordance with Specification Section 02631 Paragraph 3.04. Removal of existing structures within the limits of excavation for new drainage facilities will not be measured or paid for separately but included in the price of the new drainage facility.

### B. Abandonment.

1. Existing structures to be abandoned in place shall be as shown on the Plans or as identified by the Owner.

2. After removing structure frames, covers, grates, and similar items, all incoming and outgoing pipes shall be bulkheaded as specified in Specification Section 02632 Paragraph 3.01. The walls shall be lowered to 2 feet below final grade if in earth or to 12 inches below subgrade if in pavement. The remaining structure shall be filled with sand to the limits previously mentioned. The sand shall be placed in approximately 12 inch layers and each layer compacted to 95 percent of maximum density. A 12 inch thick plain concrete slab shall be installed over the manhole or structure top that extends 12 inches beyond the outside face of the manhole of structure. The City reserves the right to retain or reject salvage of any materials encountered. All remaining materials become the property of the Contractor who will be responsible for disposing of same.

### 3.02 STORM DRAIN PIPE INSTALLATION

### A. <u>General.</u>

1. The structures will be either of concrete (plain or reinforced as required) or of brick masonry. Where the top elevation is not shown on the Plans, the structure or appurtenance shall be built to conform to the elevation ordered by the Owner.

2. The various structures shall be built as the pipe laying progresses. The Owner, at this discretion, may stop the laying of pipe or the building of other structures until the structure just passed has been completed. Completion of the structure shall include connections to pipes, placing of castings and other construction as shown on the Plans or as directed by the Owner.

3. Inlet and outlet pipes shall extend through the walls of structures only a sufficient distance beyond the outside surface to allow for connections and shall cut off flush with the inside surface of the wall as shown on the Plans or otherwise directed. The pipe shall intersect at the structures so that the invert between the inlet and outlet pipe can be smoothly formed such that counterflow is prevented.

4. Inverts shall be of Class C concrete and shall conform to the shapes indicated on the Design Standards or otherwise directed. The inverts shall be so constructed as to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. A smooth and uniform finish will be required.

5. All rims and frames shall be placed in the positions shown in the Design Standards or as directed by the Owner and shall be set true to line and to correct elevation. Rims and frames shall be set concentric with the masonry and in a full be of mortar so that the space between the top of the masonry and the bottom flanges of the rim or frame shall be completely filled and made watertight. A ring of mortar at least 1 inch thick and pitched to shed water away from the rim or frame shall be placed around the outside of the bottom flange. Mortar shall extend to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange. If rims or frames are to be bolted or anchored in concrete or brick masonry, all anchors or bolts shall be set and held in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has hardened to adequate strength.

6. All manholes, inlets, and junction structures deeper than 4 feet, as measured from the top of the rim or frame to the invert of the structure, shall be provided with steps unless otherwise shown on the Plans or directed by the Owner.

7. Steps shall be spaced not more than 16 inches vertically and staggered at 12 inches laterally and shall be so arranged that the lowest step shall not be more than 18 inches above the bench. The top step shall not be more than 18 inches below the structure rim or frame. If precast sections are used, steps are not required to be staggered laterally.

### B. Brick Masonry Construction.

1. <u>Construction Methods.</u>

a. All bricks shall be thoroughly clean. The bed which is to receive the bricks shall be thoroughly cleaned and damp, but should be free of water before placing mortar thereon. All bricks shall be laid in courses in freshly made mortar, using the shoved-joint method so as to thoroughly bond them into the mortar and always with the joints completely filled with mortar. The bricks shall be laid in a workmanlike manner and true to the lines and grades indicated on the Plans and Design Standards. The arrangement of headers and stretchers shall be such as will thoroughly bond the masonry. Unless otherwise

indicated, brick masonry for inlets shall have a header course every fifth course. In manholes, all bricks in each course shall be headers. The course shall be laid continuously with joints broken or alternating evenly with the joints in the preceding courses. Horizontal joints shall average 3/8 inch but shall be not less than ¼ inch nor more than ½ inch in thickness. Face joints shall be flush and neatly struck, and all joints on unexposed faces shall be solidly filled. No spalls or bats shall be used except in shaping around irregular openings or connections or when unavoidable to finish out a course. In this case, a full brick shall be used at the corner with the bat in the interior of the course. If any brick is moved or a joint broken during laying, the brick shall be removed, the mortar thoroughly cleaned from the brick, bed, and joints and the brick relaid in fresh mortar.

b. In brick manholes, inlets, or junction structures, a row lock arch shall be placed over all incoming and outgoing pipes in such a manner to provide full continuous contact between masonry and outside of pipe, to prevent leakage and to form a neat connection.

c. Brick manholes, inlets, junction structures, brick radius wall, and special structures shall be plastered on the outside with a coating of mortar not less than ½ inch thick of the same composition used in laying brick to prevent excessive infiltration of water. On the inside of the manholes the vertical portion of the walls shall be plastered and the sloping section neatly pointed with trowel.

d. The inside of brick inlet, junction structure, or brick radius walls shall be plastered with not less than ½ inch of mortar of the same composition used in laying brick.

e. Brick masonry, plastering, and mortar shall be protected against damage from freezing or lack of moisture. Brick masonry shall not be constructed when the temperature is 40 degrees F or lower without permission of the Owner nor without adequate approved means for protection against freezing. Brick masonry shall have sufficient moisture for proper curing and be protected from drying. Requirements for protection of brick masonry and masonry materials are the same as required for concrete structures in Specification Section 03310.

f. A prepared concrete slab shall be placed for all brick structures after the foundation excavation is completed. This shall be of the materials and dimensions shown in the Design Standards. The slabs shall be built of Class A concrete. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Specification Section 03310.

g. Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans. Concrete reinforcing in place shall be approved by the Owner before any concrete is placed.

h. Steps constructed in brick walls shall be installed at the specified spacing as the brick laying progresses. Steps shall be placed in a full bed of mortar between brick courses.

### 2. Brick Manholes.

Brick manholes shall be neatly and accurately built, according to Design Standards or as directed by the Owner. Manholes with brick walls shall have walls not less than 9 inches thick for manholes up to 6 feet deep and not less than 13 inches thick throughout the structure for extra depth manholes.

### 3. Brick Inlets.

a. Brick inlets shall be neatly and accurately built, according to Design Standard or as directed by the Owner. Inlets with brick walls shall have walls not less than 9 inches thick

for inlets up to 6 feet deep and not less than 13 inches thick for inlets between 6 to 11 feet deep maximum throughout the structure for extra depth inlets.

b. Top slabs (when required) shall be uniform in thickness as shown on the Plans and be constructed of Class A concrete. Exposed surfaces shall have a troweled finish.

### 4. Brick Junction Structures.

Brick junction structures shall be neatly and accurately built in accordance with details included in the Plans or as directed by the Owner. Access to all junction structures shall be provided by an access shaft with a manhole rim and cover at the proposed finished grade as detailed on the Plans.

#### 5. Brick Radius.

a. Brick radius shall be neatly and accurately built, according to the Plans and Design Standards, or as directed by the Owner. Brick radius walls shall not be less than 9 inches thick. The Contractor may at his option construct radius walls of reinforced concrete in lieu of brick conforming to the requirements of Specification Section 02640 Paragraph 3.02.C.4.

b. The radius of construction as shown on the Plans shall be as measured along the centerline of the structure and shall be constant throughout its length unless specified otherwise. The minimum radius shall be 5 times the inside diameter of the larger pipe at either end of the radius.

c. The base slab and top slab of a brick radius shall be uniform in thickness as shown on the Plans and Design Standards and be constructed of Class A concrete reinforced as detailed. In lieu of cast-in-place top slabs, precast units may be used if approved by the Owner. These units shall be set securely on the brick walls using steel dowels, a mortar bed and mortared around dowels and between precast units. Care shall be exercised to set precast slabs with reinforcement on bottom side of panel when in final position.

d. Pipe at both ends of the radius shall be laid in the final position and firmly bedded prior to commencement of brick radius construction. Longitudinal reinforcement shall extend from the normal radius section into a concrete pipe collar. The collar shall extend a minimum of 1 foot over each pipe end. Precast top slabs shall not be allowed over the pipe collars.

e. Inverts shall be constructed of Class C concrete and form a smooth radius conforming with the larger of the two pipes which they adjoin.

### C. <u>Cast-In-Place Concrete Construction.</u>

### 1. <u>Construction Methods.</u>

a. All cast-in-place structures shall be built as shown on the Plans and of Class A concrete. The structures shall be built on prepared foundations and conform to the dimensions and shapes shown on the Plans. The construction shall conform to the methods, forms, placement, protection, and curing for concrete as specified in Specification Section 03310.

b. Any required reinforcement shall be of the kind, type, and size and shall be located, spaced, bent, and fastened as shown in the Plans and Design Standards. Concrete reinforcing in place shall be approved by the Owner before any concrete is placed.

c. Connections for inlet and outlet pipes shall conform to the sizes, alignments, and elevations shown on the Plans.

d. Steps, when required, shall be cast into the full depth of the wall section at spacings as previously specified. The Contractor may at his option construct steps after removing concrete forms. Under this option, holes shall be drilled of sufficient size to allow  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch of nonshrinking grout on all sides of the prongs and sufficient depth to allow full embedment of the prongs.

## 2. Cast-In-Place Manholes.

Cast-in-place manholes shall be neatly and accurately built according to the Plans or as directed by the Owner. Wall thicknesses shall be as detailed on the Plans and Design Standards but not less than 6 inch thick. All cast-in-place manholes shall be of eccentric construction as shown on the Plans and Design Standards. The access steps shall be located on the vertical wall and staggered either side of a single vertical alignment in accordance with Specification Section 02640 Paragraph 3.02.A.

### 3. <u>Cast-In-Place Inlets.</u>

Inlet walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be Class A having a minimum wall thickness of 6 inches. Cast-in-place inlets shall be constructed with the same inside dimensions as shown in the Plans and Design Standards.

### 4. Junction Structures.

Junction structure walls may be built of concrete in lieu of brick at the Contractor's option. Concrete shall be Class A having a minimum wall thickness of 6 inches. Cast-in-place junction structures shall be constructed to the inside dimensions shown on the Plans and Design Standard or as directed by the Owner.

### 5. Cast-In-Place Radius.

Concrete walls shall be Class A having a minimum wall thickness of 6 inches. Cast-in-place radius shall be constructed to the radius and inside dimensions as shown in the Plans and Design Standards. Cast-in-place radius may also be constructed with a precast top slab set in a mortar bed and dowels if approved by the Owner.

## 6. <u>Headwalls, Wingwalls, and Aprons.</u>

All headwalls, wingwalls, and aprons used with drainage pipe, box culverts, and concrete channel lining shall be constructed of Class A concrete and to the lines and dimensions shown on the Plans and Design Standards or as directed by the Owner.

### 7. Sidewalk Drains.

Sidewalk drains shall be constructed to the dimensions and of the materials shown on the Plans and Design Standard or as directed by the Owner. Fillet welds shall be provided between the steel channels and steel plates as shown on the design Standard for Prefabricated Sidewalk Drain. Sidewalk drains shall be securely bedded on an earth subgrade at the same elevation and slope as adjacent sidewalk prior to pouring adjacent sidewalk. Concrete for sidewalk shall be placed uniformly on either side of the drain to prevent dislocation of the drain. Drains shall be held firmly in place by suitable means to prevent movement during placement of concrete. Sidewalk drains shall have positive drainage away from the drain. The drain shall be constructed through the curb and be terminated neatly and flush with the face of curb. Drains shall be placed with tread plate up and matching the sidewalk surface.

### D. <u>Precast Concrete Construction.</u>

1. Precast concrete manholes shall be neatly and accurately built according to the Plans or as directed by the Owner. All precast concrete manholes shall have a 10 inch concrete base

slab constructed of Class "A" concrete, shall be cast integrally with the base section and the inlet and outlet pipes as shown on the Design Standard. Precast concrete base shall not be used.

2. Precast concrete sections shall be set so the structure will be vertical and with sections in true alignment. Joint surfaces of the base or previously installed section shall have a flexible plastic gasket as described in Specification Section 02640 Paragraph 2.01.L installed in the recess after being primed with an asphaltic cement material recommended by the manufacturer. Each joint shall be completely filled with plastic gasket material on the inside and outside of the manhole after sections have been placed.

3. All holes in precast sections used for their handling and the annular space between the wall and entering pipes shall be thoroughly plugged with nonshrinking grout, applied so that there will be no leakage through openings and around pipes. The grout shall be finished smooth and flush with the adjoining interior and exterior manhole wall surfaces.

4. All precast concrete manhole cones shall be of eccentric construction as shown on the Plans. The access steps shall be located on the vertical wall and shall be aligned with the riser steps.

5. All flat top slabs on drain manholes shall have a minimum thickness of 8 inches and the manhole rim and cover shall be located eccentrically in slab as shown on the Plans.

### E. Test Specimens.

The Contractor shall furnish the concrete necessary for casting test specimens in the field. The City will supply all molds and labor necessary to cast and test the specimens. The Owner will designate the frequency of sampling the fresh concrete. The method of making and curing test specimens will be in accordance with AASHTO Designation T 23. Test cores shall be drilled by the Contractor at this expense if required by the Owner at locations selected by the Owner.

## PART 4 – MEASUREMENT

## 4.01 STANDARD DEPTH MANHOLES.

Standard depth manholes will be measured per each, for the various diameters and types less manhole rim and cover. Standard depth is defined as a manhole depth between 0 and 6 feet as measured vertically from the top of the manhole rim to the invert of the outlet drain.

### 4.02 EXTRA DEPTH MANHOLES.

Extra depth manhole will be measured per vertical foot from a point 6.0 feet below the top of the manhole rim to the invert of the outlet drain for the various diameters and type. Only manholes greater than 6.0 feet in depth will be considered for extra depth measurement.

## 4.03 INLETS.

A. <u>Standard Depth Inlets:</u> Inlets will be measured per each, for the various types less frame and grate.

B. <u>Extra Depth Inlets</u>: Extra depth inlets will be measured per vertical foot from a point 6.0 feet below the top of the inlet grate to the outlet drain. Only inlets greater than 6.0 feet will be considered for extra depth measurement.

### 4.04 MANHOLE RIMS AND COVERS.

Manhole rims and covers will be measured per each matching set consisting of one rim and one cover for the various types.

### 4.05 INLET FRAMES AND GRATES.

Inlet frames and grates will be measured per each set consisting of one frame and the required number of matching grates for one frame for the various types.

## 4.06 SIDEWALK DRAINS.

Sidewalk drains will be measured per pound of fabricated steel.

### 4.07 JUNCTION STRUCTURES

Junction structures will be measured per each including access shaft regardless of depth but not including manhole rim and cover or inlet frame and grate.

### 4.08 RADIUS STRUCTURES.

Radius structures will be measured per linear foot along the centerline of the structure from the face of the adjoining pipe section for the various types, widths, and heights.

### 4.09 HEADWALLS, WINGWALLS, AND SKIRTS.

Headwalls, wingwalls, and skirts will be measured per each for the various types.

### 4.10 STRUCTURE REMOVAL.

Removal of existing structures will be measured per each.

## 4.11 BACKFILL FOR STRUCTURE ABNANDONMENT.

Backfill for structure abandonment will be measured per tone of material placed.

## PART 5 – PAYMENT

## 5.01 STANDARD DEPTH MANHOLES.

The accepted quantities of standard depth manholes will be paid for at the contract unit price per each complete in place for the various diameters and types less rim and cover which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; placing and jointing precast sections; construction of steps and inverts; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation; and backfilling.

### 5.02 EXTRA DEPTH MANHOLES.

The accepted quantities of extra depth manhole will be paid for at the contract unit price per vertical foot complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; placing and jointing precast sections; construction of steps; cleaning and inspection, and backfilling.

### 5.03 INLETS.

A. <u>Standard Depth Inlets:</u> The accepted quantities of inlets will be paid for at the contract unit price per each complete in place for the various types less frame and grate which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; laying, plastering, protection and curing of brick work; construction of steps and invert; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation; and backfilling.

B. <u>Extra Depth Inlets:</u> The accepted quantities of extra depth inlet will be paid for at the contract unit price per vertical foot complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing protection and curing of concrete; laying, plastering, inspection, and backfilling.

### 5.04 MANHOLE RIMS AND COVERS.

The accepted quantities of manhole rim and cover will be paid for at the contract unit price per each complete in place for the various types which price will be full compensation for materials and materials' testing; setting rim and cover; protection and curing of mortar; and cleaning and inspection.

### 5.05 INLET FRAMES AND GRATES.

The accepted quantities of inlet frames and grates will be paid for at the contract unit price per each complete in place for the various types which price will be full compensation for materials and materials' testing; setting frames and grates; protection and curing of mortar; and cleaning and inspection.

### 5.06 SIDEWALK DRAINS.

The accepted quantities of sidewalk drains will be paid for at the contract unit price per pound of fabricated steel complete in place which price will be full compensation for materials; fabrication of channels and plates; setting of sidewalk drains; and cleaning and inspection.

### 5.07 JUNCTION STRUCTURES.

The accepted quantities of junction structures will be paid for at the contract unit price per each complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection, and curing of concrete; laying, plastering, protection and curing of brick work; construction of steps and inverts; construction of access shaft; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavations; and backfilling.

### 5.08 RADIUS STRUCTURES.

The accepted quantities of radius structures will be paid for at the contract unit price per linear foot complete in place for the various types, widths, and heights which price will be full compensation for materials testing; excavation; special protection; placing, protection, and curing of concrete; laying, plastering, protection and curing of brick work; construction of inverts; connection of inlet and outlet pipes; cleaning and inspection; removal and/or abandonment of existing pipe or structures within the limits of excavation; and backfilling.

## 5.09 HEADWALLS, WINGWALLS, AND SKIRTS.

The accepted quantities of headwalls, wingwalls, and skirts will be paid for at the contract unit price per each complete in place which price will be full compensation for materials and materials' testing; excavation; special protection; placing, protection and curing of concrete; connection to pipes, channel lining or structure; cleaning and inspection; and backfilling.

# 5.10 STRUCTURE REMOVAL.

The accepted quantities of structure removal will be paid for at the contract unit price per each, complete which price will be full compensation for excavation, special protection, protection of existing utilities, structure removal, disposal of debris, handling and delivery of salvage material, and backfilling.

### 5.11 BACKFILL FOR STRUCTURE ABANDONMENT.

The accepted quantities of sand for backfilling abandoned structures will be paid for at the contract unit price per ton furnished and placed which price will be full compensation for preparing the structure for abandonment; bulkheading inlet and outlet pipes; disposal of debris; furnishing and placing backfill material; compaction; and handling and delivery of salvageable material.

## 5.12 PAYMENT WILL BE MADE UNDER THE FOLLOWING ITEMS:

Item No.	Pay Item	<u>Pay Unit</u>
02640-01	STANDARD DEPTH MANHOLES	Each
02640-01.01	'Diameter Standard Depth Cast-in-Place Manhole (0' – 6' Deep) Less Rim and Cover	Each
02640-01.02	' Diameter Standard Depth Brick Manhole	Each

02640-01.03	(0' – 6' Deep) Less Rim and Cover ' Diameter Standard Depth Precast Concrete	Each
Item No.	Pay Item	<u>Pay Unit</u>
02640-02	EXTRA DEPTH MANHOLES	Vertical Foot
02640-02.01	' Diameter Extra Depth Cast-in-Place Manhole	Vertical Foot
02640-02.02	' Diameter Extra Depth Brick Manhole	Vertical Foot
02640-02.03	' Diameter Extra Depth Precast Concrete Manhole	Vertical Foot
02640-03 02640-03.01 02640-03.02 02640-03.03 02640-03.04 02640-03.05 02640-03.06 02640-03.07 02640-03.08 02640-03.09 02640-03.10 02640-03.11 02640-03.12 02640-03.13 02640-03.14 02640-03.15	INLETS 6-72 Inlet Less Frame and Grate Twin 6-72 Inlet Less Frame and Grate 3' x 3' Inlet Less Rim and Cover #S-11 Inlet Less Frame and Grate #11 Inlet Less Frame and Grate #10 Inlet Less Frame and Grate Extra Depth 6-72 Inlet Adjust 6-72 Inlet Extra Depth Twin 6-72 Inlet Extra Depth 3' x 3' Inlet Extra Depth #10 Inlet Extra Depth #11 Inlet Extra Depth #S-11 Inlet #3070 Inlet Less Frame/Grate Extra Depth #3070 Inlet	Each Each Each Each Each Each Vertical Foot Vertical Foot Vertical Foot Vertical Foot Vertical Foot Vertical Foot Vertical Foot Each Vertical Foot
02640-04	MANHOLE RIMS AND COVERS	Each
02640-04.01	No. 7A Manhole Rim and Cover	Each
02640-04.02	No. 7A-Alt. Manhole Rim and Cover	Each
02640-04.03	No. 6 Manhole Rim and Cover	Each
02640-05	INLET FRAMES AND GRATES	Each
02640-05.01	Tapered 6-72 Frame and Grate	Each
02640-05.02	Standard Adapter Frame for No. 6 and No. 6-72 Inlet	Each
02640-05.03	#11 Frame and Grate	Each
02640-05.04	#10 Frame and Grate	Each
02640-05.05	#12 Frame and Grate	Each
02640-05.06	3' x 3' Rim and Cover	Each
02640-05.07	#S-11 Frame and Grate	Each
02640-05.08	#3070 Frame and Grate	
02640-06	SIDEWALK DRAINS	Pounds
02640-07	JUNCTION STRUCTURES	Each
02640-08	RADIUS STRUCTURES	Linear Foot
02640-08.01	H" x W" Brick Radius Structure	Linear Foot
02640-08.02	H" x W" Cast-in-Place Radius Structure	Linear Foot
02640-09	HEADWALLS, WINGWALLS, AND SKIRTS	Each
02640-09.01	Type "A" Headwall	Each
02640-09.02	Type "B" Headwall	Each
02640-09.03	Type "C" Headwall and Spillway	Each
02640-09.04	Type "D" Headwall and Wingwalls	Each
02640-09.05	Type "E" Headwall and Wingwalls	Each

02640-09.06 02640-09.07 02640-09.08	Headwall as per Detail Wingwalls as per Detail Skirt as per Detail	Each Each Each
02640-10	STRUCTURE REMOVAL	Each
02640-11	BACKFILL FOR STRUCTURE ABANDONMENT	Ton

END OF SECTION 02640

## PART 1 – SCOPE

This work shall consist of furnishing and placing one or more courses of graded aggregate on a prepared subgrade in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-sections shown on the Plans or as directed by the Owner.

## PART 2 – MATERIALS AND EQUIPMENT

2.01 A. Aggregates for Graded Aggregate Base Course shall be crushed stone or crushed or uncrushed gravel together with such material as manufactured sand or other fine materials naturally contained or added thereto as needed to conform with one of the three gradations shown in the table below, as specified

Grading Table for Graded Aggregate Base Course Total Percent, by Dry Weight, Passing Each Sieve (U.S. Standard)

<u>Size No.</u>	<u>2 ½ "</u>	<u>2"</u>	<u>1 ½ "</u>	<u>1"</u>	<u>3/8"</u>	<u>No. 40</u>	<u>Clay*</u>
1	100	95-100			35-65	10-30	1-12
2		100	95-100		40-65	10-30	1-12
3			100	90-100	45-65	10-35	2-12

\* Clay content shall be determined by the Hydrometer Test – AASHTO T 88 4. Clay content may exceed 12 percent with the written permission of the Owner.

B. Mineral aggregate for graded aggregate base course shall consist of hard durable particles or fragments of stone or gravel and other finely divided mineral matter. Individual materials shall meet the requirements specified hereinafter.

### 1. Crushed Stone.

Crushed stone shall be free of silt and clay. The coarse aggregate portion of the stone shall have a percentage of wear of not more than 50, and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15).

### 2. <u>Gravel.</u>

Gravel shall be screened and all oversize material may be crushed and fed uniformly back over the screen. The coarse aggregate portion (retained on the No. 4 sieve) shall have a percentage of wear of not more than 50, and when subjected to five (5) alternations of the sodium sulfate soundness test, the weighted percentage of loss shall not exceed fifteen (15). The portion of the material passing the No. 40 sieve shall be nonplastic or shall have a liquid limit of not more than thirty (30) and a plasticity index of not more than eight (8).

C. If fine aggregate, coarse aggregate, or binder, in addition to that present in the base material, is needed in order to meet the gradation or density requirements or for satisfactory bonding of the material, it shall be uniformly blended with the base course material at the mixing plant by a mechanical feeder to maintain a uniform flow on the belt to the mixer. Blending of materials on the stockpiles or in the pits by bulldozer, clamshell, dragline, or similar equipment will not be permitted. The composite gradation of aggregate shall be the grading specified.

### 2.02 EQUIPMENT

All equipment necessary for the satisfactory performance of this construction shall be on the Project and approved before work will be permitted to begin. If mixing is required, an approved stationary twin shaft pugmill or a mechanical mixer (for road mixing) shall be included. Pneumatic-tire rollers as described in Specification Section 02335 Part 2 and motor graders shall also be included.

## PART 3 – CONSTRUCTION REQUIREMENTS

## 3.01 GENERAL

After the subgrade has been completed as specified in Specification Section 02335, aggregate shall be spread in one or more layers for one or more lane widths as directed by the Owner. It shall not be laid on a subgrade that is frozen or contains frost. Hauling over material already placed will not be permitted until it has been spread, mixed, shaped, and compacted.

### 3.02 MIXING

If mixing of two or more materials is required, one of the following types of mixing operations may be used:

### A. <u>Stationary Plant Method</u>.

The base course material shall be mixed in an approved stationary mixing plant. Water shall be added during the mixing operation in the amount necessary to provide a moisture content satisfactory for compaction.

### B. Road Mix Method (Mechanical Mixer).

After the material for the base course has been placed by an aggregate spreader or windrowsizing device, the material shall be mixed by means of an approved mechanical mixer (for road mixing). Water shall be added during mixing in the amount necessary to provide a moisture content satisfactory for compaction.

### C. Road Mix Method (Motor Grader).

1. After the material has been thoroughly mixed, it shall be spread while at the required optimum moisture content by means of approved motor graders.

2. If the required compacted depth of the base course exceeds six (6) inches, the base shall be constructed in two or more layers of approximate equal thickness, unless vibrating or other approved types of special compacting equipment is used. In such cases, the compacted depth of a single layer of base course may be increased to eight (8) inches upon approval by the Owner.

### 3.03 MANHOLE ADJUSTMENTS

Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be as specified in Specification Sections 02532 (sewer) and 02634 (drain). Manholes, valve boxes, and other utility structures not owned by the City but within the right-of-way of the Project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

### 3.04 SHAPING AND COMPACTION

A. Except where mechanical aggregate spreading equipment is used to place the base material, final shaping of each layer prior to compaction shall be accomplished by motor grader. In the event that mechanical spreading equipment fails to shape the base material properly, final shaping shall be done by motor grader or other approved means.

B. Immediately following spreading and final shaping, each successive layer shall be compacted with pneumatic-tire rollers described under Specification Section 02335 Part 2 and any other types of compacting equipment provided the required density and the required degree of uniformity and smoothness are attained. Compaction shall progress gradually from the edges of the base to the center, parallel with the centerline of the road, and shall continue until the base layer has been compacted to its full width. Where lifts of shoulder materials are placed to confine the base material, the initial pass of the compacting equipment shall overlap the shoulder to a width of not less than twelve (12) inches. In areas where rollers or other standard types of

compacting equipment cannot be used to compact the base due to surface interference of structures or other obstructions, hand operated vibratory equipment shall be used to obtain the required density.

C. Compaction of each layer shall continue until an average dry density of not less than 100 percent of theoretical density based upon 83 percent of a solid volume has been achieved. Further, no individual test shall be less than 97 percent of theoretical density. The density determination will be based on the bulk specific gravity, AASHTO T 84 and T 85 and the dry weight of the aggregate. The compaction of each layer shall be approved before material for the next successive layer is placed. Placing and compacting areas shall be kept separate.

D. Unless otherwise specified, the above described density requirements will not apply to base construction on projects that do not include the construction of a surface upon the base, nor to projects which have a specified total base thickness less than four (4) inches. When the specified density requirements do not apply, the desired degree of compaction will be considered to have been reached when the surface is tightly bound and shows no rutting or displacement under operation of the roller or other construction equipment.

E. At the direction of the Owner, the desired degree of compaction may be considered to have been reached for any graded aggregate base construction when the surface is tightly bound and does not show evidence of pumping under operation of a motor grader and/or there is no rutting or displacement under operation of a roller or other selected construction equipment. The other selected construction equipment used to check the desired degree of compaction for any graded aggregate base shall be a loaded tandem dump truck, with a minimum of ten (10) tons weight. The degree of compaction may be considered to be reached when aggregate base does not show evidence of pumping, rutting or displacement, under the weight of said truck, when driven over the base at slow speed. This is to be done in the presence of the inspector prior to the placement of finished surface.

F. The surface of each layer shall be so constructed that the aggregates become firmly keyed and a uniform texture produced and shall be maintained in that condition until covered by the following stage of construction or until final acceptance of the project. Any irregularities that develop shall be corrected by loosening the material at those places and adding or removing material as required.

G. Approved distributors shall be used to apply water uniformly over the base materials during compaction in sufficient quantity for proper compaction. Softening of the underlying subgrade resulting from use of excess water is to be avoided.

### 3.05 MAINTENANCE

After construction of the base has been completed satisfactorily, it shall be maintained, under traffic if required, smooth and uniform until covered by the following stage of construction or until the project has been completed and accepted.

### 3.06 THICKNESS REQUIREMENTS

The thickness of the completed base shall be in conformity with the thickness shown on the Plans. The thickness shall be measured at such frequency as established by the Owner by means of test holes or other approved methods.

### 3.07 SURFACE REQUIREMENTS

The surface of the finished base shall conform to the lines, grades and cross-sections shown on the Plans or established by the Owner and shall have a satisfactorily smooth riding quality.

## PART 4 – MEASUREMENT

### 4.01 GRADED AGGREGATE BASE COURSE

Measurement will be by the square yard, compacted in place at specified thickness.

4.02 GENERAL

A. Subgrade preparation for the placing of base courses will be considered a part of the work for providing Graded Aggregate Base Course except where gravel for backfill or subgrade stabilization or cement for back fill or subgrade stabilization is required. In such cases, payment will be made in accordance with Specification Section 02335, Payment Items 02335-03 or 02335- 04.

B. Water used for compaction will not be measured for payment since it is considered incidental to the completion of the work.

C. Water for dust control when ordered by the Owner will be measured and paid for in accordance with Specification Section 02335, Payment Item 02335-05

D. Manhole adjustments will be measured and paid for in accordance with Specification Section 02532 (sewer), Payment Item 02532-01 or Specification Section 02634 (drain), Payment Item 02634-01.

## PART 5 – PAYMENT

### 5.01 GRADED AGGREGATE BASE COURSE

The accepted quantities will be paid for at the contract unit price per square yard for the specified thickness, which price will be full compensation for furnishing, mixing, spreading, and compacting the aggregate, complete in place.

5.02 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02720-01 02720-01	Graded Aggregate Base Course, " Thickness	Square Yard

## END OF SECTION 02720

## PART 1 – SCOPE

This work shall consist of constructing a pavement of portland cement concrete as specified, on a prepared subgrade or subbase, in accordance with these Specifications and in conformity with the lines, grades and typical cross-sections shown on the Plans or as directed by the Owner.

# PART 2 - MATERIALS AND EQUIPMENT

### 2.01 MATERIALS

A. <u>Concrete</u>. Materials shall meet the requirements of Specification Section 03050 for Portland Cement Concrete Class B.

#### B. Steel Wire Fabric, Dowel Bars, and Tie Bars

1. Fabric for reinforcement shall conform to ASTM A 185, or as indicated on the Plans.

Dowel bars shall be plain and shall conform to the requirements of ASTM A 306, Grade
Corrosion resistant coated dowels shall meet the requirements of AASHTO M 254.

3. Tie bars shall be billet steel bars conforming to the requirements of ASTM A 615. Tie bars that are to be bent in the course of construction shall be of such quality that they may be straightened after bending without breaking.

### C. Curing Materials

1. <u>Water</u>: Water used in curing portland cement concrete shall be free from any substance which may be injurious to concrete when applied to the surface as a curing agent.

2. <u>Burlap</u>: Burlap shall conform to AASHTO M 182, Class 3 or Class 4. If Class 1 or Class 2 burlap is permitted, at least two layers shall be used.

- 3. <u>Cotton Mats:</u> Cotton mats shall conform to AASHTO M 73.
- 4. <u>Waterproof Paper:</u> Paper for curing shall conform to AASHTO M 139.

5. <u>Liquid Membrane – Forming Compounds:</u> These compounds shall conform to AASHTO M 148, Type 2.

6. <u>White Polyethelene Sheeting:</u> This material shall conform to AASHTO M 171.

7. <u>Linseed Oil:</u> Linseed oil emulsion curing compound shall conform to Federal Specification TC 800 A or U.S. Army Corps of Engineers Specification CRD-C-302-68.

### D. <u>Preformed Joint Fillers (Nonextruding and Resilient)</u>

1. Preformed fillers for joints shall be of the bituminous type unless otherwise specified on the Plans and, when required, shall be punched to admit dowels. Bituminous type preformed fillers for joints shall conform to the requirements of AASHTO M 213.

2. If nonbituminous types are specified, they shall conform to the requirements of AASHTO M 153, Type 3, unless otherwise specified.

3. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise allowed by the Owner. When splicing is necessary and authorized, the abutting ends shall be fastened securely and held accurately in position by stapling or other positive fastening satisfactory to the Owner.

### E. Chemical Additives

1. Chemical additives such as water reducing, set retarding, set accelerating, or combination admixtures shall conform to the requirements of AASHTO M 194. No chemical additive will be used unless ordered or permitted by the Owner in writing, and no reduction in the cement content of the concrete as designed without chemical additives will be made when additives are permitted.

2. Air-entraining admixtures shall be used as specified in Specification Section 03050.

### F. Joint Sealants

1. Type I shall be preformed elastomeric compression joint seals with lubricant adhesives. Seals shall be of the open cell compression type. All materials shall conform to the requirements of AASHTO M 220.

2. Type II sealants shall be hot poured elastic type concrete joint sealer. This sealer shall conform to the requirements of AASHTO M 173 with the following exceptions:

a. The joint sealer shall be a mixture of virgin synthetic rubber or reclaimed rubber or a combination of the two with asphalt and plasticizers and tacifiers.

- b. Ground cured rubber scrap shall not be used.
- c. The sealer shall be free of foreign material and when melted shall be free of lumps.

d. The Contractor shall furnish the Owner a certified statement showing compliance with the above composition.

3. The flow at  $140^{\circ}$  F shall not exceed 1.0 centimeter in 5 hours. Ductility at  $77^{\circ}$  F shall be not less than 40 centimeters, when tested in accordance with AASHTO T 51.

4. The Contractor shall furnish the Owner a certified copy of the test results, showing the batch number, indicating that the material supplied conforms to the requirements of the Specifications.

### G. Proportioning

1. Class B concrete for concrete pavement will be a workable, well mixed concrete proportioned in accordance with Specification Section 03050.

### 2.02 EQUIPMENT

Equipment and tools necessary for handling materials and performing all parts of the Work shall be approved by the Owner as to design, capacity, and mechanical condition. All equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly by the Owner and approved.

### A. Forms

1. Straight side forms shall be made of metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth at least equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to not less than the depth of the forms. Flexible or curved forms of the proper radius shall be used for curves. Flexible or curved forms shall be of a design acceptable to the Owner. Forms shall be provided with adequate for secure setting so that

when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the face of the form shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly and for secure setting. Metal pins shall be of proper size and length to hold the forms rigidly and securely in place.

2. Built-up forms shall not be used except when approved by the Owner and shall have a minimum base width of 8 inches.

3. Forms with battered top surfaces and bent, twisted, or broken forms shall be removed from the Work. Repaired forms shall not be used until inspected and approved by the Owner.

4. The supply of forms, provided and maintained in satisfactory condition, shall not be less than that required for a full day's run.

### B. Spreading and Finishing Equipment

1. <u>Mechanical Power-Driven Spreader</u>: Equipment shall include a mechanical powerdriven spreader capable of uniformly spreading the concrete in front of the finishing machine. The mechanical finishing machine shall be equipped with at least 2 oscillating type transverse screeds.

2. <u>Vibrators:</u> Vibrators for full width and full depth vibration of concrete paving slabs shall be multiple spuds or other types approved by the Owner. They may be attached to the spreader or the finishing machine or may be mounted on a separate carriage. The frequency of the vibrators shall be that recommended by the manufacturer, subject to approval of the Owner. The Contractor shall furnish the Owner the manufacturer's recommendations for installing and operating the vibrators.

3. <u>Longitudinal Floats:</u> The mechanical longitudinal float shall be of a design approved by the Owner, and shall be in good working condition. It shall be so constructed as to provide for accurate adjustment to the required crown.

4. <u>Bridges:</u> The contractor shall furnish individual bridges as required by the Owner.

5. <u>Finishing Straightedge:</u> Straightedges, not less than 2, with handles at least 3 feet longer than 1/2 the width of the slab, shall be constructed of light metal; shall be not less than 10 feet long; and shall be maintained clean and straight.

6. <u>Straightedge Templates:</u> Straightedge templates, not less than 2, shall be provided for testing the completed surface. They may be of wood or metal; shall not be less than 12 feet long; and shall be maintained clean, straight, and free from warp.

7. <u>Water Supply Equipment:</u> Water supply equipment shall include pumps or tanks mounted on trucks, of adequate capacity to furnish more than sufficient water to accommodate the construction and at the required and necessary pressure. A pipe line appropriate to the requirements of the construction may be used.

8. <u>Small Tools:</u> Small tools, such as edgers, trowels, hand floats, and brushes shall be such as will produce the results required.

9. <u>Special Equipment and Tools:</u> Equipment and tools necessary for the construction of special features as indicated on the Plans shall be such as will produce the results required.

10. <u>Transverse Grooving Equipment:</u> Mechanical transverse grooving equipment shall consist of a steel tine comb with a minimum width of 6 feet, a vibrating beam roller, or other approved devises.

### 11. Concrete Saw:

a. When sawed joints are elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. The saws shall be equipped with water cooled diamond edge blades or abrasive wheels. Saws used for sawing longitudinal joints shall be equipped with guides to assure proper alignment of the joints.

b. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

### C. Slip Form Paver

1. The slip form paver, if used, shall be an approved self-propelled type equipped with a crawler type track of sufficient area to prevent track slippage under load. Length of ground contact per track and arrangement of track units shall be adequate to insure the established straightedge tolerance. When this method of construction is used, all provisions and requirements of the Specifications which are not in conflict shall be applicable.

2. Pavement alignment shall be controlled by means of an electronic sensing device in continuous contact with a sensing guide. The Contractor shall furnish equipment with electronic controls for the vertical adjustment of the paver strike-off and finishing components. Electronic controls, sensing devices, and sensing guides shall be furnished, installed, and maintained at the expense of the Contractor.

3. When a slip form paver is to be used the concrete shall have sufficient cohesion to prevent appreciable slumping of the pavement edges. When the concrete will not meet these requirements, production shall be stopped or slowed, and corrections to the mix shall be immediately made.

4. The slip form paver shall be designed to spread, consolidate, screed, and float finish the 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. The machine shall vibrate the concrete for the full width and depth being placed. The vibration shall be accomplished internally by vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The slip form paver shall be equipped with forms of sufficient length and rigidity to adequately support the edges of the slab so as to permit any necessary hand finishing and the installation of joints when joints are required.

5. The paver shall be operated with a continuous forward movement, and all operations of mixing, delivering, and spreading the concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately.

6. Surface smoothness and texture shall meet the requirements of Specification Section 02750 Paragraphs 3.09 and 3.10 except that a longitudinal straightedge tolerance of 1/4 inch in 10 feet will apply to the area within 6 inches of the edge of the pavement.

7. An edge slump of 1/2 inch will be permitted, except that where additional concrete pavement is to be placed adjacent to the edges the edge slump shall be not more than 1/4 inch.

8. The Contractor shall have available at all times materials for the protection of the edges of the unhardened concrete. Such protective materials shall consist of either standard metal forms or wood plank having a nominal thickness of not less than 2 inches. The depth of the forms of plank shall not be less than the thickness of the pavement. When rain appears imminent, all paving operations shall stop, and all available personnel shall assist in placing forms against the sides of the pavement in addition to placing a covering over the surface of the unhardened concrete.

## PART 3 – CONSTRUCTION REQUIREMENTS

## 3.01 SUBGRADE PREPARATION

Subgrade preparation shall be performed as provided for under Specification Section 02335 Paragraph 3.03.

### 3.02 CONSTRUCTION OF BASE

Base, when called for on the Plans, shall be constructed in accordance with the provisions of the applicable portions of Specification Sections under 02700, Bases, Ballasts, Pavements, and Appurtenances, and shall be completed not less than 500 linear feet in advance of paving. The Contractor shall construct or correct the base to such grade tolerances as will insure the concrete pavement thickness required. The base grading machine and slip form paver shall be equipped with automatic line (guidance) and grade controls.

### 3.03 SETTING FORMS

A. <u>Base Support:</u> The foundation under the forms shall be firm and true to grade so that each form, when set, will be firmly in contact for its whole length and at the specified grade. Any grade at the form line found below established grade shall be filled to grade with suitable material in lifts of 1/2 inc or less for a distance of 18 inches on each side of the base of the form and thoroughly compacted. Any grade at the form line found above grade shall be corrected by tamping or by cutting as necessary. Pedestals of earth or other material upon which to rest the forms to bring them to grade will not be permitted.

B. <u>Form Setting:</u> Forms shall be set and approved for the placing of concrete in advance of the point where concrete is being placed as approved by the Owner. After the forms have been set to correct grade, the material supporting the forms shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than three pins for each 10 foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked and free from play or movement in any directions. The forms shall not deviate from true line by more than 1/4 inch at any point. Forms that settle or spring under the spreading and finishing equipment shall be reset or removed as directed. The top and face of forms shall be cleaned and oiled prior to the placing of concrete.

C. <u>Grade and Alignment:</u> The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

### 3.04 CONDITIONING OF SUBGRADE OR BASE

A. After the forms have been set and approved, the subgrade or base shall be brought to proper grade and cross-section. High areas shall be trimmed. Low areas in subgrade or base may be filled with subgrade or base materials, respectively, and compacted to correspond with the

surrounding areas, except that low areas in cement treated bases shall be filled with concrete integral with the pavement.

B. Unless waterproof cover is specified, the subgrade shall have been previously wetted and shall be in a moist condition at the time of placing concrete. If it subsequently becomes dry previous to the actual placing of the concrete, it shall be sprinkled, but the formation of pools of water shall be avoided. The subgrade shall not be muddy or soft.

C. In addition to all applicable provisions mentioned previously, the slip form method of paving shall required that the subgrade or base be placed and compacted to the required density and to a width beyond the pavement limits sufficient to support all paving equipment. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately prior to the placing of the concrete.

### 3.05 MIXING LIMITATIONS AND PLACING CONCRETE

A. <u>Mixing Limitations:</u> Limitations of mixing of concrete due to weather shall be in accordance with the limitations specified in Specification Section 03050 Paragraph 5.02, "Limitations on Concrete Operations".

## B. Placing Concrete

1. The concrete shall be unloaded into an approved spreading device, or deposited on the subgrade or subbase, and spread in such manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it will require as little re-handling as possible.

2. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or other foreign substances.

3. Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall meet the requirements for opening to traffic stipulated in Specification Section 02750 Paragraph 3.15. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 7 days.

4. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 5 seconds in any one location.

5. The use of hand operated vibrators will be permitted. Vibrators mounted on a machine shall be operated only while the machine is in motion.

6. Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

7. Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately.

### 3.06 TEST SPECIMENS

The Contractor shall furnish the concrete necessary for casting test specimens in the field. The Owner will supply all molds and labor necessary to cast and test the specimens. The Owner will designate the

frequency of sampling the fresh concrete. The method of making and curing test specimens will be in accordance with AASHTO T 23. Test cores shall be drilled by the Contractor at his expense if required by the Owner at locations selected by the Owner. When so directed, test cores shall be taken at a rate of one core per unit, with one unit defined as a poured lane or lanes 1,000 feet in length, a street intersection, an interchange ramp, or small areas such as crossovers and entrances of 1,000 square yards or less.

## 3.07 STRIKE-OFF OF CONCRETE AND STEEL FABRIC PLACEMENT

A. Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be in conformity with the elevation shown on the Plans or established by the Owner. When steel fabric reinforced concrete pavement is placed in 2 layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric may be laid full length on the concrete in its final position without further manipulation. The steel fabric shall be placed in strips transversely with the roadway at the depth and with the lap shown on the Plans. The fabric shall extend to within 2 inches of the ends and sides of the slab. The reinforcement shall be placed directly upon the concrete, after which the top layer of the concrete shall be placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

B. Reinforcing steel fabric shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which could impair bond of the steel with the concrete.

### 3.08 JOINTS

A. Joints shall be constructed of the type and dimensions and at the locations required by the Plans and in accordance with the provisions of these Specifications.

B. Longitudinal joints shall be perpendicular to the pavement surface and shall be along or parallel to the centerline of the pavement, unless otherwise specified. Transverse joints shall be straight, perpendicular to the pavement surface and, unless otherwise specified, shall be at right angles to the centerline of the pavement.

### C. Longitudinal Joints

1. Deformed steel tie bars of specified length, size, spacing, and materials shall be placed across and perpendicular to the longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chars or other approved supports to prevent displacement.

2. When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint of the first lane constructed by the use of one of the alternate metal center strip types as detailed on the Plans, or as directed by the Owner. Tie bars may be bent at right angles against the form and straightened into final position before the concrete of the adjacent lane is placed, or they may be placed in holes drilled through the forms. Construction joints shall be tooled to a 1/4 inch radius during finishing operations and later sawed as detailed on the Plans or as directed by the Owner.

3. Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width, and line shown on the Plans, or as directed by the Owner, not later than 10 days after placing concrete and before any equipment or vehicles are allowed on the pavement.

4. Inserts that are to be sawed shall be an approved rigid material of the thickness and width shown on the Plans or as directed by the Owner, with a length equal to one-half the

pavement width for transverse joints and not less than 10 feet for longitudinal joints. Insert material that cracks, shatters, warps during installation, or that leaves a residue from sawing that will prevent seal material from adhering to the concrete will not be acceptable.

5. After the concrete has sufficiently set, the insert shall be sawed to the width and depth shown on the Plans or as directed by the Owner, leaving the remainder of the insert in place.

6. Immediately after sawing, all longitudinal contraction and construction joints shall be thoroughly cleaned of all residue by flushing with water under pressure.

7. As an alternate to sawing, the longitudinal contraction joints may consist of forming the joints by placing a permanently installed continuous strip of polyethylene sheeting having a minimum thickness of 10 mils (0.010 inches) and a width equal to 1/3 of the total thickness of portland cement concrete being placed. The joint material shall be such that it will not react adversely with the chemical constituents of the concrete.

8. The joint insert material shall be such that when placed perpendicular to the pavement surface, it will not bond with the concrete and will form an effective weakened plane joint of the specified depth. The joint material shall be inserted with an approved mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in the joint material will be permitted provided they are effective in maintaining the continuity of the joint material as placed. The joint material shall be placed in such manner that the top of the strip is not more than 1/4 inch below the finished surface of the concrete. The joint material shall not be deformed from a position perpendicular to the surface, either in the installation or in subsequent finishing operations performed on the concrete. The mechanical installation device shall vibrate the concrete during placing the strip sufficiently to cause the concrete to flow evenly about the joint material producing homogeneous concrete free of segregation and rock pockets or voids. The alignment of the finished joint shall meet the approval of the Owner.

### D. <u>Transverse Expansion Joints</u>

1. Dowels shall be prepared and placed across transverse expansion joints as indicated on the Plans or as directed by the Owner.

2. Dowels shall be held in position, parallel to the surface and centerline of the slab, by an approved metal device that is left in the slab. Dowels that are not corrosion resistant shall be painted with on coat of approved primer. When the paint has dried and immediately before placing the dowel in position, the dowel shall be thoroughly coated with a thick film of heavy grease. Bond breaker for corrosion resistant dowels shall be a s recommended by the coating manufacturer. One end of each dowel shall be covered with a close fitting, closed end metal sleeve, no less than 4 inches long, with a flange or other approved device to separate the end of the sleeve and the end of the dowel during the placing of the concrete so that a space of not less than the proposed thickness of the joint plus 1/4 inch will be provided for subsequent movement of the dowel in the sleeve. The type of metal sleeve to be used on the dowel bars shall meet the approval of the Owner. Dowels shall have ends free from burrs and distortions.

3. Transverse expansion joints shall be of the kind and type shown on the Plans or as directed by the Owner. When pre-molded joint filler is used, it shall be installed by the use of one of the alternate expansion joint and dowel assembly devices shown on the Plans, or other approved expansion joint assemblies may be used. The installing device shall have a length 1/2 inch less than the width of the slab. Assemblies shall be a rigid metal device capable of holding dowels and filler firmly in position during the entire construction operation and shall remain in place. The top of the filler shall be set below the surface of the proposed slab to accommodate the type sealant specified, as detailed on the Plans or directed by the

Owner. When in position, the filler shall be perpendicular to the surface of the slab. The top edge of the filler shall be protected, while the concrete is being placed, by an approved metal channel cap. The assembly device may be designed with this cap self-contained.

### E. <u>Transverse Contraction Joints</u>

1. Transverse contraction joints shall be placed at the intervals specified and shall be of the plain sawed groove or insert and sawed groove type, as detailed on the Plans or as directed by the Owner and in accordance with these Specifications.

2. Formed contraction joints shall not be used unless specified or required by the Owner to control random cracking. Unless otherwise directed or shown on the Plans, all joints shall be at right angles to the centerline of the pavement and perpendicular to the surface. When called for on the Plans or directed by the Owner, contraction joints shall include load transfer assemblies.

3. In lieu of using dowel assemblies at contraction joints, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Owner.

### 4. <u>Sawed Contraction Joints</u>

a. Sawed contraction joints shall be made by sawing grooves in the surface of the pavement of the dimensions shown on the Plans.

b. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling – usually 6 to 12 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. The sawing of a joint shall be discontinued when a crack develops ahead of the saw. In general, all joints shall be sawed in sequence.

c. All contraction joints in lanes adjacent to previously constructed lanes shall be sawed before uncontrolled cracking occurs. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, a contraction joint groove shall be formed at intervals of every third or fourth joint or as often as required prior to initial set of concrete as provided for under paragraph 4.d below. Immediately after sawing, the joints shall be thoroughly cleaned of all residue by flushing with water under pressure.

- 5. <u>Transverse Contraction Joints:</u> Transverse contraction joints made by the insert and sawed groove method shall comply with the applicable requirements of Specification Section 02750 Paragraph 3.08 C for the longitudinal contraction joint.
- 6. <u>Formed Contraction Joints:</u> Formed contraction joints shall be formed during the placing of the concrete. These joints shall be formed by placing inserts in the plastic concrete, at right angles to the centerline of the pavement and perpendicular to the surface. When the concrete has attained its initial set and after the joint has been carefully finished, the insert shall be removed. The groove so formed shall maintain its full width and depth as shown on the Plans, and the pavement at the joint shall meet surface requirements.

### F. <u>Transverse Construction Joints</u>

1. Transverse construction joints shall be constructed as detailed on the Plans. Grooves shall be formed by one of the methods specified under Paragraph 3.08 E.4 or E.5 of this Specification Section. The joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within

10 feet of an expansion joint, contraction joint, or plane 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 joint shall be removed and disposed of as directed.

### G. Expansion Joints at Structures

1. Expansion joints shall be formed about all structures and features projecting through, into, or against the slab by the use of pre-molded joint filler. Unless otherwise indicated such joints shall be 1/2 inch in width.

## 3.09 FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING

### A. <u>Sequence</u>

1. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straightedging, and final surface finish.

### B. Finishing at Joints

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material and under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement.

2. After the concrete has been placed and vibrated adjacent to the joints as required in Specification Section 02750 Paragraph 3.05, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed from in front of and off the joint; the front screed shall be lifted and set directly on top of the joint, and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregation in the concrete immediately between the joint and the screed or on top of the joint.

### C. Machine Finishing.

1. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been spread, it shall be struck off and screeded by an approved finishing machine meeting the requirements specified under Specification Section 02750 Paragraph 2.02 B. When the pan-float finisher combination machine is used for finishing the pavement, longitudinal floats will not be required. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish.

2. During the first pass of the finishing machine, a uniform roll of concrete shall be maintained ahead of the front screed for its entire length. The moving of rolls of concrete in excess of 6 inches with the finishing machine will not be permitted.

3. Vibrators, for full width and depth vibration of concrete paving slabs, shall meet the requirements specified in Specification Section 02750 Paragraph 2.02 B. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along
forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce satisfactory work.

## D. Hand Finishing

1. Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

b. Ramps and variable width sections, where the use of finishing machines is impractical, may be finished by hand methods.

2. When hand finishing is permitted, the concrete as soon as placed shall be struck off and screeded. The screed shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design and sufficiently rigid to retain its shape.

3. Consolidation shall be attained by the use of a suitable vibrator and other approved equipment.

4. Screeding shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

## E. <u>Floating</u>

1. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated, using one of the following methods as specified or permitted:

a. <u>Hand Method</u>: When hand finishing is permitted as provided for under Specification Section 02750 Paragraph 3.09 D, the Contractor shall use equipment and methods approved by the Owner.

b. <u>Mechanical Method</u>: The mechanical float described under Specification Section 02750 Paragraph 2.02 B.3 shall be used unless otherwise specified. The tracks from which the float operates shall be accurately adjusted to the required cross-section. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the Owner on each transverse trip. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

### F. <u>Straightedge Testing and Surface Correction</u>

1. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness. For this purpose the Contractor shall furnish and use and accurate metal straightedge, not less than 10 feet in length, swung from handles at least 3 feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline, and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than one-half the length of the straightedge. Any depressions found shall be immediately filled

with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross-section.

2. When in the opinion of the Owner, superficial water is required to assist in finishing, it shall be applied by lightly fogging.

3. Straightedging shall be followed by belting with an approved belt or hose. Belts shall not be permitted to rest on the pavement.

### G. Final Finish

1. The surface texture shall be a burlap drag finish. The drag shall consist of a seamless strip of damp burlap which, when dragged longitudinally along the full width of pavement, will produce a uniform surface of gritty texture. For pavement 24 feet or more in width, the drag shall be mounted on a bridge. The dimensions of the drag shall be such that a strip of burlap at least 3 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap 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 substituted.

2. After the pavement has been finished by the burlap drag, the surface shall be textured by the formation of transverse grooves. The transverse grooves shall be formed by mechanical equipment using a comb made of steel tines, vibrating beam roller, or other approved device. Manual tools such as rakes with spring steel tines may be used on areas inaccessible to mechanical equipment.

3. The grooves shall be formed in the concrete at an appropriate time during the setting of the concrete mixture, so that in the hardened concrete, the grooves will be between 0.09 inch and 0.13 inch in width, between 0.12 inch and 0.19 inch in depth, and will be spaced at random intervals between 0.3 inch and 1.0 inch.

4. Regardless of the method used to form the grooves, the grooves shall be relatively smooth and uniform and shall be formed without excessive tearing of the surface or without bringing pieces of the coarse aggregate to the top of the surface.

5. In the event of mechanical failure or equipment breakdown, manual tools may be used for grooving, provided all placing operations cease until proper repairs are made.

6. Any individual areas of 50 square yards or larger of the hardened grooved concrete which do not conform to these requirements shall be corrected at the Contractor's expense, by the cutting of acceptable grooves in the hardened surface with an approved cutting machine, or by other approved methods.

### H. Edging at Forms and Joints

1. After the final finish, but before the concrete has taken its initial set, the outside edges of the pavement shall be rounded to a 3/4 inch radius. When pavement is formed along a lane line, the edges shall be rounded to a 1/4 inch radius. The edges of the pavement on each side of transverse expansion joints, formed joints, and transverse construction joints shall be rounded to a 1/4 inch radius. Edging shall be performed with an approved edging tool which

will produce a well defined and continuous radius. All tool marks formed by the edging tool shall be eliminated by brushing to form a texture similar to the burlap drag finish.

# 3.10 SURFACE TEST

A. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 12 foot steel straightedge provided by the Contractor or other specified device. When the straightedge is placed parallel to the centerline of the pavement, the surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch, but not exceeding 1/2 inch in 12 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation where the area will not show surface deviations in excess of 1/8 inch when tested with a 12 foot straightedge. The ground area shall then be sealed with an epoxy resin system meeting the requirements of AASHTO M 200, Class I, as approved by the Owner. Grinding and sealing shall be at the Contractor's expense. Where surface deviation exceeds 1/2 inch, the pavement shall be removed and replaced by and at the expense of the Contractor.

B. Any area or section removed shall be not less that 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.

## 3.11 CURING

A. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide a sufficient quantity of one of the curing materials described under Specification Section 02750 Paragraph 2.01 C or lack of water to adequately take care of both curing and other requirements shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than one-half hour between stages of curing or during the curing period. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods.

1. <u>Cotton or Burlap Mats:</u> The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that, as laid, they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

2. <u>Waterproof Paper</u>: The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at leas 18 inches. The paper shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimensions that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or it shall be of pavement width with 3 foot strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be cemented together in such a manner that the joints do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. Impervious Membrane Method

a. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mats. The curing compound shall not be applied during rainfall.

b. Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but in no case at a rate less than one gallon to each 150 square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within a 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

c. Upon removal of side forms, the sides of the slabs exposed shall be protected immediately by applying curing treatment equal to that provided for the surface.

4. <u>White Polyethylene Sheeting:</u> The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. The surface of the pavement shall be thoroughly wetted prior to placing the sheeting. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

### 5. <u>Curing in Cold Weather</u>

a. Concrete pavement that is placed during cold weather, when the air temperature in the shade, away from artificial heat, is or may be expected to drop below 35° F, shall be protected by suitable blanket material placed over the surface and sides of the slab to sufficient depth to prevent freezing of the concrete. Care shall be taken during application of the blanket material not to mar the surface of the concrete. The period of time such protection shall be maintained shall be not less than 5 days.

b. The Contractor shall be responsible for the quality and strength of concrete laid during cold weather, and any concrete injured by freezing action shall be removed and replaced at this expense.

## 3.12 REMOVING FORMS

A. Forms may be removed at any time that removal does not cause damage to the slab edges. The forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above. Major honeycombed areas will be considered as defective work, and all unsound material shall be removed and replaced with satisfactory material at the Contractor's expense.

## 3.13 SEALING JOINTS

A. Joints shall be sealed with one of the joint sealing materials specified in Specification Section 02750 Paragraph 2.01 F before the pavement is opened to traffic and as soon after completion of

the curing period as is feasible. The pavement temperature shall be that recommended by the manufacturer of the sealant. Just prior to sealing, each join shall be thoroughly cleaned of all foreign material, including membrane curing compound, by sandblasting. The joint faces shall be clean and dry when the seal is applied. The sealant shall be applied to the joint immediately after cleaning.

B. The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the Owner. The sealing shall be done in such manner that material will not be spilled on the exposed surface of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

C. Sealing material that does not bond to the concrete shall be removed, and the joint recleaned and resealed to the Contractor's expense.

D. All random cracks shall be reamed with a suitable tool and filled with an approved liquid joint sealant.

# 3.14 PROTECTION OF PAVEMENT

A. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, barricades, lights, pavement bridges or crossovers.

B. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

## 3.15 OPENING TO TRAFFIC

The Owner will determine when the pavement will be opened to traffic. The pavement will not be opened to traffic until test specimens have attained the strength specified in Specification Section 03050. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete is placed. Prior to opening to traffic, the pavement shall be cleaned and all joints shall be sealed.

## 3.16 MANHOLE ADJUSTMENTS

Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be a specified in Specification Section 02530 or 02630 as appropriate. Manholes, valve boxes, and other utility structures not owned by the City but within the right-of–way of the project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

# 3.17 TOLERANCE IN PAVEMENT THICKNESS

Deficiencies in pavement thickness will be determined and payment made in accordance with the provisions of Specification Section 02710.3 Paragraph 3.06, "Tolerance in Base Thickness".

# PART 4 – MEASUREMENT

# 4.01 PORTLAND CEMENT CONCRETE PAVEMENT

Concrete pavement will be measured by the square yard, in place at specified thickness.

### 4.02 GENERAL

A. Dowel bars and assembly devices, reinforcing fabric, tie bars, curing materials, joint fillers, preparing and sealing joints, and any chemical additives used will not be measured for payment, as these items are considered incidental to the work.

B. Manhole adjustments will be measured and paid for in accordance with Pay Item 02530-01 or 02630-01.

## PART 5 – PAYMENT

#### 5.01 PORTLAND CEMENT CONCRETE PAVEMENT

Cement concrete pavement will be paid for at the contract unit price per square yard, which price will be full compensation for preparing the subgrade, forming, furnishing, consolidating, curing the concrete, provision of all items identified in Specification Section 02750 Paragraph 4.02, and maintaining the pavement until final acceptance, complete in place.

## 5.02 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02750-01 02750-01	Portland Cement Concrete Pavement " Thickness	Square Yard Square Yard

## END OF SECTION 02750

# PART 1 - SCOPE

1.01 Pavement markings are painted or plastic markings applied to the street surface for regulating, warning, or guiding traffic on the street. The work covered by this section shall consist of furnishing and supplying pavement markings in accordance with these Specifications and the latest revision of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) published by the Tennessee Department of Transportation and in conformity with the lines, dimensions, patterns, locations, and details shown on the Plans or established by the Owner.

1.02 This Section describes the general and specific requirements for conventional and rapid dry pavement marking paint, reflective hot plastics, reflective cold preformed plastics, pliant polymer film, sheeting or tape, powder pavement marking materials, glass beads for reflective pavement marking paint and plastics, and raised reflective pavement markers used by the City in its pavement marking program.

# PART 2 - MATERIALS AND EQUIPMENT

The methods of sampling and testing all materials and products covered by this specification shall be in accordance with the latest standards of the American Society for Testing Materials, the American Association of State Highway and Transportation Officials, the Federal Government, or of other recognized standardizing agencies as indicated for each material.

### 2.01 MATERIALS

A. Conventional Reflective Pavement Marking Paint (Type "A" Paint).

This describes the general and specific requirements for reflective pavement marking paints to be used by the City in its pavement marking program. This covers ready mixed paint products of spraying consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavements. The paint type relative to drying time hereinafter shall be referred to as conventional paint – over 3 minutes drying time (requiring line protection devices).

- 1. General Properties.
  - a. Condition and Stability.

The paint shall be homogeneous, shall be well ground to a uniform and smooth consistency and shall not skin or settle badly, nor cake, liver, thicken, curdle or gel in the container. The paint shall be capable of being broken up and mixed without difficulty by use of a paddle and shall show the desired characteristics at any time within a period of 6 months from the date of delivery. The paint shall be tested in accordance with ASTM D 869 and D1309 and a paint rated below six (6) shall be considered unsatisfactory.

b. Foreign Matter.

The paint shall be free from skins, dirt and other foreign matter and shall not contain more than 1 percent water. The paint shall be tested in accordance with methods 4081, 4091 and 4092 of Federal Test Method No. 141.

c. Suitability to Application.

The paint shall be suited to application by means of spray type pavement marking equipment used by the City and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

d. No Tracking Time.

The conventional paint, when applied with glass spheres to dry concrete or bituminous pavement surface under normal field conditions at the required application rates with pavement temperature between  $35^{0}$ F and  $45^{0}$ F and under all humidity conditions suitable for applying paint, shall dry to a no tracking condition in 45 minutes. The no tracking time shall

be determined by passing over the line in a simulated passing maneuver with a passenger car after the expiration of above time. A line showing no visual paint deposition to the pavement surface when viewed from a distance of 50 feet shall be considered as showing no tracking and conforming to the requirements for field drying conditions. The paint may also be tested in accordance with ASTM D 711 and when so tested, shall dry to no pickup in 30 minutes.

#### e. Viscosity.

The conventional paint, as received, shall have a consistency determined on the Stormer Viscosimeter and expressed as Krebs Units at 77<sup>0</sup> of 70-80 K.U. Any paint which changes consistency within six months after receipt so that the consistency falls outside the viscosity limits stated above shall be considered to have failed this requirement.

#### f. Color.

The paint shall visually match the Federal Highway Administration color tolerance chart for standard highway yellow or white. The color determination shall be made after the paint has dried for 24 hours on premix as received and on combination and drop-on types after the beads have been dropped in. The paint shall not contain any organic coloring matter and shall not discolor in sunlight.

### g. Bleeding.

When tested and evaluated on both tar and asphalt substrates in accordance with the Method of Laboratory Test for Degree of Resistance of Traffic Paint to Bleeding, ASTM D 969, and The Method of Evaluating Degree of Resistance of Traffic Paint to Bleeding, ASTM D 868, the numerical rating of degree of bleeding shall not be less than six (6). Paints will be tested for bleeding with the prescribed quantity of glass spheres in or on the paint.

### h. Hiding Power.

The pigmented binder, when tested in accordance with Method 4121 of Federal Test Method 141, "Dry Opacity," and when applied at the rate of 10 mils wet film thickness over a Morest Black and White Hiding Power Chart, Form 03-B, shall show complete hiding or give a contrast ration of not less than 0.98 between the reflectance of the black and of the white chart surfaces as determined by a Hunter Multipurpose Reflector.

### 2. Packaging.

Paint purchased under this Specification for regular use by the City shall be shipped in clean, open headed pails of 5 gallons capacity, sealed, vapor proof, and meeting current Interstate Commerce Commission requirements. Each container shall be plainly marked, both on the head and side, with a durable, weather resistant ink or paint, showing the name and address of the manufacturer or vendor, description of material, purchase order number, batch number and volume and weight of contents.

### 3. Special Handling or Use Instructions.

Any special handling, storage or use instructions made necessary by the use of unusually flammable solvents shall be provided by the manufacturer.

### B. Rapid Dry Reflective Pavement Marking Paint (Type "B" Paint).

This describes the general and specific requirements for reflective pavement marking paints to be used by the City in its pavement marking program. This covers ready mixed paint products of spraying consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavements. The paint type relative to drying time hereinafter shall be referred to as rapid dry paint—1 to 3 minutes drying time. The rapid dry paint is heated during application to achieve uniform sprayable viscosity.

### 1. General Properties.

### a. Condition and Stability.

The paint shall be homogeneous, shall be well ground to a uniform and smooth consistency and shall not skin or settle badly, nor cake, liver, thicken, curdle or gel in the container. The paint shall be capable of being broken up and mixed without difficulty by use of a paddle and shall show the desired characteristics at any time within a period of six months from the date of delivery. The paint shall be tested in accordance with ASTM D 869 and D 1309 and a paint rated below six (6) shall be considered unsatisfactory.

## b. Foreign Matter.

The paint shall be free from skins, dirt and other foreign matter and shall not contain more than 1 percent water. The paint shall be tested in accordance with methods 4081, 4091 and 4092 of Federal Test Method No. 141.

## c. Suitability to Application.

The paint shall be suited to application by means of spray type pavement marking equipment used by the City of Memphis and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

## d. No Tracking Time.

The rapid dry paint, when applied with glass spheres to dry concrete or bituminous pavement surface under normal field conditions at the required application rates with pavement temperature between  $35^{\circ}F$  and  $45^{\circ}F$  and under all humidity conditions suitable for applying paint shall dry to a no tracking condition in 60 seconds. The no tracking time shall be determined by passing over the line in a simulated passing maneuver with a passenger car after the expiration of above time. A line showing no visual paint deposition to the pavement surface when viewed from a distance of 50 feet shall be considered as showing no tracking and conforming to the requirements for field drying conditions. The paint may also be tested in accordance with ASTM D 711 and when so tested, shall dry to no pickup in 8 minutes.

### e. Viscosity.

The rapid dry paint, as received, shall have a consistency determined on the Stormer Viscosimeter and expressed as Krebs Units at 77<sup>°</sup> of 90-110 K.U. Any paint which changes consistency within 6 months after receipt so that the consistency falls outside the viscosity limits stated above shall be considered to have failed this requirement.

### f. Color.

The paint shall visually match the Federal Highway Administration color tolerance chart for standard highway yellow or white. The color determination shall be made after the paint has dried for 24 hours on premix as received and on combination and drop-on types after the beads have been dropped in. The paint shall not contain any organic coloring matter and shall not discolor in sunlight.

### g. Bleeding.

When tested and evaluated on both tar and asphalt substrates in accordance with the Method of Laboratory Test for degree of Resistance of Traffic Paint to Bleeding, ASTM D 969, and The Method of Evaluating Degree of Resistance of Traffic Paint to Bleeding, ASTM D 868, the numerical rating of degree of bleeding shall not be less than six (6). Paints will be tested for bleeding with the prescribed quantity of glass spheres in or on the paint.

### h. Hiding Power.

The pigmented binder, when tested in accordance with Method 4121 of Federal Test Method 141, "Dry Opacity", and when applied at the rate of 10 mils wet film thickness over a Morest Black and White Hiding Power Chart, Form 03-B, shall show complete hiding or give a

contrast ratio of not less than 0.98 between the reflectance of the black and of the white chart surfaces as determined by a Hunter Multipurpose Reflector.

#### 2. Packaging.

Paint purchased under this specification for regular use by the City shall be shipped in clean, open headed drums of 55 gallons capacity, sealed, vaporproof, and meeting current Interstate Commerce Commission requirements. Each container shall be plainly marked, both on the head and side, with a durable, weather resistant ink, or paint, showing the name and address of the manufacturer or vendor, description of material, purchase order number, batch number and volume and weight of contents.

#### 3. Special Handling or Use Instructions.

Any special handling, storage or use instructions made necessary by the use of unusually flammable solvents shall be provided by the manufacturer.

#### C. Hot Extruded and Hot Spray Thermoplastics.

#### 1. Type of Material.

This section covers thermoplastic materials suitable for use as reflecting pavement markings on Portland cement concrete or bituminous pavement. The materials shall be manufactured for application by extrusion or spraying onto the pavement in molten form with glass spheres mixed in and also dropped into the material immediately after it is applied.

#### 2. General Characteristics.

The compound shall resist deterioration by contract with sodium chloride, calcium chloride or other chemicals used to prevent roadway ice, or because of the oil content of pavement materials or from oil droppings or other effects of traffic. In the plastic state, materials shall be free of fumes which are toxic or otherwise injurious to persons or property. The material shall withstand deterioration if held at the plastic temperature for a period of four hours, or by reason of three reheatings to the plastic temperature. The temperature versus viscosity characteristics of the plastic material shall remain constant through up to three reheatings and shall be the same from batch to batch. The color shall be stable for at least three reheatings and between batches. To insure the best possible adhesion, the compound, as specified, shall be installed in a melted state at the temperature recommended by the manufacturer, and the material shall retain its color if kept at this temperature for up to four hours.

a. Foreign Matter.

The binder shall consist of a mixture of resins, at least one of which is solid at room temperature. The total binder content of the thermoplastic compound shall be a minimum of 15 percent and a maximum of 35 percent by weight. The pigmented binder shall be well dispersed and free from all skins, dirt, foreign objects or such ingredients as will cause bleeding, staining, or discoloration. The filler shall be a white calcium carbonate silica or an equivalent filler with a compression strength of 5,000 pounds per square inch (34.5 MPa).

### b. Suitability for Application.

The thermoplastic material shall be a product especially compounded for traffic markings. The markings shall remain intact under normal traffic conditions at temperatures below  $140^{\circ}$ F ( $60^{\circ}$ C). The markings shall have a uniform cross-section. Pigment shall be evenly dispersed throughout the material. The density and character of the material shall be uniform throughout its thickness. The stripe shall maintain its original dimensions and placement. The exposed surface shall be free from tack and shall not be slippery when wet. The material shall be such as to permit normal movement with the road surface without chipping or cracking.

### c. Drying Time.

The drying time shall follow a characteristic straight line function, the lower limits of which are

2 minutes maximum at  $50^{\circ}$ F ( $10^{\circ}$ C), the upper limits of which are 15 minutes at  $90^{\circ}$ F ( $32.2^{\circ}$ C), both temperatures measured as surface temperatures. After application and proper drying time, the material shall show no appreciable deformation or discoloration under local traffic conditions or in air and/or road temperatures ranging from  $-20^{\circ}$ F to  $120^{\circ}$ F ( $-30^{\circ}$ C to  $50^{\circ}$ C).

d. Reflectorization.

During manufacture, reflectorizing glass spheres shall be mixed into the material as follows by weight of the material; Extruded Thermoplastic -- 20 percent minimum to 50 percent maximum. Hot Spray Thermoplastic -- 20 percent minimum to 30 percent maximum. Glass spheres shall also be automatically applied to the surface of the material at a uniform rate of approximately 6 pounds (2.72 kg) of glass spheres of every 100 square feet (9.29 m<sup>2</sup>) of line. These glass spheres shall be dropped or sprayed onto the thermoplastic material while it is in a molten state immediately after it has been applied to the pavement. Required properties of glass spheres used in hot thermoplastic installations are described in Specification Section 02760 Paragraph 2.01 J.

- 3. Physical Requirements.
  - a. Color.

The color shall conform to the following when tested by Federal Test Method Standard 141 Method 4252;

White: Federal Color Chip No. 37875 (Fed. Std. No. 595). Yellow: Federal Color Chip No. 33535 (Fed. Std. No. 595).

b. Water Absorption.

Materials shall have a maximum of 0.5 percent by weight of retained water when tested by ASTM D 570. "Water-Absorption of Plastics", procedure (A).

c. Softening Point.

Materials shall have a softening point of 190<sup>°</sup>F (87.8<sup>°</sup>C) minimum, as determined by ASTM E 28, "Method of Test for Softening Point by Ring and Ball Apparatus".

d. Specific Gravity.

Specific gravity of the thermoplastic compound, at 77<sup>o</sup>f (23.2<sup>o</sup>C), shall be from 1.6 to 2.3.

e. Impact Resistance.

Impact resistance shall be a minimum of 10 inch pounds (1.13J) at  $77^{0}F$  ( $23.2^{0}C$ ) after the material has been heated for four hours, at application temperature and cast into bars of 1 inch (2.54cm) cross-sectional area, 3 inches (7.62 cm) long and placed with 1 inch (2.54 cm) extending above the vice in a cantilever beam (Izod type) tester using the 25 inch-pound (2,825 J) scale. This instrument is described in ASTM D 256.

f. Abrasion Resistance.

The material shall show a maximum loss of 0.5 grams when subjected to 200 revolutions on a Taber Abraser at  $77^{0}F(23.2^{0}C)$  using H-22 calibrate wheels weighted to 500 grams. The panel for this test will be prepared by forming a representative lot of material at a thickness of 125 mils (3.175 mm) on a 4 inch square (25.8 cm<sup>2</sup>) monel panel 0.050 inch (1.27 mm) thick, on which a suitable primer has been applied. The wearing surface shall be kept wet with distilled water during the test.

4. Packaging.

a. The material shall be delivered in containers of sufficient strength to permit normal handling during shipment and transportation on the job without loss of material. Each container when filled shall weigh a minimum of 21 pounds (9.59 kg) and a maximum of 52

pounds (23.6 kg).

b. Each unit container shall be clearly and adequately marked to indicate the color of the material, the process batch number or other similar manufacturer's identification, the manufacturer's name, address of the plant and the date of manufacture.

### D. Cold Thermoplastics.

1. Type of Material.

This section covers reflectorized cold thermoplastic materials preformed into rolls or ribbons of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or bituminous pavement.

2. General Characteristics.

a. Reflectorized cold plastic pavement marking material shall consist of homogeneous, extruded, prefabricated thermoplastic ribbon of specified thickness and width of either white or yellow color and shall contain reflective glass spheres uniformly distributed throughout the entire cross-section that shall be capable of being affixed to nonbleeding bituminous or Portland cement concrete pavements. The reflectorized material shall be of the plastic, cold flow type.

b. The reflectorized cold plastic pavement marking material shall consist of the following components with maximum and minimum composition by weight tolerances as shown:

	Maximum	Minimum
Plastics and Plasticizers	46%	40%
Pigments	42%	38%
Glass Spheres	18%	14%

c. Pigments shall include titanium dioxide conforming to the requirements of ASTM D 476 for white plastic material and CP medium chrome yellow conforming to the requirements of ASTM D 211 for yellow materials. Reflective glass spheres shall contain the physical properties described in Specification Section 02760 Paragraph 2.01 H.

d. When extruded, the reflectorized cold thermoplastic material without precoated adhesive shall be 0.09 inch thick, with a tolerance of plus or minus 5 percent. The edges shall be clear cut and true. The cold plastic material may be supplied complete with a precoated, factory applied adhesive backed with a protective release paper so as to make possible immediate pavement application without the use of heat, solvent, or other types of adhesive operations or it may be furnished with separate adhesives as recommended by the manufacturer. Whether the adhesive is precoated or supplied separately, the adhesive shall be such as to allow the cold thermoplastic material to be repositioned on the pavement surface to which it is applied before permanently fixing it in its final position with a downward pressure.

- 3. Physical Requirements.
  - a. Bend Test No. 1 (With Precoated Adhesive).

The plastic shall be of such a structure that at a temperature of  $80^{\circ}$ F, a piece of 3 inch x 6 inch material (with paper backing) placed upon a 1 inch diameter mandrel, may be bent over the mandrel until the end faces are parallel and 1 inch apart. By visual inspection, there shall be no fracture lines apparent in the uppermost surface.

b. Bend Test No. 2. (Without Paper Backing).

A piece of plastic 6 inch x 12 inch in size (paper backing removed) when balanced upon a supported  $\frac{1}{2}$  inch diameter mandrel, reflective side up, and left in this position at a

temperature of  $80^{\circ}$ F, shall have flexed out of its own weight at the end of eight hours into an inverted "V" position with the free ends at an angle of not more than  $30^{\circ}$  from the vertical. The uppermost surface of the plastic shall show no fracture or breaks. Upon removing the plastic from the mandrel, the material should be firmly but not abruptly returned to a semi-flat position with the reflective side down. The plastic, at a temperature of  $80^{\circ}$ F on a smooth, flat, glass surface, shall have returned to its original flat condition in not more than 8 hours.

c. Tensile Strength.

Employing ASTM D 638, the plastic shall have a tensile strength of 300 psi plus or minus 100 psi. The elongation shall be no greater than 50 percent. The tensile strength calculations should be based on the minimum measured thickness of the test specimen. The rate of pull of the test shall be 0.25 inch per minute. The test shall be conducted at a temperature of  $70^{\circ}$  to  $80^{\circ}$  F using a strip of material 6 inches long and 1 inch wide.

d. Plastic Pull Test.

A 6 inch long by 1 inch wide section of the thermoplastic material shall support a dead load weight of 6 pounds for not less than thirty minutes. This test shall be conducted at a temperature of  $70^{\circ}$  to  $80^{\circ}$  F.

e. Glass Sphere Retention.

A 2 inch specimen of thermoplastic material shall be cut at right angle to the beveled edge and bent parallel to the beveled edge on a  $\frac{1}{2}$  inch diameter mandrel. While the specimen is bent, a strip of  $\frac{1}{2}$  inch wide masking tape shall be applied firmly along the length of the area of maximum bend and then removed. Retention of any glass spheres on the masking tape when the tape is removed shall be cause for rejection of the material

f. Gloss.

The plastic material shall have a maximum  $60^{\circ}$  gloss of 10 units as measured in accordance with ASTM D 523.

g. Abrasion Resistance.

The plastic material shall have a maximum loss in weight of 0.25 grams in 500 revolutions when abraded according to Federal Test Method Standard No. 141 (Method 6192), using H-18 calibrate wheels with 1,000 gram load on each wheel.

4. Suitability for Application.

a. The cold thermoplastic material shall be capable of application to nondefective pavement surfaces that are free from dirt or other foreign matter and at a temperature of  $60^{\circ}$ F or more.

b. Adhesive, activators, or special coatings for various types of pavement surfaces shall be provided with the thermoplastic material. Detailed information must be supplied with the thermoplastic material outlining required application procedures for such adhesives, activators, or special coating.

c. Cold plastics shall be capable of being applied to new asphaltic pavement immediately prior to the final rolling of the new surface and of being rolled into place with conventional pavement and highway rollers. The plastic material and adhesives used in such applications shall be of the type that water used on the road roller to prevent asphalt pickup shall not be harmful to the successful application of the plastic.

5. Packaging.

The cold thermoplastic strips shall be supplied in rolls or strips of specified lengths (usually 150 feet), of the width specified, except for standard symbols and words. Rolls or strips shall be packaged in cartons suitable to allow for easy dispensing.

- E. Pliant Polymer Films.
  - 1. Type of Material.

This section covers reflectorized pliant polymer film materials processed into rolls or ribbons of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement.

2. General Characteristics.

a. Reflectorized pliant polymer film shall consist of a laminated retroreflective coating of glass beads bonded to a conformable resilient pliant polymer film white or yellow in color which is protected on the reverse side by a protective liner. This liner is removed before application. The marking film shall have reflective elements uniformly dispersed throughout and when properly applied using a specially designed contact cement shall conform and adhere to asphaltic concrete and portland cement concrete surfaces.

- b. Color shall be white and yellow, consistent with normal highway use.
- c. The normal thickness of the marking films shall be available as follows:

White	Yellow
0.06" (1.5mm)	0.06" (1.5mm)

3. Physical Requirements.

a. The marking film shall have the following average minimum brightness values at  $0.2^{\circ}$  and  $0.5^{\circ}$  observation angles and  $86^{\circ}$  entrance angle, measured in accordance with the photometric testing procedure in Federal Specification FP-74, Section 718.01 (a), except that the brightness values shall be expressed as candlepower per foot candle per 5 sq. ft. panel (2-1/2 feet by 2 feet (0.76 m x 0.61 m)). The five square feet is derived from a standard stripe, defined as 4 inches by 15 feet = 5 sq. ft. (10.1 cm by 4.57 m = 0.46 sq. meters).

b. Brightness Values (candle power per foot candle per 5 sq. ft.)

	Wh	nite	Yell	ow
Observation Angle	0.2 <sup>0</sup>	0.5 <sup>0</sup>	0.2 <sup>0</sup>	0.5 <sup>0</sup>
Entrance Angle – 86 <sup>0</sup>	0.20	0.15	0.15	0.10

# 4. Suitability for Application.

The marking film shall adhere to asphaltic concrete and Portland cement concrete surfaces when applied according to the manufacturer's recommendations at pavement surface and ambient air temperatures down to  $50^{\circ}$ F ( $10^{\circ}$ C) when daily temperatures above  $70^{\circ}$ F are prevailing to ensure film conformance and adherence to pavement surface. Following application the marking film shall be ready for traffic. Areas of minor damage may be readily patched with an inlay of this film in accordance with the manufacturer's recommendation.

5. Durability.

The marking film, when applied in accordance with the manufacturer's recommended procedures, shall provide a neat, durable marking maintaining the original design and configuration. Although the reflectivity will be reduced by wear, the film shall provide a cushioned resilient substrate to reduce bead crushing and loss. The film shall be weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage throughout the useful life of the marking, and shall show no significant tearing, roll back, or other signs of poor adhesion. Applied

as recommended the marking film shall be expected to have an effective performance life, under normal conditions, of 3 years.

6. Packaging.

The pavement marking film as supplied shall be of good appearance, free of cracks, and the edges shall be clean cut and well defined. The film and contact cement shall be packaged in standard commercial containers in accordance with commercially accepted standards. These materials as supplied may be stored at normal temperatures for a period of one year after purchase.

### F. Sheeting and Tape.

1. Type of Material.

This section covers reflectorized sheeting or tape materials processed into rolls of various lengths and widths or other specified shapes suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement.

2. General Characteristics.

Reflectorized sheeting or tape shall consist of a white or yellow, weather and traffic resistant reflective film on a conformable backing precoated with a pressure sensitive adhesive. The adhesive shall be protected by a removable liner. Color shall be white or yellow as specified for pavement markings. The average thickness of the sheeting or tape shall be 0.03 inch.

- 3. Physical Requirements.
  - a. Reflectivity.

(1) The white and yellow sheeting or tape shall be retroreflective reflecting white or yellow respectively, shall be readily visible when viewed with automobile headlights at night, and shall have the following minimum reflective values at  $0.2^{\circ}$  and  $0.5^{\circ}$  divergence angles measured in accordance with the photometric testing procedures of Federal Specification LS-300A, "Sheeting & Tape, Reflective; Nonexposed Lens Adhesive Backing", Para. 4.4.7 or as amended. Reflective values shall be expressed as candlepower per foot candle per square foot (candelas per lux per square meter) measured on a 5 sq. ft. panel (2-1/2 feet by 2 feet) at an 86° incidence angle. The 5 sq. ft. is derived from a standard stripe, defined as 4 inches by 15 feet = 5 square feet. From this the 2-1/2 feet x 2 feet panel used is for convenience in testing and comparison.

Reflectivity Value (candle power per foot candle per square foot)

	Wh	ite	Yellow	N
Divergence Angle	0.2 <sup>0</sup>	$0.5^{0}$	0.2 <sup>0</sup>	0.5 <sup>0</sup>
Incidence Angle 86 <sup>0</sup>	0.20	0.18	0.18	0.16

(2) A 2-1/2 feet x 2 feet panel, completely covered with either white or yellow pavement marking sheeting, shall be placed, reflective side up, in a horizontal pan sufficiently high above the pan side (or edge) so that the reflective pan shall be completely in view for measurement. The panel shall be tipped at an angle of  $4^{\circ}$  to the horizontal bottom of the pan for drainage. The entire panel shall be quickly flooded with clean water and allowed to drain. The minimum reflective value expressed as candlepower per foot candle per square foot shall be measured between 15 and 30 seconds after the panel starts to drain. The minimum reflective values shall be as follows:

Reflectivity Value (candle power per foot candle per square foot)

	White	Yellow
Divergence Angle	$0.2^{0}$ $0.5^{0}$	0.2 <sup>0</sup> 0.5 <sup>0</sup>

Incidence Angle 86<sup>0</sup> 0.10 0.09 0.09 0.08

b. Adhesive and Liner.

(1) The marking material shall have a precoated pressure sensitive adhesive and require no activation. The adhesive shall be protected, prior to application, with a removable liner to prevent contamination during processing, cutting, and handling. The liner shall release from the adhesive easily, without splitting or tearing, and shall not shrink or prematurely release from the adhesive during processing, storage or handling.

(2) Test pieces of the marking material shall be applied according to manufacturer's instructions and tested in accordance with ASTM D 1000, Method D, with two exceptions:

(a) A stiff, short bristle, roller type, tamper brush shall be substituted for the weighted rubber roller used to roll the test strips onto the metal test panel. The stiff, short bristles, shall be required to produce a tamping action between the beads to assure maximum contact of the marking material adhesive to the metal panel. Heavy pressure shall be exerted on the brush when rolling the sample.

(b) The beaded surface of the marking test pieces shall be covered with a thin tape not over 1 inch wide to prevent interference with or locking of the beads when the test piece is bent back  $180^{\circ}$  on itself for the adhesion test.

c. Application Properties.

The material shall adhere to asphalt and concrete surfaces when applied to manufacturer's recommendations at surface temperatures down to  $35^{0}$ F ( $2^{0}$ C) and shall be immediately ready for traffic following application.

d. Conformability.

The marking material shall be thin, flexible, formable, and following application shall remain conformed to the texture of the pavement surface.

e. Thickness.

The average thickness of the material, excluding liner, shall be determined by taking 5 micrometer readings (using micrometer with approximately ¼ inch anvil and spindle) on a sample applied to an aluminum panel and deducting the thickness of the aluminum panel. The average thickness of 5 readings shall not be less than 20 mils nor more than 45 mils.

f. Removability.

Marking material shall be removable by following the manufacturer's recommendations, if the material is substantially intact. Removal shall not require sandblast, solvent or grinding methods and shall not result in objectionable staining of the pavement surface.

g. Durability and Wear Resistance.

The pavement marking material applied to asphalt or concrete in accordance with the manufacturer's recommended procedures shall be weather-resistant and show no appreciable fading, lifting, or shrinkage during the useful life of the line. Samples of material shall be applied to 4 inch by 4 inch test panels of 0.040" aluminum, (6061-T6 alloy), prepared according to recommendations of marking material manufacturer. The applied sample shall be tested in accordance with Federal Test Method Standard No. 141, Method 6192, using a CS-17 wheel and 1000 gram load and shall not wear through to the metallic surface in less than 5000 cycles. Care shall be taken to adjust the vacuum suction for the most effective removal of the abradings.

NOTE: Taber wheels used for this test shall have a "Shore A" Durometer hardness of

between 76 and 86 measured according to ASTM D 2240.

4. Packaging.

a. The pavement marking material as supplied shall be of good appearance, free from cracks, and edges will be true, straight and unbroken. The marking material shall be available in precut symbols and legends as specified and as roll goods up to 48 inches in width with no more than three splices per 50 yards of length.

b. The pavement material shall be packaged in accordance with accepted commercial standards and when stored under normal conditions shall be suitable for use for a period of at least on year after purchase.

#### G. Striping Powder.

1. Type of Material.

This section covers ready mixed powder products of application consistency suitable for use as reflecting pavement markings on Portland cement concrete or asphaltic concrete pavement with or without liquid road surface conditioner.

- 2. General Properties.
  - a. Description.

The striping powder shall be a free flowing plastic type pavement marking material which is premixed with glass spheres for reflectorization. When flame sprayed to clean portland cement concrete and asphaltic concrete pavement road surface by a suitable mechanical striper, the striping powder shall produce an instant dry to no pickup, adherent, reflectorized stripe capable of resisting deformation by traffic. A liquid may be desired for application to some road surfaces before application of the marking powder; if so, it shall be so stated on the request for bid.

b. Suitability to Application.

(1) The powder shall be suited to application by means of flame sprayed gun type pavement marking equipment used by the City of Memphis and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

(2) The liquid road surface conditioner shall be suited to application by pressure spray gun system or by conventional paint roller.

### c. Physical Characteristics of Striping Powder.

The striping powder shall be a dry mixture capable of freely flowing through the flame spray marking equipment at the rate of 14 to 18 ounces per 30 seconds when exposed to combined conditions of humidity up to 90 percent relative humidity and ambient air temperature up to  $100^{\circ}$ F. The striping powder shall require no thinning, mixing or heating prior to use and shall be satisfactorily usable at minimum road surface temperatures of  $50^{\circ}$ F and minimum ambient air temperature of  $60^{\circ}$ F.

d. Color.

The striping powder shall match the Federal Highway Administration color tolerance chart for standard highway yellow or standard highway white as required by the order. Color determinations shall be made on casts of samples melted at 200<sup>0</sup>F and poured into aluminum foil weighting dishes of the following dimensions:

Rim diameter - 58mm

Height - 18mm

e. Particle Size.

The finished powder as supplied shall have the following grading:

	Percent by
U.S. Sieve No.	Weight Retained
30	0 - 2
230	93 - 100
Pan	0 - 5

f. Softening Point.

Tested in accordance with "ring and ball softening point determination" ASTM Test No. E 28, the softening point shall be from 215<sup>°</sup> to 225<sup>°</sup>F.

g. Liquid Road Surface Conditioner.

The liquid, when specified, shall require no thinning, be easily applied, and be compatible with road surfaces and the marking powder supplied.

h. Glass Spheres.

The finished powder shall contain intermixed glass spheres.

NOTE: Representative finished powder samples, taken from a thoroughly mixed, full carton of finished powder, must be used for all glass sphere determinations.

- (1) Index of refraction of glass spheres: 1.5 minimum; 1.6 maximum.
- (2) Percent of weight of glass spheres: 30 percent minimum; 35 percent maximum.

Method of Determination of Percent by Weight of Glass Spheres:

- Equipment:
  - Laboratory triple beam balance.
  - U.S. standard screen (270) mesh.
  - 400 ml. glass beaker.
  - Oven at 200<sup>°</sup>F.
- Procedure:
  - Weigh 100 grams of finished powder in 400 ml. beaker.
  - Add 200 ml. of suitable solvent (alcohol, aromatic solvent, or Ketone)
  - Pour solution on 270 mesh screen (flush beaker with solvent to remove all the beads).
  - Wash the beads on the screen with solvent until they are clear.
  - Dry in oven at 200<sup>°</sup>F and weigh the amount of beads recovered.
  - Calculate percent of beads by: <u>Wt. of Beans</u> x 100% = % of beads. Wt. of Sample
- (3) Grading of glass spheres.

U.S. Sieve No.	Percent by Weight Retained
40	0 - 5
70	15 - 60
230	35 - 85
Pan	0 - 15

(4) Other Properties of Glass Spheres.

The properties of crushing resistance, roundness, index of refraction and chemical resistance shall be as required in Specification Section 02760 Paragraph 2.01 H.

#### 3. Equipment.

Striping powder id designed for application by a light weight hand propelled striper as described in Specification Section 02760 Paragraph 2.02 D.

#### 4. Packaging.

The finished powder shall be delivered ready for use and shall be packaged in 25 pound cartons or other acceptable containers clearly identified as to manufacturer, color, contents and quantity and shall be free of lumps, foreign particles or other matter. Cartons employed for packaging shall withstand normal handling and shall have a suitable protective interliner to resist moisture absorption. The powder, as supplied, may be stored at temperatures not to exceed 90°F for up to one year, without adversely affecting the physical properties stated in this Specification. The liquid road surface conditioner, if required, shall be delivered ready for use in one gallon containers meeting current Interstate Commerce Commission requirements.

#### 5. Properties of Applied Powder Line.

Dispensed and properly applied by flame spray gun type striper, the finished line shall be reflective and shall adhere so as to form a smooth continuous film on both portland cement concrete and asphaltic concrete road surfaces. Minor temporary line discoloration, due to surface soot, shall be permissible on adjacent overlapping lines. Lines exhibiting surface soot shall regain full color with traffic wear. A properly applied striping powder line shall not exhibit bleeding when applied on cured asphalt surfaces. An applied line shall dry to no pickup (10 mils application) when tested in accordance with ASTM Test No. D 711. Determination shall be made by averaging a minimum of 3 no-pickup readings at each pavement temperature tested. When the pavement temperature is between 50°F and 90°F, drying time should be 10 seconds or less. When the pavement temperature is between 90°F and 140°F, drying time should be 25 seconds or less. Liquid road surface conditioner shall be easily applied by pressure spray gun or conventional paint roller with a solvent resistant sleeve with 7/16 inch nap. It shall be allowed to dry on the pavement surface for approximately 5 minutes prior to applying marking powder.

## H. Glass Spheres For Reflectorization.

This section describes the general and specific requirements for glass beads to be applied with pavement marking paints and the physical properties of glass spheres to be applied with other binders to be used by the City.

1. Physical Properties for all Glass Spheres.

#### a. General.

Glass beads 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 bisymmetric bonding in that when applied to a paint, plastic, or polymer binder they shall hemispherically embed (to approximately their equator) in the binder film for maximum durability and brightness.

#### b. Crushing Resistance.

The crushing resistance of glass spheres shall be determined in accordance with ASTM D 1213. A 40 pound dead weight for 20 to 30 mesh spheres shall be the average resistance of the spheres tested.

#### c. Roundness.

The roundness of glass spheres shall be determined by ASTM D 1155. A maximum of 25 percent (by weight) shall contain irregular or fused sphered particles

d. Refractive Index.

The spheres shall have an average index of refraction not less than 1.50 nor more than 1.60 when tested by the liquid immersion method at  $25^{\circ}$ C.

#### e. Chemical Resistance.

The glass spheres shall withstand immersion in water and acids without undergoing noticeable corrosion or etching and shall not be darkened or otherwise noticeably decomposed by sulfides. The tests for chemical resistance shall consist of one hour immersion in water and in solutions of corrosive agents followed by microscopic inspection. A 3 to 5 gram portion of the sample shall be placed in each of three Pyrex glass beakers or porcelain dishes; one sample shall be covered with distilled water, one with a 3N solution of sulfuric aced and the other with a 50 percent solution of sodium sulfide. After one hour of immersion, the glass spheres of each sample shall be examined microscopically for evidence of darkening and frosting.

NOTE: The tests described in United States Federal Specification TT-P-85b, items 4.4:13; 4.4:14; 4.4:15; and 4.4:16 may be substituted for the test described above.

f. Flow Properties.

The glass spheres shall flow freely through the dispensing equipment in any weather suitable for striping.

g. Color.

The glass spheres shall be colorless to the extent that they impart no off-color day or nighttime hue to the binder when applied at normal application rates.

- 2. Properties Of Glass Spheres For Use With Pavement Marking Paint.
  - a. Gradation.

A sieve analysis of glass spheres shall be made in accordance with ASTM D 1214. Required gradations are as follows:

- (1) 5 to 20 percent passing #20; retained on #30 sieve.
- (2) 30 to 75 percent passing #30; retained on 350 sieve.
- (3) 9 to 32 percent passing #50; retained on #80 sieve.
- (4) 0 to 10 percent passing #80 sieve.
- b. Flotation.

(1) A minimum of 90 percent of the flotation glass spheres shall float on xylol (aromatic solvent) and a minimum of 75 percent shall float on heptane (aliphatic solvent) when tested as follows:

(2) A single layer of spheres shall be spread on the flat center of a clean inverted pint tin can lid. Solvent shall be slowly introduced with a syringe or dropper into the circular groove at the edge of the lid until it overflows into the center. The percentage of spheres floating on the solvent surface shall be estimated visually.

3. Gradation of Glass Spheres For Use With Plastic Pavement Marking Materials.

A sieve analysis of glass spheres should be made in accordance with ASTM D 1214. Gradations of glass spheres must be approved by the Owner for use with each plastic material. Typical gradations required for various types of plastic pavement marking materials are as follows:

- a. To be included in hot thermoplastic material:
  - (1) 80 to 100 percent passing #60 sieve.
  - (2) 0 to 10 percent passing #140 sieve.
- b. For application on molten thermoplastic material:

- (1) 90 to 100 percent passing #20 sieve.
- (2) 20 to 50 percent passing #50 sieve.
- (3) 0 to 10 percent passing #80 sieve.
- c. For cold thermoplastics and pliant polymer film:
  - (1) 100 percent passing #60 sieve.
  - (2) 0 to 15 percent passing #140 sieve.

#### 4. Packaging.

The glass spheres shall be packaged in multiply paper, polyethelene, or burlap bags with a waterproof liner. The bags shall be strong enough to permit normal handling during shipment and transportation on the job without any loss of spheres and shall be sufficiently water resistant so that spheres will not become wet or caked during transit. The bags of glass spheres shall weigh a maximum of 60 lbs. each.

- I. Raised Reflective Pavement Markers.
  - 1. Classification.

Type 1, One Color, Reflective Markers (Two-way Traffic).

- Type 2, One Color, Reflective Markers (One-way Traffic).
- Type 3, Two Color, Reflective Markers (One-way Traffic).

### 2. Description.

Reflective pavement markers shall be of the prismatic reflector type, consisting of a high impact plastic shell filled with a mixture of inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain one or two prismatic faces, molded to reflect incident light, from a single direction or from opposite directions. The shell shall be of one color or of a combination of two colors which will be the same as reflective elements and shall be of size and shape shown on the plans. The base of the marker shall be free from gloss or substances which may reduce its bond to the adhesive. The presence of a soft or resin film on the surface of the base will be cause for rejection.

#### 3. Specific Intensity.

The specific intensity of each reflective surface, when tested at 0.2 degree angle of divergence, shall not be less than the following specified values:

	Clear	Yellow	Red
0 <sup>0</sup> Incidence Angle -	3.0	1.5	0.75
20 <sup>0</sup> Incidence Angel -	1.2	0.60	0.30

The following definitions and tests shall be applicable:

#### a. Angle of Incidence.

The angle formed by a ray from the light source to the marker, and the normal to the leading edge of the marker face.

### b. Angle of Divergence.

The angle formed by a ray from the light source to the marker and the returned ray from the marker to the measuring receptor.

c. Specific Intensity.

The mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incident light.

$$SI = R_L / I_L \times D^2$$

Where:	
--------	--

SI = Specific Intensity R1 = Reflected Light

 $I_L$  = Incident Light D = Test Distance

- d. Test Method.

The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch. The photocell receptor width shall be 0.05 inch and shall be shielded to eliminate stray light. The distance from the center of the light source aperture to the center of the photocell shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receptor shall be modified in the same proportion as the test distance.

### 4. Color.

The color of the raised reflective pavement markers when illuminated by an automobile headlight shall be clear, yellow, or red as required. Off-color reflection shall constitute grounds for rejection.

### 5. Load Test.

The raised reflective pavement markers shall support a minimum load of 2,000 pounds applied in the following manner: A random sample of three markers shall be selected for the load test. The markers shall be centered base down over the open end of a vertically positioned hollowed metal cylinder. The cylinder shall be one inch high, with an internal diameter of 3 inches and a wall thickness of  $\frac{1}{4}$  inch. A load necessary to test the marker shall be applied at a speed of 0.2 inch per minute to the top of the marker through a one inch diameter solid metal plug centered on the top of the marker. Failure shall consist of either (1) breakage or significant deformation of the marker at a load of less than 2,000 pounds; or(2) significant delaminating of the shell and the filler material regardless of the load required to break the marker.

6. Sampling and Tolerances.

### a. Sampling.

Twenty markers selected at random will constitute a representative sample for each lot consisting of 10,000 markers or less. Forty markers will constitute a representative sample for lots consisting of more than 10,000 markers. The lot size shall not exceed 25,000 markers.

b. Tolerances.

(1) At least 90 percent of the original sampling of each lot of markers shall pass all tests except the strength tests. If less than 90 percent but more than 70 percent pass all tests, a resample of that lot will be allowed at the request of the Contractor. When less than 70 percent of the markers from the original sample comply with the requirements, the lot represented by the samples will be rejected and not resample will be allowed.

(2) Should any one of the 3 samples selected for strength testing fail to comply with the strength requirements of this Specification, 6 additional samples will be tested. The failure of any one of these 6 samples shall be cause for the rejection of the entire lot or shipment represented by the samples.

### 7. Packing And Shipping.

Shipments shall be made in containers which are acceptable to common carriers and packages in such a manner as to ensure delivery in perfect condition. Any damaged shipments shall be replaced by the Contractor. Each package of pavement markers shall be clearly marked as to name of the manufacturer, color, type, lot number, quantity enclosed, and date of manufacture.

J. Epoxy Adhesive For Pavement Markers.

1. General.

a. This Specification describes Type 1R epoxy adhesive (Rapid Setting Pavement Marker Adhesive) which is designed to bond plastic traffic markers to roadway and bridge surfaces. The adhesive is intended for mixing by automatic metering, mixing and application equipment. Rapid Setting Marker Adhesive must be used when pavement temperature is above  $50^{\circ}$ F.

b. The adhesive shall be furnished in two components, herein referred to as Epoxy Resin Component and Hardener Component; the two components shall be mixed 1 to 1 by volume just prior to use.

### 2. Component Properties.

The manufacturer shall certify by lot number the following chemical properties as determined by the designated test methods.

a. Component Resin:

(1) Viscosity, Poises @ 77 <sup>0</sup> F.	ASTM D 445 Note (1)
(2) Epoxide Equivalent (Filled and also unfilled	
when applicable)	ASTM D 1652 Note (2)
(3) Volatiles, percent by weight distilled below 350 <sup>0</sup> F.	ASTM D 1078
(4) Ash Content percent by weight	ASTM D 482
• · · · · ·	

### b. Component Hardener.

(1)	Viscosity, Poises @ 77 <sup>0</sup> F.	ASTM D 445 Note (1)
(2)	Volatiles, percent by weight distilled below 350 <sup>0</sup> F.	ASTM D 1078
(3)	Ash content percent by weight	ASTM D 482

Note (1) 400 ml. sample with Brookfield Viscometer, Model LVT with specified spindle rotating at specified speed.

Note (2) Grams of material containing 1 gram equivalent of epoxide (WPE).

c. Component Ratio.

The ration of Resin and Hardener components to be mixed together to form the finished adhesive shall be 1 to 1 by volume and the components will be packaged in the proper proportions.

d. Dispersion.

All pigments, fillers, and/or thixotropic agents present in either the Epoxy Resin or Hardener component must be sufficiently dispersed so that no appreciable separatin or settling will occur during storage.

e. Nonvolatile Components.

Each component of the adhesives shall be 100 percent nonvolatiles. A test for any volatiles shall be made.

f. Color Coding.

The components shall be color coded so that visual inspection will assure homogeneous mixing. The color will be subject to approval of the Owner.

3. Mixed Components – Physical Properties

The mixed marker adhesive shall comply with the following physical requirements when tested according to the methods which are available from the Owner.

Property	Requirements
Thixotrophy – Sag Test (Maximum)	.250 inches
Gel Time or Pot Life	7 – 12 minutes
Property	Requirements
Set time (to obtain a minimum strength of 180 psi) @ 77 <sup>0</sup> F or at temperature recommended by manufacturer:	40 minutes
Bond Strength (24 hours @ 77 <sup>0</sup> F) (Minimum)	250 psi
Property Retention – after 5 cycles 0 <sup>0</sup> F to 100 <sup>0</sup> F (Minimum)	98 percent

## 4. Packing and Marking.

The component resin and component hardener shall be delivered in the manufacturer's original clean, sealed containers. Each container shall bear a label with the following information shown thereon: The name and address of the manufacturer, designation (component resin or component hardener), date of manufacture, batch number (a batch shall consist of a single charge of all components in a mixing chamber), mixing instructions, a warning concerning toxicity and handling precautions.

# 5. Sampling.

A sample from each batch of each component shall be submitted to the City for testing. The sample shall be taken from the vendor's stock or from the shipment to the Contractor.

## 2.02 APPLICATION EQUIPMENT

All equipment required for the satisfactory performance of this Work shall be on hand and approved by the Owner before execution of the Work will be permitted to begin.

### A. Painting Equipment.

1. Paint shall be applied by means of a machine of the spray type capable of satisfactorily applying the paint under pressure through a nozzle spraying directly upon the pavement. The machine shall be equip[ed with an air blast device for cleaning the pavement ahead of the painting operation, a guide pointer to keep the machine on an accurate line, and a device to agitate the paint. It shall also have a device to maintain a uniform flow and application of the paint, an automatic device to provide a broken or skip line of the length required, and a least 3 spray guns capable of being operated either individually or 2 or 3 together. The machine shall be equipped with a bead or sphere dispenser which can be regulated to dispense the spheres automatically at the uniform rate required. The equipment shall be so designed and operated as to permit traffic to pass on the roadbed with safety.

2. Each spray application machine must be equipped with an automatic counting mechanism capable of recording the number of linear feet of material applied to the roadway surface with a accuracy of 0.50%, to be checked by the Owner.

3. The equipment required for the application of conventional paints may range from simple hand or self-propelled stripers to relatively large truck mounted equipment. Paint heating equipment is not normally required for the application of this type material.

4. The application equipment for rapid dry paint shall be truck-mounted due to the pain heating equipment required. Rapid dry paints require heating to a maximum of 170<sup>°</sup>F at the spray nozzle as recommended by the manufacturer.

### B. Hot Plastic Application Equipment.

1. The equipment used to install hot extruded thermoplastic materials by contract under this Specification shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the shaping die shall prevent accumulation and clogging. All parts of the equipment which come in contact with the material shall be constructed for easy accessibility and exposure for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the shaping die, maintain the material at the plastic temperature. The use of pans, aprons or similar appliances which the die overruns will not be permitted under this Specification. The equipment shall provide for varying die widths and to produce varying widths of traffic marking. The equipment shall permit preheating of the pavement immediately prior to application of the thermoplastic material if preheating is recommended by the thermoplastic manufacturer.

2. The equipment used to install hot extruded or spray thermoplastic materials by contract under this Specification shall be constructed so as to insure continuous uniformity in the dimensions of the stripe. The thickness of the material on the pavement shall be as specified on the Plans. The applicator shall provide a means for clearly cutting off square stripe ends and shall provide a means for applying "skip" lines. The equipment shall provide for varying widths of traffic markings. The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

3. Glass spheres applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the striping machine so that the beads are dispensed almost instantaneously upon the installed line. The glass sphere dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

4. A special kettle shall be provided for melting and heating the thermoplastic material. The kettle must be equipped with an automatic thermostatic control device for positive temperature control and to prevent overheating of the material. The heating kettle and applicator shall meet the requirements of the National Board of Fire Underwriters, of the National Fire Protection Association of the state and of the local authorities.

### C. Cold Plastic Application Equipment.

Cold thermoplastics may be rolled into place with conventional pavement and highway rollers. Special equipment necessary for the successful installation of any cold thermoplastic shall be provided on a loan basis by the manufacturer of the thermoplastic material.

### D. Striping Powder Application Equipment.

Striping powder is designed for application by a light weight hand propelled striper with a propane fired application gun. An external compressor capable of delivering 18 cfm at 70 psi is required for the system.

# PART 3 - APPLICATION REQUIREMENTS

# 3.01 REFLECTIVE PAVEMENT MARKING PAINT.

A. Cleaning and painting shall be performed utilizing equipment of the kind and in the manner specified herein. On sections where no previously applied line is available to serve as a guide or if the line is to be relocated, the proposed location of the new line shall be spotted with paint in advance of the application. On tangent sections the control points shall be spaced no more than 500 feet apart and on curves at intervals that will insure the accurate location of the line. Gaps in all lines shall be left at intersections as shown in the MUTCD, or as directed.

B. No paint shall be applied over a chalk line, wire, or cord, but such guide marks shall offset the

paint line to be placed. On sections where previously applied lines are visible, the Contractor shall use the old lines unless otherwise directed. No paints shall be applied to areas of pavement when any moisture remains on the surface, or wind conditions are such as to cause a film of dust to be deposited on the line areas after these areas have been prepared for painting.

C. Paint shall be applied so as to deposit a uniform wet film thickness of 0.015 inches, which is at the rate of 16.5 gallons per mile for a solid stripe 4 inches wide, or as recommended by the manufacturer when approved in writing by the Owner. This rate of application shall apply to all types of paint, with proper adjustment made in gallons for an intermittent line or wider lines. The quantity of paint shall not underrun the designated amount by more than 5%, and if a check of the rate of application (are of line applied per unit volume of material) indicates a greater variation than this, the work shall be stopped until the paint machine is properly adjusted or replaced. This percent of variation is set out to give the contractor some leeway in starting the job and in getting his machine in adjustment but it is not expected that there shall be either a continuous overrun or underrun but that the final figures shall indicate that the average rate application closely approaches the rate established above.

D. Rapid dry (Type "B") paint shall be heated before application to a maximum of 170<sup>0</sup>F at the spray nozzle or as recommended by the manufacturer.

E. Drop-on type glass beads shall be uniformly applied to the painted surface at a uniform rate of not less than six pounds per gallon of paint applied.

F. Protection of traffic lines and markings shall be provided by the Contractor. Warning and directional signs as shown on the Plans or as directed shall be placed to control traffic in the marking area. If the drying time of the material being used exceeds 60 seconds, the newly applied markings shall be protected by placing traffic cones or other approved warning devices at frequent intervals as directed. These devices shall be left on the line until the material is dry or firm enough not to track or receive impressions from normal traffic. They shall be removed as soon as possible (because of the traffic hazard) and shall never be left in the roadway overnight. If so directed, flaggers shall be provided to direct traffic.

G. The general appearance shall be that of clearly delineated lines with a minimum crooked and waving appearance, due consideration being given to the contours and roughness of the pavement. Segments of broken line strip shall square off positively at each end. The paint lines shall be without mist, drip or splatter. Lines that do not meet these requirements when placed shall be removed and/or corrected by the Contractor to the satisfaction of the Owner and without extra compensation.

H. The paint equipment shall be so operated that it will be unnecessary for traffic to cross the newly painted line behind the equipment in order to safely pass the painting machine, and traffic shall be allowed to keep moving at all times.

### 3.02 HOT THERMOPLASTICS.

A. The material shall be applied to the pavement by the spray method or by the extrusion method wherein one side of the shaping die is the pavement and the other three sides are contained by, or a part of, suitable equipment for heating and controlling the flow of material.

B. The material, when formed into traffic stripes, must be readily renewable by placing a thin overlay of new material directly over an old line of the same material. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place.

C. The finished lines shall have well-defined edges. The Contractor shall clean off dirt and grease where necessary by sand blasting or other approved methods.

D. A primer sealer of a type and if recommended by the manufacturer of the thermoplastic material shall be applied to the pavement surface prior to the installation of the thermoplastic material.

E. To insure optimum adhesion, the thermoplastic material shall be installed in a melted state at a temperature of  $375^{\circ}$  to  $475^{\circ}$ F ( $190^{\circ} - 246^{\circ}$ C).

F. Longitudinal lines shall be offset at least (2) inches (5cm) from construction joints of portland cement concrete pavements.

G. Openings of (6) inch (15cm) lengths shall be provided at (20) foot (6m) intervals in edge lines placed on the inside of superelevated curves to prevent the ponding of water on the pavement surface.

H. For non-defective pavement surfaces carrying volumes less than 50,000 vehicles per day, the contractor shall guarantee to replace or renew without cost to the City that part of the pavement markings installed which have not remained to perform useful service as follows:

1. Crosswalks and Stop Lines applied at a thickness of 125 mils (3.157mm): 75% of the total of any one intersection for one year

2. Lane Lines, Edge Lines and Center Lines applied at a thickness of 90 mils (2.286mm): 80% of a unit for one year and 60% of a unit for two years. (A "unit" is defined as any length of highway having installed thereon 2,000 lineal feet (610 m) of line of specified width in any combination or pattern). Warranties for thinner lines in these applications or for traffic volumes may be reduced commensurately.

3. The replacement material installed under this guarantee shall be guaranteed the same as the original material, from the date of the original installation.

Note 1: The intent is not to extend the original warranty period.

Note 2: The warranty does not cover those markings that have been removed by such devices as snow plows, chains, or studded tires.

### 3.03 COLD THERMOPLASTICS.

A. The cold thermoplastic material shall be applied to non-defective pavement surfaces that are free from dirt or other foreign matter. For normal application the pavement temperature shall be  $60^{\circ}$ F or more. Application to be made at pavement temperatures below  $60^{\circ}$ F shall be approved in writing by the Owner. Special instructions shall be supplied by the vendor for application to be made at pavement temperatures below  $60^{\circ}$ F.

B. Adhesive, activators, or special coatings for various types of pavement surfaces provided with the thermoplastic material shall be installed according to the manufacturer's specifications. Cold plastics may be applied to new asphaltic pavement immediately prior to the final rolling of the new surface and rolled into place with conventional pavement and highway rollers.

C. Longitudinal lines shall be offset at least 2 inches from construction joints of portland cement concrete pavements. Openings of 6 inches length shall be left at 20 foot intervals in edge lines placed on the inside of superelevated curves so as to prevent the ponding of drainage of the pavement surface.

## 3.04 PLIANT POLYMER FILM.

The marking film shall be applied to asphaltic concrete and portland cement concrete surfaces according to the manufacturer's recommendations at pavement surface and ambient air temperatures 60<sup>°</sup>F or more and when daily temperatures above 70<sup>°</sup>F are prevailing to insure film conformance and adherence to pavement surface. Following application, the marking film is ready for traffic. Areas of minor damage shall be patched with an inlay of this film in accordance with the manufacturer's recommendation.

## 3.05 SHEETING AND TAPE.

Sheeting and tape material shall be applied directly to clean portland cement concrete and asphaltic concrete surfaces according to the manufacturer's recommendations at surface temperatures above 35<sup>0</sup>F and shall be ready for traffic immediately following application.

## 3.06 STRIPING POWDER.

The powder shall be flame sprayed to clean portland cement concrete and asphaltic concrete to produce a solid, full width line of the required thickness. A liquid road surface conditioner may be required for application to some road surfaces before the application of the marking powder. Liquid road surface conditioner shall be applied by pressure spray gun system or by conventional paint roller.

## 3.07 RAISED REFLECTIVE PAVEMENT MARKERS.

A. Raised reflective pavement markers shall be cemented to the pavement with epoxy resin adhesive spaced as shown on the Plans. Markers shall not be installed over joints in rigid type pavements.

B. The portion of the highway surface to which the marker is attached by the adhesive shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers and any other material which would adversely affect the bond of the adhesive. Cleaning shall be done by sand blast cleaning on all pavement surfaces. The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient t result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been pressed in place. All markers shall be cemented to the pavement within 10 minutes after the start of mixing of any one batch of adhesive. The marker shall be placed in position and pressure applied until firm contact is made with the pavement. Excess adhesive around the edge of the marker and all adhesive obscuring the reflective surface of the marker shall be immediately and completely removed with a clean, absorbent cloth. The use of thinners or solvents or any type for this purpose is prohibited. The marker shall be protected against impact until the adhesive has hardened to the degree designated by the Owner.

C. The specified adhesive requires that mixing operation and placing of the marker be done rapidly. The pot life of the adhesive may be prolonged by cooling after mixing the components or by spreading it out in a thin layer on a board before application. Any mixed batch of adhesive which becomes viscous because of its acquiring a partial set such that the marker cannot be pressed into place with the adhesive readily extruding from the edges shall not be used.

D. Immediately prior to mixing, each component of the adhesive (Package A and B) shall be thoroughly redispersed by stirring. Any material that cannot be readily redispersed shall be rejected. After redispersement, one volume from Package A shall be mixed with one volume from Package B until a uniform gray color without visible streaks of white or black is obtained.

E. When approved fast setting adhesive is used, the components shall be mixed by a 2 component type automatic mixing and extrusion apparatus, and the markers shall be placed immediately after the adhesive has been mixed and extruded.

## 3.08 REMOVAL OF PAINTED MARKINGS.

A. Painted pavement markings shall be removed where specified. The method used for paint removal shall be approved by the Owner prior to the beginning of the work. Removal of existing painted pavement markings by painting over with black paint or asphalt will not be allowed.

B. When the method of removal causes sand or other material to be accumulated on the pavement, the residue shall be removed as the work progresses. Painted markings shall be removed by methods that cause the least possible damage to the pavement. All damage to the pavement or surface caused by pavement marking removal shall be repaired as directed by the Owner at the

Contractor's expense.

C. Where a plastic marking will replace the painted marking, paint removal shall consist of removing enough paint to assure proper installation of the plastic. The paint removal shall be uniform and shall expose a minimum of 75 percent of the surface area that is to receive the plastic materials.

# PART 4 – CERTIFICATION AND GUARANTEE

4.01 The Contractor shall furnish the Owner at, or before, the time of delivery, three copies of certification of conformance to the tests and requirements for traffic pavement marking materials of these Specifications. The certification shall consist of the following:

- A. The name of the manufacturer of the material.
- B. The batch or lot number of the material represented.
- C. The test results of each required test.

D. A statement to the effect that a representative sample of the specific lot shipped has been tested and meets the requirements of these Specifications.

E. The name and title of the authorized representative of the manufacturer certifying to the correctness of the report.

F. The manufacturer shall guarantee the traffic pavement marking material supplied under these Specifications to meet all parts of these Specifications and shall agree to replace any amount of material found defective during inspection or installation of the material.

G. All replacement by the manufacturer shall be free of charge to the City, including all freight and handling charges. Material replaced under this guarantee shall, at the written request and expense of the manufacturer, be returned to the manufacturer by the City, unless said material has been installed.

### PART 5 - MEASUREMENT

Accepted installed items related to pavement marking shall be measured in the units and as described herein. All work not described herein, included removal of existing pavement marking, shall be considered incidental to the installation of pavement markings and shall not be measured separately.

### 5.01 RAISED REFLECTIVE PAVEMENT MARKERS.

Accepted raised reflective pavement markers of each type shall be measured by the raised reflective pavement marker complete in place, per each.

### 5.02 PAINTED CURB.

Accepted curb painting shall be measured in linear feet to the nearest foot along the edge of the painted curb complete in place.

### 5.03 SOLID BARRIER LINE (4")

Accepted solid barrier lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

### 5.04 BROKEN LANE LINE (4")

Accepted broken lane lines shall b e measured in linear feet to the nearest foot along the center of each line including painted and unpainted portions complete in place.

## 5.05 DOUBLE SOLID BARRIER LINE (4")

Accepted double solid barrier lines shall be measured in linear feet to the nearest foot along the center of each pair of lines complete in place.

### 5.06 DOUBLE BROKEN BARRIER LINE (4")

Accepted double broken barrier lines for reversible lanes shall be measured in linear feet to the nearest foot along the center of each pair of lines including painted and unpainted portions complete in place.

## 5.07 DOUBLE BROKEN / SOLID BARRIER LINE (4")

Accepted double broken / solid barrier lines for restriction of passing in one direction or two-way left turn lanes shall be measured in linear feet to the nearest foot along the center of each pair of lines including painted and unpainted portions complete in place.

### 5.08 DOTTED LINE (4")

Accepted dotted lines for extension of lines through intersections shall be measured in linear feet to the nearest foot along the center of each marked dot complete in place.

## 5.09 SOLID BARRIER LINE (12")

Accepted solid barrier lines for channelization shall be measured in linear feet to the nearest foot along the center of each line complete in place.

#### 5.10 CROSSWALK.

Accepted crosswalk lines shall be measured in linear feet to the nearest foot along the center of each line complete in place. The boundary lines shall be measured separately.

#### 5.11 STOP LINE.

Accepted stop lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

### 5.12 TRANSVERSE SHOULDER LINES.

Accepted transverse shoulder lines shall be measured in linear feet to the nearest foot along the center of each line complete in place.

#### 5.13 CHANNELIZATION.

Accepted pavement channelization marking complete in place shall be measured in square feet to the nearest square foot for the total area, marked and unmarked, to be channelized including boundary lines.

#### 5.14 – 5.20 PAVEMENT MARKING (DESCRIPTION).

Accepted pavement marking (description) complete in place shall be measured as described on the Plans or in the Contract Documents.

#### 5.21 STRAIGHT ARROW.

Accepted straight arrows shall be measured by the pavement arrow complete in place, per each.

#### 5.22 TURN ARROW.

Accepted turn arrows shall be measured by the pavement arrow complete in place, per each.

#### 5.23 STRAIGHT-TURN ARROW.

Accepted straight-turn arrows shall be measured by the pavement marking arrow complete in place, per each.

#### 5.24 DOUBLE TURN ARROW.

Accepted double turn arrows shall be measured by the pavement marking arrow complete in place, per each.

#### 5.25 PAVEMENT MARKING WORD "ONLY"

Accepted word "ONLY" pavement markings shall be measured by each pavement marking word complete in

place, per each work.

5.26 PAVEMENT MARKING WORD (DESCRIPTION).

Accepted pavement marking words as described on the Plans shall be measured by each pavement marking word complete in place, per each word.

#### 5.27 PAVEMENT MARKING DESIGNS (DESCRIPTION).

Accepted pavement marking designs as described on the Plans shall be measured by each pavement marking design complete in place, per each design.

EXISTING STRIPING REMOVAL AS PER PLAN. 5.28

Accepted lane striping and pavement markings in place as per plan. Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price shall be full compensation.

#### LANE STRIPING AND PAVEMENT MARKINGS IN PLACE AS PER PLAN. 5.29

Accepted removal of all existing striping as shown per plan. Payment will be made for the work, completed and accepted by the Owner, at the contract lump sum price, which price shall be full compensation.

## PART 6 – PAYMENT

6.01 The unit price to be paid for pavement markings shall include the locating and layout of all pavement markings. The contract unit price shall be full compensation for accepted and installed pavement marking, complete in place, measured as described herein and shall include layout, materials, labor, equipment, tools, royalties, and other incidentals required to complete the work. Payment shall be made under the Pay Item Schedule which describes each pay item. The material of which each pavement marking except Item 02760 5.01, "Raised Reflective Pavement Markers", is to be constructed is defined by the two digits following the decimal according to the following code:

Α.		<u>Code</u>	<u>Material</u>		
		01	Conventional Reflective Pavement Marking Paint (Type "A" Paint)		
02 03 04 05 06		02	Rapid Dry Reflective Pavement Marking Paint (Type "B" Paint)		
		03	Hot Thermoplastics		
		04	Cold Thermoplastics		
		05	Pliant Polymer Film		
		06	Sheeting and Tape		
		07	Striping Powder		
6.02 PAYMENT WILL BE MADE UNDER:		L BE MADE UNDER:			
Item Number		er	Item Description	<u>Pay unit</u>	
02760-5.01			RAISED REFLECTIVE PAVEMENT MARKER		

02760-5.01 02760-5.01.01 02760-5.01.02 02760-5.01.03	RAISED REFLECTIVE PAVEMENT MARKER Raised Reflective Pavement Marker (Type I) Raised Reflective Pavement Marker (Type II) Raised Reflective Pavement Marker (Type III)	Each Each Each	Each
02760-5.02	PAINTED CURB	Lin. Ft.	
02760-5.03	SOLID BARRIER LINE (4")	Lin. Ft.	

02760-5.04	BROKEN LANE LINE (4")	Lin. Ft.
02760-5.05	DOUBLE SOLID BARRIER LINE (4")	Lin. Ft.
02760-5.06	DOUBLE BROKEN BARRIER LINE (4")	Lin. Ft.
02760-5.07	DOUBLE BROKEN / SOLID BARRIER LINE (4")	Lin. Ft.
02760-5.08 02760-5.09	DOTTED LINE SOLID BARRIER LINE (8")	Lin. Ft. Lin. Ft.
02760-5.10	CROSSWALK	Lin. Ft.
02760-5.11	STOP LINE	Lin. Ft.
02760-5.12	TRANSVERSE SHOULDER LINES	Lin. Ft.
02760-5.13	CHANNELIZATION	Lin. Ft.
02760-5.14-5.20	PAVEMENT MARKING (DESCRIPTION)	Each
02760-5.21	STRAIGHT ARROW	Each
02760-5.22	TURN ARROW	Each
02760-5.23	STRAIGHT-TURN ARROW	Each
02760-5.24	DOUBLE TURN ARROW	Each
02760-5.25	PAVEMENT MARKING WORD "ONLY"	Each
02760-5.26	PAVEMENT MARKING WORD (DESCRIPTION)	Each
02760-5.27	PAVEMENT MARKING DESIGN (DESCRIPTION)	Each
02760-5.28	EXISTING STRIPING REMOVAL AS PER PLAN	LumpSum
02760-5.29	LANE STRIPING & PAVEMENT MARKNGS IN PALCE AS PER PLANING REMOVAL AS PER PLAN	Lump Sum

# **END OF SECTION 02760**

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02820 CHAIN LINK FENCE

## PART 1 - SCOPE

This work shall consist of the construction of chain link fences and gates in accordance with these Specifications and at the locations and in conformity with the lines, grades, and dimensions shown on the Plans or as directed by the Owner. Chain link fence may be located atop concrete channel lining walls, retaining wall or similar structure, or may be located independently of structures.

## PART 2 - MATERIALS AND EQUIPMENT

## 2.01 MATERIALS.

Materials used throughout the project shall be of constant design and manufacture in respect to individual items or parts, excepting where the proposed fence will be an extension of an existing fence, in which case the new fence shall be constructed of materials similar in appearance to those in the existing fence and continued until broken by cross street, railroad, fence ditch, or other physical feature. Unless otherwise directed, new materials shall be as described hereinafter.

## A. Fabric.

The fabric shall be zinc coated steel chain link type meeting the requirements of AASHTO M 181 for Type I, Class B fabric (zinc coating =  $2 \text{ oz/ft}^2$ ). All chain link fabric shall be manufactured of No. 9 gauge wire pickets, forming a uniform 2 inch mesh, and shall be of the height shown on the Plans or specified in the Contract Documents. Fabric up to and including 60 inches high shall be knuckled at the top and bottom selvage and fabric over 60 inches high shall be twisted on the top selvage and knuckled on the bottom selvage.

### B. Line Posts.

1. Line posts shall be zinc coated steel pipe or H-sections of the following dimensions and of the lengths shown on the Plans or specified herein:

			H - Section			
	Nominal	Outsid	le We	eight	Wei	ght
Fence <u>Height</u>	Size <u>(inch)</u>	Diameter <u>(inch)</u>	Per Foot <u>(Pounds)</u>	Dimension (inches)	Per Foot (pounds)	-
6 feet or less	1 ½	1.9	2.72	1.875 x 1.625	2.70	
6 feet to 8 feet	2	2.375	3.65	2.25 x 1.95	4.10	

2. Steel pipe shall conform to ASTM A 120 or AASHTO M181-85I Grade 2 and H-Sections shall be produced from ASTM A 570 and ASTM A 572, Grade 45. The weight of zinc coating shall be a minimum of 1.8 oz/square foot. The weight of zinc coating and weight per foot for steel post meeting the requirements of AASHTO M181-85I grade 2 may vary from the above noted valves.

### C. End Posts, Corner And Pull Posts, And Braces.

1. End posts, corner posts, and pull posts shall be zinc coated steel pipe or square sections of the following dimensions and of the lengths shown on the Plans or specified herein:

			Square Section		
	Nominal	Outside	e We	eight Out	side Weight
Fence	Size	Diameter	Per Foot	Dimension	Per Foot
<u>Height</u> 6 feet	<u>(inch)</u> 2	<u>(inch)</u> 2.375	<u>(Pounds)</u> 3.65	<u>(inches)</u> 2.0	<u>(pounds)</u> 3.60
or less	-				
6 feet to 8 feet	2 1⁄2	2.875	5.79	2.5	5.70

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02820 CHAIN LINK FENCE

2. Diagonal braces shall be 1 ¼ inch (1.660 inch O.D.) galvanized steel pipe, weighing 2.27 pounds per foot. Steel pipe and square sections shall conform to ASTM A 120 or AASHTO M181-85I Grade 2. The weight of zinc coating and weight of pipe per foot for steel post meeting the requirements of the AASHTO M181-85I grade 2 may vary from the above noted valves.

## D. <u>Top Rail.</u>

Top rail shall be used when specified on the Plans in lieu of top tension wire. The top rail shall be  $1\frac{1}{4}$  inch (1.660 inch O.D.) galvanized steel pipe, weighing 2.27 pounds per foot, meeting the requirements of ASTM A 120 or AASHTO M181-85I Grade 2. Top rails in random lengths shall be fitted with expansion sleeves for connecting lengths into a continuous run or shall have a 3 inch swagged end. Suitable fittings shall be provided for securing top rail to each gate, corner, and end post.

## E. Barbed Wire.

Barbed wire shall consist of two No. 12 ½ gauge, twisted steel strands with No. 14 gauge four-point barbs spaced not more than 5 inches apart. The galvanized strands shall meet the requirements of ASTM A 121, Class II coating.

### F. Miscellaneous Fittings And Hardware.

Zinc coated miscellaneous fittings and hardware shall be commercial grade steel or better quality, pressed, wrought, or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric, posts, and wires of the quality specified herein. All steel fittings and hardware shall be galvanized in accordance with AASHTO M 111.

## G. Barbed Wire Support Arms.

Barbed wire support arms shall be single arms for carrying 3 barbed wire strands. Barbed wire support arms for line posts shall be at an angle of 45 degrees (plus or minus 5 degrees) and shall be fitted with clips or other suitable means for attaching three lines of barbed wire, with the top strand of barbed wire 12 inches (plus or minus 1 inch) above and horizontally from the fence line, and the remaining two strands of barbed wire spaced uniformly between the top of the fence fabric and top strand of barbed wire. Support arms shall be capable of withstanding a load of 250 pounds when the base is clamped securely and the vertical load applied from where the outer strand of barbed wire passes over the arm.

### H. <u>Wire Ties.</u>

Wire ties shall be No. 9 gauge and shall be either zinc coated steel, aluminum coated steel or aluminum alloy and sufficient in strength and other properties to provide a balanced design when used in conjunction with fabric, posts, and wire of the qualities specified herein. When tension wire is used, wire ties and clips for fastening fabric to tension wire shall be No. 11 gauge.

### I. Tension Wire.

Tension wire shall be used at the bottom of fencing fabric when not otherwise secured and used at the top unless a top rail is specified. Tension wire shall be No. 6 gauge, spring rolled, aluminized steel wire.

### J. <u>Truss Rods and Turnbuckle.</u>

Truss rods shall be 3/8 inch diameter steel rods and shall be equipped with a turnbuckle having a take-up of not less than four inches and shall be galvanized in accordance with AASHTO M 111.

### K. Fence Gates.

Fence gates shall be of the kinds and sizes shown on the Plans or specified in the Contract Documents. They shall be of the swing type, complete with latches, stops, keepers, hinges, and fabric. The latch shall have provision for fastening with a padlock. The gates shall be covered with fabric matching the fence. The hinges shall be of adequate strength to support the gate and shall not twist or turn under action of the gate. The gates, gate posts, and braces shall be of the same material

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02820 CHAIN LINK FENCE

and finish as the adjoining fence. All gate posts and rails shall be furnished complete with ball caps and rail ends.

1. Posts, braces, and framing members for chain link fence gates shall be zinc coated steel pipe meeting the requirements of Specification Section 02820 Paragraph 2.01.C. Gate post shall be 2  $\frac{1}{2}$  inch (2.875 inch O.D.) pipe weighing 5.79 pounds per foot for gate widths of 5 feet or less; and 3  $\frac{1}{2}$  inch (4.0 inch O.D.) pipe weighing 9.10 pounds per foot for gate widths between 5 feet and 13 feet.

2. Framing members and interior bracing shall be of the following minimum dimensions:

Fence Height	<u>Fra</u> Nominal Size	<u>aming and Bracing</u> Outside Diameter	Weight Per Foot
6 feet or less	1 ¼	1.66	2.27
6 feet to 8 feet	1 ½	1.90	2.72

Gate frames shall be welded at all corners or assembled with corner fittings. When corner fittings are used, gates shall have truss rods as specified in Specification Section 02820 Paragraph 2.01.J to prevent sag or twist. All welded joints shall receive a shop applied zinc coating equivalent in thickness to that of the members being joined.

- 3. Fabric shall meet the requirements of Specification Section 02820 Paragraph 2.01.A.
- 4. Barbed wire shall meet the requirements of Specification Section 02820 Paragraph 2.01.E.

5. Miscellaneous fittings and accessories shall meet the applicable requirements of Specification Section 02820 Paragraphs 2.01 F, G, H, and J. The hinges shall be of such design to allow the gate to swing back 180 degrees, parallel with the fence line.

L. Concrete.

Concrete for post footings shall be Class A as specified in Specification Section 03050.

M. General.

1. Posts shall be fitted with ornamental tops or extension arms as stipulated in the Plans or in the Contract Documents. Caps or ornamental tops for tubular posts shall have a base fitting into the post with a flange extending over the top of the posts to protect against moisture. When a top rail is provided, all posts shall be provided with caps having a ring or hole suitable for the through passage of the top rail. Rail and brace ends, or other suitable means of connection, shall be provided when top rail or braces are required.

2. Fabrication of all materials shall be in conformity to the sizes, shapes, and other factors set out in these Specifications or shown on the Plans, and shall show careful, finished craftsmanship in all respects.

3. The weights specified for steel posts, braces, and rails are nominal weights, and a plus or minus tolerance of 5 percent will be permitted. All posts located on the top of concrete channel lining walls or similar structure shall be of sufficient length to be set fully 12 inches into the wall or structure.

4. All line posts located on the ground shall be of sufficient length to be set fully 24 inches deep
#### CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02820 CHAIN LINK FENCE

into concrete footings, and all end, corner, and pull posts shall be of sufficient length to be set 30 inches deep into concrete footings.

#### 2.02 EQUIPMENT

All equipment necessary for the satisfactory performance of the work shall be on hand and inspected by the Owner before construction work will be permitted to begin.

#### PART 3 - CONSTRUCTION REQUIREMENTS

#### 3.01 GENERAL REQUIREMENTS.

A. Fencing shall be placed atop concrete structures, such as concrete channel linings, in accordance with Plans and Design Standards. Fence post inserts will normally have been set into the concrete walls prior to fence construction activities. Inserts shall be 12 inch ling solid wall PVC pipe conforming to ASTM D2241, thin wall metal conduit conforming to ANSI C 80.3 and sealed at one end or other material approved by the Owner. Cans, bottles and the like shall not be used as inserts. Alternatively, posts may be sect directly into the structure concrete as the concrete is poured, making sure that all posts are plumbed and held securely in the proper position until the concrete has set.

B. The inside diameter of the inserts shall be sufficient to provide a minimum of ¼ inch clear space between the outside surface of the post and the inside surface of the insert. Inside of inserts shall be cleaned of debris and other foreign matter, insert space filled full of nonshrinking grout, the posts set into place in the insert and plumbed, and the post held plumb until the grout has set. All excess grout shall be removed before it sets. Where inserts have not been provided in the concrete structure, post holes of the same diameter and depth as required for inserts shall be cored in the concrete. Posts shall be set in cored holes in the same manner as posts set in inserts.

#### 3.02 FENCING SET INDEPENDENTLY OF STRUCTURES.

A. Before beginning construction or placing of fences, all necessary work for clearing and grubbing, removal of structures and obstructions, and site preparation shall be performed in accordance with the applicable Sections of these Specifications. Clearing for fence construction shall not extend beyond the construction easements without written approval of the property owner. Living trees and shrubs one foot or more each side of the fence line shall remain undisturbed unless otherwise directed by the Owner. Any rock protruding above the ground surface and in the line of the fence shall be removed to ground surface.

B. Posts for chain link fence shall be set at intervals not to exceed 10 feet. The interval between posts shall be measured parallel to the bottom of the fabric of the proposed fence and in line of fence from center to center of post.

C. All line posts located on the ground shall be set fully 24 inches deep in concrete footings; end, corner and pull post shall be set 30 inches deep in concrete footings. Diameters of footing shall be : for line post not less than 8 inches; for end, corner or pull post not less than 10 inches. Footings for gate post shall be designed to support the cantilever load of the gate. Concrete for embedment of posts and for anchors shall be Class A and shall be crowned to shed water. Concrete shall be cured a minimum of 3 days prior to installation of fabric.

#### 3.03 ERECTING FENCE.

A. For fence heights less than 6 feet a top and bottom tension wire shall be installed, unless specified otherwise. For fence heights 6 feet or greater a top rail and bottom tension wire shall be installed. When a top rail is specified, the top rail shall be connected with expansion sleeves to form a continuous rail.

B. Bracing assemblies consisting of the specified bracing pipe as the compression member and

#### CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS SECTION 02820 CHAIN LINK FENCE

specified truss rod as the tension member shall be installed and securely tightened prior to installation of fabric. One brace assembly shall be provided for end post and two brace assemblies for corner and pull posts. When fence alignment changes abruptly by more than 30<sup>°</sup> a corner brace assembly shall be installed. When the internal angle of a curved fence alignment exceeds 30<sup>°</sup> one brace assembly shall be installed at each point of curvature. Pull post shall be installed at abrupt changes in grade or at the midpoint of a straight fence alignment exceeding 500 feet in length.

C. The fabric shall be placed on the side of the post as directed by the Owner and 2" above ground or concrete structure. Fabric shall be secured at one end and sufficient tension applied to remove all slack before making attachment elsewhere. The fabric shall be fastened to the posts with wire ties at intervals not exceeding 14 inches. Fabric shall be fastened to the tension sire or rail with wire ties at intervals not exceeding 24 inches. When specified, barbed wire shall be installed and pulled taut before being permanently attached to a post or arm. Fence gates shall be constructed in accordance with the Plans, Specifications and manufacturer's standards and instructions, or as directed by the Owner.

#### 3.04 TEST

Before any fencing is installed, manufacturer's certificates stating that the fabric, post, rails, braces, barbed wire, tension wire, ties and hardware are made in accordance with applicable standards as specified herein shall be filed with the Owner. At the option of the Owner, test samples of any materials to be furnished shall be furnished at the job site before work commences.

#### PART 4 – MEASUREMENT

#### 4.01 CHAIN LINK FENCE.

Fences will be measured for payment by the linear foot along the bottom of the fabric and from end to end of fence, complete and in place, deducting the width of gates and openings, for each type and height of fence provided.

#### 4.02 CHAIN LINK FENCE.

Gates will be measured for payment by the unit, per each, complete and in place, for the kinds and dimensions as shown on the Plans.

#### PART 5 – PAYMENT

#### 5.01 CHAIN LINK FENCE.

The accepted quantities of chain link fence will be paid for at the contract unit price per linear foot, complete and in place, for each type and height of fence, which price will be full compensation for fabric, posts, rails, tension wire, miscellaneous hardware, post hole excavation, concrete footings, concrete coring and grouting.

#### 5.02 FENCE GATES.

The accepted quantities of gates will be paid for at the contract unit price per each, complete and in place, for the kinds and dimensions of gates stipulated or shown on the Plans.

#### 5.03 Payment will be made under:

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02820-5.01 02820-5.01	CHAIN LINK FENCE ' Height x Description	Linear Foot Linear Foot
02820-5.02 02820-5.02	FENCE GATES' Height x' Width of Opening	Each Each

### CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS <u>SECTION 02820 CHAIN LINK FENCE</u>

END OF SECTION 02820

#### PART 1 - SCOPE

1.01 Traffic control signs include all regulatory, warning, and guidance signs designed to convey a message to users of the streets and highways. The work covered by this Specification Section shall consist of the construction of foundations and supports and the fabrication, furnishing, assembly, and erection of traffic control signs on the supports.

#### PART 2 - MATERIALS AND EQUIPMENT

#### 2.01 GENERAL REQUIREMENTS

A. Traffic control and traffic information signs shall be constructed and erected in accordance with these Specifications and at such locations and in conformity with the lines and grades indicated on the Plans or as otherwise directed by the Owner.

B. All signs shall be of the size, dimensions, shape, and legend as indicated on the Plans and/or as shown in the Tennessee Department of Transportation Manual on Uniform Traffic Control Devices, Current Edition (MUTCD). All materials and construction of traffic control signs furnished, fabricated, and/or installed under these Specifications shall be certified and/or guaranteed to the City by the Contractor according to the requirements of Specification Section 00710 Article 18.

#### 2.02 SIGNS

A. All signs shall be fabricated from flat aluminum sheets meeting the requirements of these Specifications and covered with the reflective sheeting material specified herein, unless otherwise specified. Sign message color and dimensions shall conform to the requirements of the MUTCD. Sign legends shall be screened with process inks compatible with the Reflective Sheeting.

B. All colors for signs, when thoroughly dry, shall match the Standard Interstate Colors (AASHTO Manual) when compared in natural daylight. Black paint for nonreflectorized message application shall be high quality opaque process paste made with synthetic resin as manufactured or recommended by the manufacturer of the reflective sheeting. Transparent blue, red, and green paint and thinner for the application on the silver reflective sheeting for signs and reflectorized backgrounds shall be as recommended by the manufacturer of the reflective sheeting.

C. <u>Flat Sheet Aluminum For Signs.</u> All traffic control signs shall be fabricated of a single piece of flat sheet 0.080 gauge aluminum meeting the requirements of ASTM B 209 without joints and without supporting frame, unless otherwise specified. The aluminum sign blanks shall be of Alloy 6061-T6 or as specified, vapor degreased and etched or treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product in strict accordance with the recommendations of the manufacturer of the chemical used. All corner radii shall be cut and holes shall be punched as required by the MUTCD.

D. <u>Extruded Aluminum Sign Blades.</u> All street name signs shall be fabricated from extruded aluminum meeting the requirements of ASTM B 221, Alloy 6061-T6, 0.250 bulk, 0.091 web, vapor degreased and etched or treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product, in strict accordance with the recommendations of the manufacturer of the chemical.

E. <u>Hardware</u>. All bolts, nuts, washers, and other hardware shall conform to the requirements of the following specifications:

- 1. Aluminum
  - a. Bolts.

Bolts shall meet the requirements of ASTM B 211, Alloy 2024-T4. Chromated sealed anodic coating at least 0.0002 inch thick shall be applied to all finished bolts

b. Nuts.

Nuts shall meet the requirements of ASTM B 211, Alloy 6262-T9 for 5/16 inch and larger, and Alloy 2024-T4 for  $\frac{1}{4}$  inch and under, tamper proof type.

c. Washers.

Washers shall meet the requirements of ASTM B 209, Alloy Alclad 2024-T4.

d. Caps, Clamps, Clips, Brackets, and Other Hardware.

Caps, clamps, clips, brackets, and other hardware shall meet the requirements of the following specifications: ASTM B 308, Alloy 6061-T6 for structural shapes; ASTM B 221, Alloy 6063-T6 for extruded shapes; and ASTM B 26, Alloy SG-70A-F for cast shapes.

2. Steel.

a. Bolts, Nuts, and Washers. Bolts, nuts, and washers shall be cadmium plated meeting the requirements of ASTM A 307.

b. Other Hardware.

Other hardware shall meet the requirements of ASTM A 36, galvanized in accordance with ASTM A 123, for structural shapes and plates and ASTM A 27, galvanized in accordance with ASTM 123, for cast shapes.

3. Stainless Steel.

a. Bolts and Washers.

Bolts and washers shall meet the requirements of ASTM A 193, Austenitic Steel.

b. Nuts.

Nuts shall meet the requirements of ASTM A 194, Grade 8F, except that the nuts shall be lock nuts with semi-finished hex nuts equivalent to American Standard Heavy Series.

F. <u>Reflective Sheeting Materials.</u> Sign face materials shall be of Reflective Sheeting Material (Glass Bead Retroreflective Element Material) conforming to the following requirements unless otherwise specified.

1. Description.

a. Reflective sheeting shall consist of a Retroreflective lens system having a smoother outer surface. When adhesive backing is used the sheeting shall have a precoated adhesive on the backside protected by an easily removable liner. Types I – IV refer to levels of performance in terms of reflective intensity. Type III Reflective Sheeting Material with Class 2 adhesive backing shall be used unless otherwise specified.

2. Color Requirements.

a. The colors specified shall be matched visually and shall by within the color tolerance limits shown on the appropriate Highway Color Tolerance Charts issued by the Federal Highway Administration utilizing the instruction thereon. Certification as to conformance with this requirement shall be provided by the Contractor.

(or)

b. Through instrumental color testing the diffuse day color of the reflective material shall conform to the requirements of Table I or II and shall be determined in accordance with ASTM E 97, "Standard Method of Test for 45 Degree, 0 Degree Directional Reflectance of

Opaque Specimens by Filter Photometry." (Geometric characteristics must be confined to illumination within 10 degrees of, and centered about, a direction of 45 degrees from the perpendicular to the test surface; viewing is within 15 degrees of, and centered about, the perpendicular to the test surface. Condition of illumination and observation must not be interchanged.) The standards to be used for reference shall be the MUNSELL PAPERS designated in Tables 02891-1 and 02891-2. The papers must be recently calibrated on a spectrophotometer. The test instrument shall be one of the following or approved equal:

(1) GARDNER Multipurpose Reflectometer or Model XL20 Color Difference Meter.

(2) GARDNER Model AC-2a Color Difference Meter or Model XL30 Color Difference Meters.

- (3) MEECO Model V Colormaster.
- (4) HUNTERLAB D25 Color Difference Meter.

#### TABLE 02891-1 Color Specification Limits and Reference Standards Types I and II Sheeting

Chromaticity Coordinates* (Corner Points)									Re	flect Limi	tance ts		
		1		2		3	4	4	(%	Y) Y		Re	er Starre
Color	х	У	Х	У	Х	у	х	У	N	lin Max	(Mur	isell	Papers)
White**	.305	.290	.350	.342	.321	.361	.276	.308	35		6.3G	iΥ	6.77/0.8
Red	.602	.317	.664	.336	.644	.356	.575	.356	8	12	8.2R		3.78/14.0
Orange	.535	.375	.607	.393	.582	.417	.535	.399	18	30	2.5Y	R	5.5/14.0
Brown	.445	.353	.604	.396	.556	.443	.445	.386	4	9	5.0Y	R	3/6
Yellow	.482	.450	.532	.465	.505	.494	.475	.485	29	45	1.25	Y	6/12
Green	.107	.439	.155	.460	.130	.369	.180	.391	3.5	9	0.65	BG	2.84/8.45
Blue	.147	.075	.176	.091	.176	.151	.106	.113	1	4	5.8P	В	1.32/6.8

\* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illumination source C. \*\*Silver white is an acceptable color designation.

\*\*\*Available from Munsell Color Co., 2441 Calvert St., Baltimore, MD 21218

#### **TABLE 02891-2**

Color Specification Limits and Reference Standards Types III and IV Sheeting

Chromaticity Coordinates* (Corner Points)								Reflec Limi	tance ts			
		1		2		3		4	(%	Y) Y	Re	ef Std***
Color	х	У	х	У	х	У	х	У	ÌN	lin Max	(Munsell	Papers)
White**	.303	.287	.368	.353	.340	.380	.274	.316	27		5.0PB	7/1
Red	.613	.297	.708	.292	.636	.364	.558	.352	2.5	11	7.5R	3/12
Orange	.550	.360	.630	.370	.581	.418	.516	.394	14	30	2.5YR	5.5/14.0
Yellow	.498	.412	.557	.442	.479	.520	.538	.472	15	40	1.25Y	6/12
Green	.030	.380	.166	.346	.286	.428	.201	.776	3	8	10G	3/8
Blue	.144	.030	.244	.202	.190	.247	.066	.208	1	10	5.8PB	1.32/8.8

\* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illumination source C.

\*\*Silver white is an acceptable color designation.

\*\*\*Available from Munsell Color Co., 2441 Calvert St., Baltimore, MD 21218

3. Reflective Intensity. The reflective sheeting shall have minimum Specific Intensity per unit area (SIA) as shown in Tables 02891-3 through 02891-6 expressed as "candelas per footcandle per square foot" ((Cd 1c<sup>-1</sup>) ft.<sup>-2</sup>). Measurement of SIA shall be conducted in accordance with the method detailed in Section 718, Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (Federal Highway Specifications).

#### **TABLE 02891-3**

#### Minimum Specific Intensity Per Unit area (SIA) (Candelas Per Footcandle Per Square Foot) Type I Sheeting

Observation	Catronoo	Type Toneeung								
Angle(*) Blue	Angle(*)	White	Red	Orange	Brown	Yellow	Green			
0.2	-4	50	10	13.0	1.0	25	5	3.8		
0.2	+30	12	3	4.0	0.3	7	2	1.0		
0.5	-4	15	15	6.5	0.3	10	3	2.0		
0.5	+30	6	1	2.5	0.2	3	1	0.8		

## TABLE 02891-4Minimum Specific Intensity Per Unit area (SIA)<br/>(Candelas Per Footcandle Per Square Foot)<br/>Type II Sheeting

Observation Angle(*) Blue	Entrance Angle(*)	White	Red	Orange	Brown	Yellow	Green	
0.2	-4	70	14.5	25.0	1.0	50	9.0	4.0
0.2	+30	30	6.0	7.0	0.3	22	3.5	1.75
0.5	-4	30	7.5	13.5	0.3	25	4.5	2.0
0.5	+30	15	3.0	4.0	0.2	13	2.2	0.8

# TABLE 02891-5Minimum Specific Intensity Per Unit area (SIA)<br/>(Candelas Per Footcandle Per Square Foot)<br/>Type III SheetingA – Glass Bead Retroreflective Element Material

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45	20.0
0.2	+30	150	25	60	100	25	11.0
0.5	-4	95	15	30	82	15	7.5
0.5	+30	65	10	25	45	10	5.0

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45.0	100	170	45.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	10	25	45	10	5.0

#### **B** – Prismatic Retroreflective Element Material

## TABLE 02891-6Minimum Specific Intensity Per Unit area (SIA)(Candelas Per Footcandle Per Square Foot)Type IV Sheeting

Observation Angle(*)	Entrance Angle(*)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	35.0	70	170	30.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	60	8.4	17	40	7.2	4.8

\*Test samples are to be mounted in accordance with manufacturer's recommendation.

4. Specular Gloss. The reflective sheeting shall have an 85 degree specular gloss of not less than 40 for Types I and II, and not less than 50 for III and IV, when tested in accordance with ASTM D 523.

5. Color Processing. The sheeting shall permit cutting and color processing with compatible transparent and opaque process inks in accordance with the Manufacturer's recommendation at temperatures of  $60^{\circ}$  F to  $100^{\circ}$  F and relative humidity at 20 to 80 percent. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures as recommended by the manufacturer. Color processing for Type III material shall be restricted to sheeting with heat activated adhesive backing unless otherwise recommended by the manufacturer.

6. Shrinkage. A 9 inch by 9 inch reflective sheeting specimen with liner shall be conditioned a minimum of 1 hour at  $72^{0}$  F and 50 percent relative humidity. The liner shall be removed and the specimen placed on a flat surface with the adhesive side up. Ten minutes after liner is removed and again after 24 hours, the specimen shall be measured to determine the amount of dimensional change. The reflective sheeting shall not shrink in any dimension more than 1/32 inch in 10 minutes nor more than 1/8 inch in 24 hours.

7. Flexibility.

a. Types I and II Sheeting Material applied according to the manufacturer's recommendations to a clean, etched 0.020 inch by 2 inch by 8 inch aluminum panel of alloy 6061-T6 conditioned a minimum of 48 hours and tested at  $72^{\circ}F$  and 50 percent relative humidity shall be sufficiently flexible to show no cracking when bent around a  $\frac{3}{4}$  inch mandrel.

b. Types III and IV sheeting material, with the liner removed and conditioned for 24 hours at 72°F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when

slowly bent, in one second's time, around a 1/8 inch mandrel with adhesive contacting the mandrel. NOTE: For ease of testing, spread talcum powder on adhesive to prevent sticking to the mandrel.

c. Non-adhesive sheetings shall show no signs of cracking or crazing when flexed repeatedly over a 1/16 inch mandrel to  $180^{\circ}$  at  $72^{\circ}$ F.

8. Adhesive.

a. The reflective sheeting shall include a precoated pressure sensitive adhesive backing (Class 1) or a tack free heat activated adhesive backing (Class 2) either of which may be applied without necessity of additional adhesive coats on either the reflective sheeting or application surface. The Class 1 adhesive shall be a pressure sensitive adhesive of the aggressive tack type requiring no heat solvent or other preparation for adhesive activated by applying heat in excess of 175<sup>0</sup>F to the material as in the heat vacuum process of sign fabrication.

b. The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solvents without breaking, tearing, or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at 160<sup>o</sup>F under a weight of 2.5 pounds per square inch.

c. The adhesive backing of the reflective sheeting shall produce a bond to support a 1  $\frac{3}{4}$  pound weight for 5 minutes, without the bond peeling for a distance of more than 2.0 inches when applied to a smooth aluminum surface and tested as specified in Section 718, Federal Highway Specifications.

9. Impact Resistance. Types I, II, III, and IV reflective sheeting material, applied according to the manufacturer's recommendations to a cleaned, etched aluminum panel of alloy 6061-T6, 0.04 inches by 3.0 inches by 5.0 inches and conditioned for 24 hours at  $72^{0}$ F and 50 percent relative humidity shall show no cracking when the face of the panel is subjected to an impact of a 2.0 pound weight with a 5/8 inch rounded tip dropped from a 10 inch pound setting on a Gardner Variable Impact Tester, IG-1120.

10. Accelerated Weathering. When applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning in accordance with manufacturer's recommendations, shall show no appreciable discoloration, cracking, blistering or dimensional change. Following exposure, the panels shall be washed with a 5% HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth, brought to equilibrium at standard conditions and tested. It shall have not less than the percent of the minimum SIA specified in Table 02891-7 when subjected to an accelerated weathering test of the specified duration in accordance with ASTM G 23, Type E or EH Weatherometer with the humidifier off.

### TABLE 02891-7 MINIMUM SIA AFTER WEATHEROMETER TEST

Type of		Minimum Specific
Material	Hours Tested	Intensity Per Unit Area
	1 000	E0% of Table 02801.3
1	1,000	50% OF TAble 02691-5
II	1,000	50% of Table 02891-4
	2,200*	80% of Table 02891-5
IV	250	50% of Table 02891-6

\* For orange material having glass bead retroreflective elements, the hours tested shall be 500. 11. Intended Use. The reflective sheeting specified herein is intended for use on surfaces of highway signs and other traffic control devices to assure their optimum visibility by day and at night when exposed to a light source and whether dry or totally wet by rain.

#### 2.03 SIGN SUPPORTS.

Sign supports for traffic control signs shall be furnished and installed as specified herin, unless otherwise specified.

A. <u>Steel Stanchions.</u> Steel stanchions of one continuous length meeting the requirements of ASTM A 499, U.S. Highway Type, shall be used for all ground mounted traffic control signs. Stanchions shall have a weight of 3.00 pounds per foot and shall have drilled a minimum of 58 3/8 inch holes on one inch centers. The stanchions shall be painted green.

B. <u>Steel Tubes.</u> Steel tubes of one continuous length meeting the requirements of ASTM A 53, galvanized in accordance with ASTM A 123, shall be used for all ground mounted street name signs. Steel tubes shall have a 2-3/8 inch outside diameter, minimum 12 gauge.

C. <u>Steel Strain Poles.</u> Steel strain poles furnished and installed for span mounted overhead signs shall meet the requirements of Specification Section 02890 Paragraph 2.02.F. Clamps shall be sized to fit each pole at a point eighteen inches from the top of the pole and 21.5 feet above the roadway crown. The poles shall be installed according to the requirements of Specification 02890 Paragraph 3.02.F.

D. <u>Wood Strain Poles.</u> Wood strain poles furnished and installed for span mounted overhead signs shall meet the requirements of Specification Section 02890 Paragraph 2.05.D. Guy assemblies shall meet the requirements of Specification Section 02890 Paragraph 2.02.L and 3.02.L.

E. <u>Span Wire Assembly.</u> The span wire assembly furnished and installed for span mounted overhead signs shall include span wire, tether line, and all appurtenances required to complete sign installation. The materials used shall meet or exceed ASTM standards. All 3/8" diameter dead ends, pole clamps, and overhead sign mounting devices shall be galvanized in accordance with ASTM A 123. All 5/16" diameter dead ends shall be copper clad steel. All structural steel shall have a minimum yield stress of 36,000 psi.

1. Span Wire and Tether Line. All wire rope used for span wire and tether line at locations other than signalized intersections shall be utility grade 3/8 inch diameter steel having a minimum breaking strength of 11,500 pounds. Each individual wire within the wire rope shall be protected by a uniform coating (galvanized) of pure zinc in accordance with ASTM A 123.

2. Spiral Dead Ends. Spiral Dead Ends shall be of the same material, size and strength as the connecting span wire and/or tether line and of a design similar to that shown in the Design Standards.

3. Strain Insulator. Strain insulator shall be fiberglass, shall be capable of transmitting a minimum force of 15,000 pounds, and shall be of a design similar to that shown in the Design Standards.

4. Overhead Sign Mounting Devices.

a. Span Wire Clamp Assembly. Span wire clamp assembly shall consist of two 3/8 inch Ubolts with nuts and washers, one 5/8 inch pin with cotter pin and one clamp (two-piece) assembly for 3/8 inch wire rope as shown in the Design Standards.

b. Balance Adjuster. Balance adjusters shall be malleable iron.

c. Galvanized Conduit, Galvanized Steel Tubing, Galvanized Bars, and Angles. Galvanized bars and angels shall be the size and types shown in the Design Standards.

d. Overhead Sign Mounting Bracket. Overhead sign mounting brackets shall be of the type and shape shown on the Plans or Design Standards.

e. Signs. Signs shall be of the type and size shown on the Plans and called for in these Specifications.

f. Clamp for Existing Concrete Poles. Clamp shall be galvanized steel as shown in the Design Standards.

g. Clamp for Steel Poles. Clamp shall be galvanized steel as shown in the Design Standards.

h. Fastening Device for Span & Tether Line. Fastening device for span on tether line shall be as shown on the Plans or Design Standards.

#### 2.04 CONSTRUCTION EQUIPMENT.

All equipment required for the satisfactory performance of the Work shall be on hand and approved by the Owner before construction will be permitted to begin.

#### PART 3 - CONSTRUCTION REQUIREMENTS

3.01 GENERAL REQUIREMENTS.

A. Before beginning any excavation or driving any sign posts, the Contractor shall determine the location of any underground electrical lines, drainage, or other utility lines in the vicinity and shall conduct his work in such manner as to avoid damage to same.

B. All signs are numbered or otherwise identified and shall be located as indicated on the Plans. Any changes in locations shall be approved by the Owner prior to erection.

C. The Owner will identify in the field the location of all sign supports and each sign to be mounted. The Contractor shall install the signs at the approved locations and complete the work.

#### 3.02 SIGNS.

A. Traffic signs shall be furnished, fabricated, and erected on their supports as specified herein. The reflective sheeting shall be applied to the properly prepared aluminum with the equipment and in a manner prescribed by the sheeting manufacturer.

B. All completed signs shall be free from defects in materials and workmanship and effectively present the specified message under conditions of both day and night viewing. Reflectorized sign surfaces shall exhibit uniform color and brightness over the entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or the incident beam of an automobile headlamp.

C. The reflectorized legend optical performance shall be such that incident light from motor vehicle headlamps will be uniformly reflected back to the eyes of the operator at entrance angles up to 30 degrees without gaps or irregularities.

D. Signs shall be positioned on and fastened to the support as shown on the Plans, or as directed by the Owner. All signs, once erected, shall be clean and free of any substance which would hide or otherwise obscure any portion of the sign face.

#### 3.03 SIGN SUPPORTS.

#### A. Stanchion and Tube Supports For Ground Mounted Signs.

1. Stanchion and tube supports to be furnished and erected shall consist of one or more posts of the type specified, set directly in the ground, embedded in concrete, or bolted to a foundation, ash shown on the Plans. All stanchions and tubes set directly in the ground shall be held in proper position, and backfilling shall be placed in 6 inch layer, each layer being thoroughly tamped. All stanchions and tubes shall be set, driven or embedded so that the sign face will be plumb, oriented and aligned as shown on the Plans and Design Standards. In driving stanchions or tubes, a method shall be used which will not damage or deface the top of the stanchions or tubes.

2. The excavation for sign stanchions or tubes that are to be embedded in or bolted to a concrete foundation shall be made as nearly to neat lines as possible and all parts of the sign post encasement shall generally be poured against the soil but forming below ground level shall be used in sandy soils or when directed by the Owner. Forming will be required for all concrete work above the finished ground level and the top 12 inches of all concrete work. Necessary braces shall be provided to keep anchor bolts and encased posts in proper position. Concrete for foundations and encasement shall be Class A, meeting the requirements of Specification Section 03050. Concrete placement shall be performed in accordance with the provisions of Specification Section 03310, Concrete Structures. The Contractor shall remove and dispose of all surplus excavated material.

3. All cracked, chipped, or scratched galvanized steel members shall be repaired with a "touchup". Zinc powder, wire, or stick shall be used to repair the damaged areas. The zinc shall become completely liquid at a temperature no greater than 475<sup>0</sup>F. The area to be regalvanized shall be thoroughly cleaned, including removal of slag on welds, the surface heated, and zinc applied in accordance with the recommendations of the manufacturer of the material being used.

#### B. Supports For Span Mounted Overhead Signs.

Construction requirements for supports for span mounted overhead signs shall include all excavation and backfill; disposal of surplus or unsuitable material; forming, placement of reinforcement, conduit, concrete, and anchor bolts; finishing; and curing. This construction shall meet the requirements of Specification Section 02890 Paragraph 3.02.F. Signs shall be placed on the span according to the Plans.

#### **PART 4 - MEASUREMENT**

Accepted installed items related to traffic control sign installation shall be measured as described herein. Construction work required for the installation of a traffic control sign shall be measured according to the respective paragraph of these Specifications.

Supports for span mounted signs will not be measured as a unit but will be measured according to their components. Steel and wood strain poles will be measured as specified in Specification Section 02890 Paragraph 4.06.

The span wire assembly will be measured as specified in Specification Section 02890 Paragraph 4.12.

All other work shall be considered incidental to the installation of the traffic control signs and shall not be measured separately from the items described herein.

#### 4.01 FLAT SHEET ALUMINUM SIGNS.

Accepted field installed flat sheet aluminum signs shall be measured in square feet to the nearest tenth of one square foot for each gauge aluminum sign black used.

#### 4.02 EXTRUDED ALUMINUM SIGNS

Accepted field installed extruded aluminum signs shall be measured in square feet to the nearest tenth of one

square foot for each gauge aluminum sign blade used.

#### 4.03 STEEL STANCHIONS

Accepted field installed steel stanchions of each unit weight and length shall be measured as one complete installed unit, per each.

#### 4.04 STEEL TUBES

Accepted field installed steel tubes of each unit weight and length shall be measured as one complete installed unit, per each.

#### PART 5 - PAYMENT

Payment for accepted work, measured as above, shall be made at the appropriate contract unit price which shall be payment in full for all work required to complete the installation. Payment shall be made for quantities as shown on the Plans unless a field measurement is requested by the Contractor, in which case payment shall be for approved field measured quantities. Payment shall be made under the pay items listed at the end of this section.

#### 5.01 FLAT SHEET ALUMINUM SIGNS.

Payment for the area of accepted and installed flat sheet aluminum signs for each gauge will be made at the contract unit price. Payment shall include the aluminum sign black with reflective sheeting applied and bands and brackets required for a complete installation according to the Plans.

#### 5.02 EXTRUDED ALUMINUM SIGNS.

Payment for the area of accepted and installed extruded aluminum signs for each gauge will be made at the contract unit price. Payment shall include the aluminum sign blades with reflective sheeting applied and all bolts, nuts, washers, clamps, and brackets required for a complete installation according to the Plans.

#### 5.03 STEEL STANCHIONS.

Payment for each accepted and installed steel stanchion of cross section weight and length installed according to the Plans as a complete unit will be made at the contract unit price. This payment shall be compensation for any excavation, backfilling, drilling, removal, and replacement of concrete and other items required for the complete installation of the stanchions.

#### 5.04 STEEL TUBES.

Payment for each accepted and installed steel tube of each cross section and length installed according to the Plans as a completed unit will be made at the contract unit price. This payment shall be compensation for any excavation, backfilling, drilling, removal, and replacement of concrete, and other items required for the complete installation of the stanchions.

#### 5.05 PAYMENT WILL BE MADE UNDER:

<u>Item No</u> .	Pay Item	Pay Unit
02891-01	FLAT SHEET ALUMINUM SIGNS	Sq. Ft.
02891-01.01	Flat Sheet Aluminum Sign, 0.080"	Sq. Ft.
02891-02	EXTRUDED ALUMINUM SIGNS	Sq. Ft.
02891-02.01	Extruded Aluminum Sign, 0.080"	Sq. Ft.
02891-03 02891-03	STEEL STANCHIONS Steel Stanchions, Length (feet) Unit weight (tenth of lb/ft,)	Each Each
02891-04	STEEL TUBES	Each
02891-04.01	Steel Tubes, 2-3/8" O.D., 12 gauge,	Each

Length (feet)

#### END OF SECTION 02891

#### PART 1 - SCOPE

This work shall consist of furnishing and placing seed, commercial fertilizer, agricultural limestone, erosion control fabric, and mulch material when specified, and of caring for such areas until acceptance, all in accordance with these Specifications, on all newly graded earthen areas that are not to be paved, stabilized, or sodded, unless otherwise indicated on the plans or directed by the Owner.

#### PART 2 - MATERIALS AND EQUIPMENT

#### 2.01 MATERIALS.

A. Grass Seed.

1. The seed shall meet the requirements of the Tennessee Department of Agriculture and no "Below Standard" seed will be accepted. Grass seed furnished under these Specifications shall be packed in new bags or bags that are sound and not mended.

2. The Contractor shall furnish the Owner a certified laboratory report from an accredited commercial seed laboratory or from a State seed laboratory showing the analysis of the seed to be furnished and approving the seed for purity and germination. The report from an accredited commercial seed laboratory shall be signed by a Senior Member of the Society of Commercial Seed Technologists. At the discretion of the Owner, samples of the seed may be taken for a check against the certified laboratory report. Sampling and testing will be in accordance with the requirements of the Tennessee Department of Agriculture.

3. When a seed group is used, the percentages forming the group shall be as set out below, unless otherwise specified.

Name	Quantity, Percent by Weight
Group A Lespedeza (Common or Korean) Sericea Lespedeza Ky. 31 Fescue English Rye White Dutch Clover Weeping Love Grass	20 15 40 15 5 5
Group B Ky. 31 Fescue Redtop English Rye White Dutch Clover Weeping Love Grass	55 15 20 5 5
Group C Sericea Lespedeza Ky. 31 Fescue English Rye White Dutch Clover	50 30 15 5

4. In mixing or forming "Groups" of seed, they shall be uniformly mixed. "Group" seed shall not be mixed until after each type seed that is used to form the "Group" has been tested and inspected separately and approved for purity and germination. Seed mixed before tests and inspection are made will not be accepted.

#### B. <u>Fertilizer.</u>

Manufactured fertilizer shall be a standard commercial fertilizer containing the specified percentages by weight of nitrogen (N), phosphoric acid ( $P_2O_5$ ) and potash ( $K_2O$ ). The fertilizer shall be furnished in standard containers with the name, weight, and guaranteed analysis of the contents clearly marked. The containers shall insure proper protection in handling and transporting the fertilizer. All commercial fertilizer shall comply with local, state, and federal fertilizer laws.

#### C. Agricultural Limestone.

Agricultural limestone shall contain not less than eighty-five (85%) of calcium carbonate and magnesium carbonate combined and shall be crushed so that at least 85 percent will pass the No. 10 mesh sieve and 100 percent will pass the 3/8 inch sieve.

#### D. Mulch Material.

All mulch material shall be air dried and virtually free of noxious weeds and weed seeds or other materials detrimental to plant growth on the work site or on adjacent agricultural lands. Hay shall be stalks of approved grasses, sedges, or legumes seasoned before baling or loading. Straw shall be stalks of rye, oats, wheat, or other approved grain crops. Both hay and straw shall be suitable for spreading with standard mulch blower equipment. Biodegradable fabric as specified in this section may be used as an alternate to mulch material at the Contractor's option.

#### E. Inoculants for Legumes.

Inoculants for treating legume seed shall be standard cultures of nitrogen fixing bacteria that are adapted to the particular kind of seed to be treated. The inoculant shall be supplied in convenient containers of a size sufficient to treat the amount of seed to be planted. The label on the container shall indicate the specified legume seed to be inoculated and the date period to be used.

#### F. Mulch Binder.

Cut back asphalt, Grade RC-70 or RC-250 conforming to AASHTO Specifications shall be used.

#### G. Water.

Water shall be free from any harmful or objectionable qualities or organisms.

#### H. Biodegradable Fabric.

1. Biodegradable fabric shall consist of a knitted or bonded construction of yarn with uniform openings interwoven with strips of biodegradable paper. The fabric shall be degradable by exposure to ultraviolet light. The fabric shall be "Hold/Gro" as manufactured by Gulf States Paper Corporation of Tuscaloosa, Alabama, or equal. The fabric shall be furnished in rolls and shall conform to the following requirements:

- a. Roll Widths: 5 feet minimum and 10 feet maximum.
- b. Roll Length: Approximately 360 feet.
- c. Weight: Approximately 0.2 pounds per square yard of fabric.
- 2. Fabric shall be secured in a place with wood pegs or other biodegradable materials.

3. The manufacturer shall provide moisture proof bags comparable to 4 to 6 mil opaque polyethylene bags for protection of the fabric prior to installation.

#### 2.02 EQUIPMENT.

All equipment necessary for the satisfactory performance of this construction shall be on the project and inspected before work will be permitted to begin.

#### PART 3 - CONSTRUCTION REQUIREMENTS

#### 3.01 GENERAL

The Contractor shall notify the Owner at least 48 hours in advance of the time he intends to begin sowing seed and shall not proceed with such work until permission to do so has been granted by the Owner. Before starting seeding operations on any area, final dressing and the placing of topsoil shall have been completed in accordance with the project requirements. All seeding and related operations shall be continuous operations.

#### 3.02 PREPARING THE SEEDBED.

Each area to be seeded shall be scarified, disked, harrowed, raked, or otherwise worked until it has been loosened and pulverized to a depth of not less than one inch. This operation shall be performed only when the soil is in a tillable and workable condition. Fertilizer, at the rate of not less than 23 pounds of Grade 6-12-12 or equivalent, per 1,000 square feet, and agricultural limestone, at the rate of not less than 100 pounds per 1,000 square feet, shall be distributed evenly over the seedbed, unless other are specified on the plans or in the Contract Documents. The limestone and fertilizer shall be lightly harrowed, raked, or otherwise incorporated into the soil as specified above when mixed with seed in water and applied with power sprayer equipment.

#### 3.03 TIME OF SEEDING.

Group "A" seed shall be used for seeding from February 1 to August 1, and Group "B" seed shall be used from August 1 to December 1, except that either Group "A" or "B" may be used during the month of August. Group "C" seed shall be used from February 1 to December 1 and only when specified on the Plans or in the Contract Documents. Seeding shall be performed only when the soil is in a tillable and workable condition, and no seeding shall be performed between December 1 and February 1, unless otherwise permitted.

#### 3.04 SEEDING.

Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed and thoroughly watered after seeding. Care shall be exercised to not wash seeding by over watering. Seed shall be sown uniformly by means of a rotary seeder, wheelbarrow seeders, hydraulic equipment, or other satisfactory means, and unless otherwise specified on the Plans or in the Contract Documents, at the rate of 1 ½ pounds per 1,000 square feet. Group "C" seed and seeds of legumes when sown alone shall be inoculated before sowing in accordance with the recommendations of the manufacturer of the inoculant and as directed by the Owner. No seeding shall be done during windy weather, or when the ground surface is frozen, wet, or otherwise nontillable.

#### 3.05 BIODEGRADABLE FABRIC.

A. When biodegradable fabric is specified, the fabric shall be loosely draped over the seeded area. The seed bed to be covered shall be prepared, fertilized, limed, seeded, and watered prior t installation of the fabric. If the slope is greater than 3 to 1, fabric shall be applied vertically with paper strips oriented parallel to the slope.

B. The Contractor shall dig a 4 inch deep check ditch 1 foot back from the slope crown, then fold, place and peg fabric every 9 inches in the check ditch, and cover with soil. An identical check ditch shall be provided 1 foot away from the bottom of the slope. When 2 or more lengths of fabric are required to be installed side by side to cover an area, they shall overlap 4 inches minimum. Fabric installed end to end shall overlap 4 inches minimum with the upgrade section on top of the lower grade section. End to end overlaps of adjacent rows of fabric shall be staggered a minimum of 5 feet. Each length of fabric shall be pegged in 3 rows, each edge and the center, with pegs placed on 3 foot centers maximum. Overlapped ends shall be pegged on 9 inch centers across the fabric overlap. Pegs shall be driven flush with the ground. The Contractor shall strictly adhere to the installation directions provided by the manufacturer of the fabric.

C. The Contractor shall maintain and protect the biodegradable fabric until Final Acceptance or until the Owner has determined that the fabric has served its useful life, whichever occurs first. Maintenance shall consist of watering as required, repairs made necessary by erosion, wind, fire, or any other cause until Final Acceptance. Following the restoration of damaged areas under plant establishment requirements for applicable underlying items, the fabric shall be repaired or replaced to

meet the original requirements and maintained until Final Acceptance of the Project.

#### 3.06 MULCHING.

When seeding with mulch is specified, the mulch material shall be spread evenly over the seeded areas at an approximate rate of 75 pounds per 1,000 square feet immediately following the seeding operations. This rate may be varied by the Owner, depending on the texture and condition of the mulch material and the characteristics of the area seeded. All portions of the seeded areas shall be covered with a uniform layer of mulch, so that approximately 25 percent of the ground is visible. The mulch shall be held in place by the use of an approved mulch binder. Cutback asphalt or emulsified asphalt shall be applied at the approximate rate of 4 gallons per 1,000 square feet as required to hold the mulch in place. Mulch in medians and other areas affected by traffic shall be held in place by applying asphalt binder at the approximate rate of 11 gallons per unit. The Contractor shall cover exposed structures, guardrails, signs, and appurtenances, if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

#### 3.07 MAINTENANCE AND REPAIR.

All seeded areas shall be cared for and maintained properly to the Owner's satisfaction until Final Acceptance of the Work and for the duration of the warranty period. Such care shall include, but not be limited to watering as necessary, fertilizing, and mowing the seeded areas when required by the Owner. When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth. Areas which have been previously seeded and mulched in accordance with this Specification Section but which have been eroded, damaged or failed to successfully establish a stand of grasses or legumes shall be repaired as directed by the Owner. All material and labor required to maintain and repair seeded areas shall be furnished by the Contractor at no cost to the City. If the Owner directs the Contractor to place additional fertilizer on the area to be reseeded, and additional 4 pounds of agricultural limestone will be required for each additional pound of fertilizer.

#### PART 4 – MEASUREMENT

The furnishing of seeding as specified herein may be incidental to the work of the Contract, or may be measured and payment made under the Pay Items described herein, as defined by the Pay Items in the Proposal Sheet(s) and/or as included in the Plans and Contract Documents. If payment is made separately, measurement for the work of this Specification will be as described below.

#### 4.01 SEEDING (WITH MULCH).

The area of seeding (with mulch) to measured for payment will be the number of seeding units, with mulch, in accordance with these Specifications. Each unit will consist of 1,000 square feet measured along the surface.

#### 4.02 SEEDING (WITHOUT MULCH).

The area of seeding (without mulch) to be measured for payment will be the number of seeding units in accordance with these Specifications. Each unit will consist of 1,000 square feet measured along the surface.

#### 4.03 BIODEGRADABLE FABRIC.

Biodegradable fabric to be measured for payment will be the number of 1,000 square foot units for which biodegradable fabric has been applied over seeded areas. Measurement will be along the surface.

#### 4.04 GENERAL.

All work and materials for seed bed preparation, application of fertilizer and limestone, application of mulch binder, watering and maintenance and repair of work, and all other similar items included in this section of the Specifications but not covered by a Pay Item herein will be considered as a subsidiary obligation of the Contractor under other items of the Contract.

#### PART 5 – PAYMENT

#### 5.01 SEEDING (WITH MULCH).

Seeding (with mulch) will be paid for at the contract unit price per unit (1,000 square feet), for the accepted quantities, which price will be full payment for preparing the seedbed, and for furnishing and placing all materials including fertilizer, water, agricultural limestone, seed, mulch materials, mulch binder and inoculant,

complete in place; and for maintenance and repair of the seeded and grassed area.

#### 5.02 SEEDING (WITHOUT MULCH).

Seeding (without mulch) will be paid for at the contract unit price per unit (1,000 square feet) for the accepted quantities, which price will be full payment for preparing the seedbed, and for furnishing and placing all materials including fertilizer, water, agricultural limestone, seed, and inoculant, complete in place; and for maintenance and repair of the seeded and grassed areas.

#### 5.03 BIODEGRADABLE FABRIC.

Biodegradable fabric will be paid for at the contract unit price per unit (1,000 square feet) for furnishing, installing, maintaining, and protecting the fabric, which price will be full payment for accomplishing the above.

#### 5.04 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	<u>Pay Unit</u>
02920-5.01	SEEDING (WITH MULCH)	Unit of 1,000 SF
02920-5.02	SEEDING (WITHOUT MULCH)	Unit of 1,000 SF
02920-5.03	BIODEGRADABLE FABRIC	Unit of 1,000 SF

#### END OF SECTION 02920

#### PART 1 - SCOPE

This work shall consist of furnishing and placing sod at all locations shown on the Plans or where directed by the Owner, and in conformity with these Specifications. Ordinarily, the work will consist of the furnishing and placing of new sod originating from sources outside the rights-of-way and easement limits. In some cases, however, the work will include removing sod from areas where the requirements of the project would destroy existing sod, storing the sod so removed, and resetting it in areas shown on the Plans or designated by the Owner.

#### PART 2 - MATERIALS AND EQUIPMENT

#### 2.01 MATERIALS.

A. <u>Sod.</u>

1. New sod shall consist of live, dense, well rooted growth of Bermuda grass, free from Johnson grass, nutgrass, and other obnoxious grasses or weeds, well suited for the intended purpose and for the soil in which it is to be planted. All sod shall be cleanly cut in strips having a reasonably uniform thickness of not less than 2 inches and cut in 10 to 12 inch squares.

2. The sale or movement of sod for propagation is controlled by Tennessee Plant Pest Act of 1955, TCA 43-55 et. Seq., and the Contractor shall be responsible for obtaining all inspections, authorizations, and permits which may be required by such law and the Tennessee Department of Agriculture.

#### B. Fertilizer.

Manufactured fertilizer shall meet the requirements of Specification Section 02920 Paragraph 2.01.B and shall be Grade 15-15-15 unless otherwise specified on the Plans or in the Contract Documents.

#### C. Ammonium Nitrate.

Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified in Specification Section 02920 Paragraph 2.01.B, and shall have a minimum of 33 ½ percent nitrogen.

#### D. Agricultural Limestone.

Agricultural limestone shall meet the requirements of Specification Section 02920 Paragraph 2.01.C.

#### 2.02 EQUIPMENT.

All equipment necessary for the satisfactory performance of this work shall be on the project and approved before work will be permitted to begin.

#### PART 3 - CONSTRUCTION REQUIREMENTS

#### 3.01 WEATHER LIMITATIONS.

Sod shall be set or reset only when the soil if most and favorable to growth. No setting or resetting shall be done between December 1 and February 1, unless weather and soil conditions are considered favorable and permission is granted by the Owner.

#### 3.02 REMOVING AND STORING SOD FOR RESETTING.

If specified, sod removed from such areas as lawns, yards, and lots shall be so cut, handled, and stored that the sod can be reset in the same locations from which it was removed. No exchange of sod will be permitted unless approved by the Owner. Unless reset immediately after cutting, sod shall be stacked in piles and kept moist until reset. Sod shall be reset within 7 days after removal, unless otherwise specifically permitted by the Owner. Reset sod shall show vitality and growth at the time of acceptance by the City and for duration of the warranty period.

#### 3.03 SODDING.

A. The area to be sodded shall be brought to the lines and grades shown on the Plans or as directed by the Owner. The surface of the ground to be sodded shall be loosened to a depth of not less than one inch with a rake or other device. If necessary, it shall be sprinkled until saturated for a minimum depth of one inch and kept moist until the sod is placed. Immediately before placing the sod, fertilizer and lime shall be applied uniformly to the prepared surface of the ground. Fertilizer shall be applied at the rate of 8 pounds of Grade 15-15-15, or equivalent per 1,000 square feet. Agricultural limestone shall be applied at the rate of 100 pounds per 1,000 square feet.

B. Sod shall be placed as soon as practical after removal from the point of origin and shall be kept in a moist condition during the interim. The sod shall be carefully placed by hand on the prepared ground surface with the edges in close contact and, as far as possible, in a position to break joints. Each strip of sod laid shall be fitted and rolled using a roller of sufficient size and weight to fix the sod into place. Immediately after placing, the sod shall be thoroughly wetted and rolled with an approved roller or hand tamped, as approved by the Owner. Pinning or pegging shall be required on slopes greater than 2 to 1 to hold the sod in place or in other instances at the direction of the Owner.

#### 3.04 MAINTENANCE AND REPAIR.

The sod shall be watered as frequently as necessary for a period of two weeks, after which, ammonium nitrate shall be applied at the rate of 3.5 pounds per 1,000 square feet, and the sod given an additional watering. The Contractor shall not allow any equipment or material placed on any planted area and shall erect suitable barricades and guards to prevent his equipment, labor, or the public from traveling on or over any area planted with sod. Care shall include periodic watering, fertilizing and mowing necessary to maintain the vitality and appearance of the sod. When mowing is required, mower blades shall be set at sufficient height to protect the vitality of the growth. Sodded areas that become eroded, damaged or fail to successfully establish a stand of grass shall be repaired and/or replaced as directed by the Owner. All material and labor required to maintain and repair seeded areas shall be furnished by the Contractor at no cost to the City. Sod must be living at the time of final acceptance of the project and through the duration of the warranty period.

#### 3.05 DISPOSAL OF SURPLUS MATERIAL.

All surplus material shall be disposed of off-site.

#### PART 4 – MEASUREMENT

The furnishing and setting of sodding as specified herein may be incidental to the work of the Contract, or may be measured and payment made under the Pay Items described herein, as defined by the Pay Items in the Proposal Sheet(s), and/or as included in the Plans and Contract Documents. If payment is made separately, measurement for the work of this Specification shall be as described below.

#### 4.01 SODDING.

Sod will be measured for payment by the square yard of surface upon which the sod has been set.

#### 4.02 REMOVING, STORING, AND RESETTING SOD.

Sod to be removed, stored, and reset will be measured for payment by the square yard of surface upon which the removed sod has been reset.

#### PART 5 – PAYMENT

#### 5.01 SODDING.

Sodding will be paid for at the contract unit price per square yard for the accepted quantities, which price will be full payment for furnishing, setting, pinning and pegging if required, fertilizing, watering, mowing, providing and placing agricultural limestone, and for the maintenance and repair of the sodded area.

#### 5.02 REMOVING, STORING, AND RESETTING SOD.

This work will be paid for at the contract unit price per square yard for the accepted quantities, which price will be full payment for removing and storing the sod or turf, setting, pinning and pegging if required, fertilizing,

watering, mowing, providing and placing agricultural limestone, and for the maintenance and repair of the sodded area.

5.03 PAYMENT WILL BE MADE UNDER:

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02921-5.01	SODDING (NEW SOD)	Square Yard
02921-5.02	REMOVING, STORING, AND RESETTING SOD	Square Yard

#### END OF SECTION 02921

#### PART 1 - SCOPE

This Work shall consist of the removal and replacement of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs made necessary by the construction of drainage facilities, sanitary sewers, traffic control conduit, and other items of construction that require temporary cuts. Such replacement shall be to a condition at least equal to the condition existing prior to removal and of in-kind material and shall be compliance with the Plans, these Specifications, or as directed by the Owner. The Work which will be included in the Contract and for which the Contractor shall be compensated therefore is limited to that area within the rights-of-way and construction easements for the Project. The Contractor will not be compensated for the removal and replacement of facilities outside the rights-of-way, easements, and limits of construction of the Project.

#### PART 2 – MATERIALS AND EQUIPMENT

#### 2.01 MATERIALS

A. <u>Concrete:</u> Concrete materials shall meet the requirements of Specification Section 03050, Portland Cement Concrete for Class A concrete.

B. <u>Curing Material:</u> Curing materials shall conform to the applicable provisions of Specification Section 02750 Paragraph 2.01 C.

C. <u>Asphaltic Concrete Wearing Surface and Asphalt Curb:</u> Asphaltic concrete wearing surfaces and asphalt curb shall meet the requirements of Specification Section 02741 Paragraph 2.01 D., "Composition of Mixtures", for Mix No. 1.

D. <u>Asphalt Driveway Pavement:</u> Asphalt driveway pavement shall meet the requirements of Specification Section 02741 Paragraph 2.01 D., "Composition of Mixtures", for Mix No. 2.

E. <u>Expansion Joint Filler</u>: Preformed expansion joint filler shall be of the bituminous type, shall conform to eh requirements of AASHTO M 213 and shall not be more than 1 inch or less than 1/2 inch in thickness. The filler shall be cut to the full depth of pavement, curb and gutter, sidewalk, or driveway being replaced.

F. <u>Gravel Pavement or Base:</u> Camden gravel or crushed limestone meeting the requirements of Specification Section 02720 Paragraph 2.01, Aggregates for Gradation No. 1, 2 or 3 shall be used to replace graveled areas disturbed by construction.

#### 2.02 EQUIPMENT

A. Equipment and tools necessary for cutting, removal, and hauling of existing items; handling and placement of new material; and all equipment necessary to perform all parts of the Work shall be at the job site sufficiently ahead of the start of construction operations to be examined and approved by the Owner.

B. When saws are used to cut pavement, the Contractor shall provide sawing equipment adequate in power to complete the sawing to a minimum of 1-1/2 inches below the pavement surface in one pass. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations.

C. Other types of pavement cutting equipment shall be capable of cutting the pavement to a neat straight line of 1-1/2 inch minimum depth below the pavement surface in one pass.

D. The Contractor shall provide equipment capable of removal of pavements, sidewalks, driveway aprons, curbs and gutters, driveways, paved areas, and curbs without disturbance of adjacent items to remain in place.

E. Equipment necessary for the handling, placement, and finishing of concrete shall meet the applicable requirements of Specification Section 02750 Paragraph 2.02, "Portland Cement Concrete Pavement"; Specification Section 02775 Paragraph 2.02, "Portland Cement Concrete Sidewalks and Driveways"; and Specification Section 02770 Paragraph 2.02, "Curb, Curb and Gutter, and Water Table".

F. Equipment necessary for the handling, placement, and compaction of asphalt shall meet the requirements of Specification Section 02741 Paragraph 2.02.

#### PART 3 – CONSTRUCTION REQUIREMENTS

#### 3.01 REMOVAL OF ASPHALT PAVEMENT

Asphalt pavement shall be removed to a clean straight line as detailed on the Plans. Pavement shall be cut by saw or other equipment approved by the Owner in advance. Edges of existing asphalt pavement adjacent to trenches where damaged shall be recut in a clean straight line within the limits of damaged pavement only. Such recuts shall be parallel to the original cuts and perpendicular to the pavement surface.

#### 3.02 REMOVAL OF CONCRETE PAVEMENT

A. Concrete pavement shall be removed to a neat straight line as detailed on the Plans. Care shall be used to avoid damage to pavements and to the pavement base remaining in place.

B. Concrete pavement may, at the Contractor's option, be removed by saw cutting to a neat straight line. Saw cuts shall be made to a minimum depth of 1-1/2 inches and at a location to provide a cutback edge in accordance with the Design Standards. The edges of the existing concrete pavement adjacent to trenches where damaged subsequent to saw cutting of pavement shall again be saw cut in a neat straight line to remove the damaged pavement areas. Such saw cuts shall be parallel to the original saw cuts and perpendicular to the pavement surface.

#### 3.03 REMOVAL OF CONCRETE SIDEWALK, CURB AND GUTTER, AND DRIVEWAY

Concrete sidewalks, curbs and gutters, and driveways shall be removed to the nearest contraction or expansion joint. Care shall be used to avoid damage to sidewalks, curbs and gutters, and driveways remaining in place.

#### 3.04 REMOVAL OF GRAVEL PAVEMENT

Gravel surfaces encountered in construction shall be removed to the limits shown on the Plans.

#### 3.05 REPLACEMENT OF PAVEMENT

A. <u>Asphalt or Surface Treated Pavements:</u> Replacement of asphalt or surface treated pavement and base shall consist of 8 inches of Class A concrete base and 1 inch of asphaltic concrete surface course Mix No. 1 for the entire cross-section of pavement removal area, including all areas where pavement was re-cut subsequent to the initial pavement removal.

#### B. Concrete Pavements

1. Concrete pavement shall be replaced with Class A concrete pavement equal in thickness to the pavement removed but not less than 8 inches thick. Concrete pavement and base replacement shall be constructed for the entire cross-section of pavement removal area including all areas where pavement was re-cut subsequent to the initial pavement removal.

2. Reasonable efforts shall be made to avoid contrast in the color and texture of existing and restored surfaces.

#### C. Placing, Curing, and Protection of Concrete

1. After the backfill in the trench has been brought to the appropriate subgrade elevation shown on the Plans, compacted to the specified density, and permission has been given by the Owner, a concrete slab of the appropriate thickness shall be placed within the entire disturbed area.

2. Any loose or disturbed pavement or base shall be removed prior to placement of the concrete. Concrete shall be placed only on a moist subgrade and shall not be placed unless the ambient temperature is  $35^{\circ}$  F and rising. In no case shall concrete be placed on a frozen or frosty subgrade. After the concrete is placed, it shall be struck off in an approved manner to the appropriate grade as shown on the Plans and shall be finished with floats and straight edges until the required surface texture has been obtained.

3. Curing and cold weather protection shall be performed as provided for under Specification Section 02750 Paragraph 3.11. No vehicles or loads shall be permitted on any concrete until the Owner has determined that the concrete has obtained sufficient strength for such loads. The contractor shall construct and place such barricades and protection devices as are necessary to protect the concrete.

- D. <u>Placing Asphaltic Concrete Wearing Surface:</u> After the concrete base has been placed and adequately cured, an asphaltic concrete wearing surface of the minimum specified thickness shall be placed and compacted as specified in Specification Section 02710.4 Paragraphs 3.01 – 3.11, Asphaltic Concrete, Construction Requirements.
- 3.06 REPLACEMENT OF SIDEWALKS, DRIVEWAY APRONS, CURBS AND GUTTERS, DRIVEWAYS AND OTHER PAVED AREAS, AND CURBS

A. Concrete sidewalks and driveway aprons shall be replaced in accordance with the requirements of Specification Section 02775 Paragraphs 3.01 - 3.08, "Portland Cement Concrete Sidewalks and Driveways, Construction Requirements". Any expansion joint material removed shall be replaced at the original locations. Existing concrete edges shall be cleaned prior to placement of concrete. The finished concrete elevation, texture, and color shall conform to the adjacent concrete surfaces.

B. Unless otherwise directed, curb and gutter shall be replaced with new concrete curb and gutter of the same cross-section and at the same top of curb elevation and flow line as that removed. Where curb and gutter of a different type than existing is to be used for replacement, the replacement flow line shall match existing and a transitions section provided between the existing and replacement cross-sections. Curb heights shall be transitioned at a trate of 1 inch in 5 feet. Granite curb shall be replaced with new concrete curb whose height matches existing adjacent curb top elevations. New concrete curb and gutter construction shall conform to the requirements of Specification Section 02770 Paragraphs 3.01 - 3.10, "Curb, Curb and Gutter, and Water Table, Construction Requirements". Any expansion joint material removed shall be replaced at the original locations. Existing concrete edges shall be cleaned prior to placement of concrete. The finished curb and gutter cross-section, elevations, texture, and color shall conform to the adjacent concrete surfaces.

C. Replacement of paved areas other than street pavement; concrete, asphalt, or gravel driveways; and asphalt or concrete curb within the right-of-way or construction easement limits shall be in kind for those cross-sections removed, unless directed otherwise by the Owner.

#### 3.07 DAMAGE DUE TO SETTLEMENT

A. The Contractor shall be responsible for any damage caused by settlement of backfill placed beneath pavements, sidewalks, driveway aprons, curbs, curbs and gutters, driveways, paved areas other than street pavement, and asphalt or concrete curb within the right-of-way or construction easement limits. This includes any damage which may occur at any time prior to,

and during a period of one year from and after the date of Final Acceptance of the Work covered by the Contract.

B. During such period, the Contractor shall at his own cost and expense refill all excavations where settlement damage has occurred and replace damaged pavements, sidewalks, driveway aprons, curbs, curbs and gutters, paved areas, driveways, and all other damaged items to the satisfaction of the City. Should the Contractor fail to repair settlement damage which may occur as described above within 30 days after being given notice thereof, the City shall have the right to repair such settlement and charge the cost of such repairs to the Contractor.

#### 3.08 DAMAGE OUTSIDE CONSTRUCTION EASEMENT LIMITS

A. The Contractor will be held responsible for all damage to roads, highways, shoulders, curbs and gutters, ditches, embankments, bridges, culverts, and other property, caused by him or any of this Subcontractors in hauling or otherwise transporting materials to and from the several sites of Work, regardless of the location of such damage. The Contractor shall make arrangements relative to the payment for, or repair or replacement of, such damage or damaged surfaces or structures which are satisfactory and acceptable to the owner or owners of such damaged surfaces or structures, or to their legally responsible officers, agents, or other representatives, at the Contractor's cost and expense.

#### PART 4 – MEASUREMENT

#### 4.01 PAVEMENT REMOVAL AND REPLACEMENT

Pavement removal and replacement shall be measured for payment by the square yard, complete in place.

#### 4.02 CONCRETE SIDEWALK REMOVAL AND REPLACEMENT

Sidewalk removal and replacement shall be measured for payment by the square foot, complete in place.

#### 4.03 CONCRETE DRIVEWAY APRON REMOVAL AND REPLACEMENT

Driveway apron removal and replacement shall be measured for payment by the square foot, complete in place.

#### 4.04 CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT

Curb and gutter removal and replacement shall be measured for payment by the linear foot, complete in place.

4.05 ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACEMENT Asphalt or concrete driveway and paved area removal and replacement shall be measured for payment by the square foot, complete in place.

#### 4.06 GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT

Gravel driveways and gravel area removal and replacement shall be measured for payment by the ton of Camden gravel or crushed limestone, complete in place.

#### 4.07 ASPHALT AND CONCRETE CURB REMOVAL AND REPLACMENT

Asphalt and concrete curb removal and replacement shall be measured for payment by the linear foot along the face of curb, complete in place.

#### PART 5 – PAYMENT

#### 5.01 PAVEMENT REMOVAL AND REPLACEMENT

The accepted quantities of pavement removal and replacement shall be paid for at the contract unit price per square yard for the type specified, which price will be full compensation for cutting and recutting pavement; removal and disposal of pavement and base; preparing the subgrade; placing, finishing,

curing, and protection of concrete; and placing and compacting asphaltic concrete wearing surfaces, complete in place.

#### 5.02 CONCRETE SIDEWALK REMOVAL AND REPLACEMENT

The accepted quantities of sidewalk removal and replacement shall be paid for at the contract unit price per square foot, which price will be full compensation for removal and disposal of sidewalk; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

#### 5.03 CONCRETE DRIVEWAY APRON REMOVAL AND REPLACEMENT

The accepted quantities of driveway apron removal and replacement shall be paid for at the contract unit price per square foot for the type specified, which price will be full compensation for removal and disposal of driveway apron; preparing the subgrade; and placing, finishing, curing, and protection of concrete, complete in place.

#### 5.04 CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT.

The accepted quantities of curb and gutter removal and replacement shall be paid for at the contract unit price per linear foot for the type specified, which price will be full compensation for removal and disposal of curb and gutter; preparing the subgrade; and placing, finishing, curing and protection of concrete, complete in place.

#### 5.05 ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACMENT

The accepted quantities of asphalt or concrete driveway and paved area removal and replacement shall be paid for at the contract unit price per square foot for the type specified, which price will be full compensation for cutting and recutting; pavement removal and disposal of pavement and base; preparing the subgrade; placing, finishing, curing, and protection of concrete; and placing and compacting asphalt, complete in place.

#### 5.06 GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL AND REPLACEMENT

The accepted quantities of gravel driveway and gravel area removal and replacement shall be paid for at the contract unit price per ton of Camden gravel or crushed limestone, which price will be full compensation for preparing the subgrade and replacing the gravel, complete in place.

#### 5.07 ASPHALT AND CONCRETE CURB REMOVAL AND REPLACEMENT

The accepted quantities of asphalt and concrete curb removal and replacement shall be paid for at the contract unit price per linear foot, which price will be full compensation for removal and disposal of curb and placing new curb, complete in place.

#### 5.08 PAYMENT WILL BE MADE UNDER:

<u>Item No.</u>	Pay Item	<u>Pay Unit</u>
02950-01 02950-01.01 02950-01-02	PAVEMENT REMOVAL AND REPLACEMENT Asphaltic Concrete Pavement Concrete Pavement	Square Yard Square Yard Square Yard
02950-02	CONCRETE SIDEWALK REMOVAL AND REPLACEMENT	Square Foot
02950-03	CONCRETE DRIVEWAY APRON REMOVAL AND	Squara East
02950-03	(Description)	Square Foot
02950-04	CONCRETE CURB AND GUTTER REMOVAL AND	Lincor Foot
02950-04	(Description)	Linear Foot

02950-05 02950-05.01 02950-05.02	ASPHALT OR CONCRETE DRIVEWAY AND PAVED AREA REMOVAL AND REPLACEMENT Asphalt Driveway and Paved Area Concrete Driveway and Paved Area	Square Foot Square Foot Square Foot
02950-06	GRAVEL DRIVEWAY AND GRAVEL AREA REMOVAL	Ton
02950-06.01	Replacement with Camden Gravel	Ton
02950-06.02	Replacement with Crushed Stone	Ton
02950-07	ASPHALT AND CONCRETE CURB REMOVAL AND	Line of Fred
02050 07 01	Concrete Curb	Linear Foot
02950-07.01	Asphalt Curb	Linear Foot
02000 07.02		

#### END OF SECTION 02950

#### PART 1 - SCOPE

This specification covers the classification, materials, proportioning of materials, equipment, mixing requirements, and testing for portland cement concrete to be used for construction of streets, bridges, and miscellaneous structures and facilities as defined in Division 2 – Site Construction of these Specifications. The classification requirements, forming, curing, measurement, and payment for specific uses of concrete are specified and defined in the appropriate sections of Division 2.

#### PART 2 - CONCRETE CLASSIFICATION

#### 2.01 CONCRETE CLASSIFICATION

Portland cement concrete used for construction of the various items covered in Division 2 of these Specifications shall be classified by usage as follows:

#### A. Class A.

Class A concrete shall be used as specified for such items as concrete curb, curb and gutter, sidewalks, drainage and sewer structures other than box culverts, ditch paving, bridges (other than superstructure) and similar uses.

#### B. Class A S.

Class A S concrete shall be used for bridge superstructures and channel lining of ditches.

#### C. Class B.

Class B concrete shall be used for roadway base and pavement.

#### D. Class C.

Class C concrete shall be used as specified for such items as concrete cradles, encasements, embankment slope paving at bridge abutments, and other low strength applications.

#### E. Class P.

Class P concrete shall be used for cast-in-place box culverts and precast and precast-prestressed concrete structures or structural members. High-early-strength concrete shall be as specified in Specification Section 03050 Paragraph 6.05.

#### PART 3 - MATERIALS.

Materials used in the production of portland cement concrete of the various classifications specified herein shall meet the following requirements.

#### 3.01 PORTLAND CEMENT.

Portland cement shall be Type I cement conforming to the requirements of AASHTO M 85, except that for high-early-strength concrete, Type III cement may be used.

#### 3.02 FINE AGGREGATE.

A. Fine aggregate shall consist of natural sand, clean and free from any surface film or coating and graded from fine to coarse. Fine aggregate shall conform to the requirements of ASTM C 33 and the specifications included herein. The amount of deleterious substance shall not exceed the following percentage by weight:

Removed by decantation	3 percent
Coal or lignite	1 percent
Clay lumps	1 percent

Other local deleterious substances (such as shale, alkali,

Mica, coated grains, soft and flaky particles)..... 1 percent

B. All fine aggregate shall be free from amounts of organic impurities that would be detrimental to concrete strength and durability. Aggregate shall be subjected to the colorimetric test made in the field as follows:

Fill a 12 oz. graduated bottle to the 4  $\frac{1}{2}$  oz. mark with the sand to be tested. Add a 3% solution of sodium hydroxide until the volume, after shaking, amounts to 7 ounces. Shake thoroughly and let stand for 24 hours. The sample shall then show a practically colorless solution, or at least, a solution not darker than straw color.

C. Fine aggregate shall be well graded from coarse to fine and, when tested by means of laboratory sieves, shall conform to the following requirements:

Passing	Percent
3/8 in. Sieve	100
No. 4 Sieve	95 to 100
No. 16 Sieve	50 to 90
No. 50 Sieve	10 to 30
No. 100 Sieve	0 to 10
No. 200 Sieve	0 to 3

Note: Not more than 45% should be retained between any two consecutive sieves.

D. Fine aggregate shall be of such quality that mortar composed one (1) part portland cement and three (3) parts fine aggregate, by weight when made into briquets or cylinders, shall show a tensile or compressive strength at seven (7) and twenty-eight (28) days at least equal to the strength of briquets or cylinders composed of one (1) part of the same cement and three (3) parts standard Ottawa sand by weight. The percentage of water used in making the test specimens of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand test specimens of standard consistency.

#### 3.03 COARSE AGGREGATE.

A. Coarse aggregate for any class of portland cement concrete shall consist of crushed stone or crushed or uncrushed gravel unless otherwise specified.

B. Coarse aggregate for Class A, Class B, or Class C concrete shall be furnished in two sizes: Size No. 4 and Size No. 67 as shown hereinafter in Table 03050.1, Coarse Aggregate Gradation Table. The two sizes shall be manufactured, within the specified limits, to produce Size No. 467 when combined in the proper proportions at the batching plant. If the supplier provides a proper stockpile to prevent segregation, then a combined Size No. 467 can be used in lieu of blending Size No. 4 and Size No. 67.

C. Coarse aggregate for Class AS concrete shall be Size No. 57. Only limestone coarse aggregate will be used for Class AS concrete; gravel coarse aggregate will not be permitted.

D. Coarse aggregate for Class P concrete shall be size No. 57 or Size No. 67 as may be specified or directed. Only limestone coarse aggregate shall be used for Class P concrete; gravel coarse aggregate will not be permitted.

E. Coarse aggregate for concrete curbing placed by machine extrusion methods shall be Size No. 57 or Size No. 67.

F. The coarse aggregates shall otherwise conform to the requirements of AASHTO M 80 and ASTM C 33 with the following exceptions and stipulations:

1. Deleterious Substances.

The amount of deleterious substances shall not exceed the following limits:

 		Maximum Percent by Weight
a.	Soft or nondurable fragments (fragments which are structurally weak such as shale, soft sandstone, limonite concretions, gypsum, weathered schist or cemented gravel)	3.0
b.	Coal and lignite	1.0
C.	Clay lumps	0.25
d.	Material passing the No. 200 sieve	1.00
e.	Thin or elongated pieces (length greater than 5 times average thickness)	10.00
f.	Other local deleterious substances	1.00

Notes: 1. In the case of crushed aggregate, if all the material finer than the 200 mesh sieve consists of the dust of fracture essentially free of clay or shale, Item 4, Maximum Per Cent by Weight, may be increased to 1.5.

2. The sum of the percentages of Items No. a, b, c, d, and f shall not exceed 5.0.

3. When the coarse aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than nine.

4. Alternate freeze/thaw tests for soundness will not be performed.

5. The percentage of wear as determined by AASHTO T 96 shall not exceed 40.

#### COARSE AGGREGATE GRADATION TABLE Table 03050.1

Size	Amou	nts Finer	Than Each Lai	o. Sieve (S	Sq. Openings)	, % By We	eight	
Number	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No.8
4	100	90-100	20-55	0-15		0-5		
467	100	95-100		35-70		10-30	0-5	
57		100	95-100		25-60		0-10	0-5
67			100	90-100		20-55	0-10	0-5

#### 3.04 WATER.

The water used in mixing concrete shall be clean, free from oil, acid, strong alkalis, organic or vegetable matter.

#### 3.05 AIR-ENTRAINING ADMIXTURES.

A. Air-Entraining Admixtures shall conform to the requirements of AASHTO M 154, except that the tests for bleeding, bond strength and volume change will not be required.

B. The Owner will maintain a list of qualified products. The Contractor shall be required to furnish a material that appears on this list.

C. A product may become approved by furnishing test data from a recognized laboratory showing that the air-entraining admixture proposed for use conforms to the requirements of these Specifications. A recognized laboratory is defined as one of the following: A State Transportation Department Laboratory; a Federal Highway Administration Laboratory; or other laboratories which are approved by the Owner.

#### 3.06 CHEMICAL ADDITIVES.

A. For portland cement concrete mixtures, these additives shall conform to the requirements of AASHTO M 194 covering the following five types:

- 1. Type A Water reducing admixtures
- 2. Type B Retarding admixtures
- 3. Type C Accelerating admixtures
- 4. Type D Water reducing and retarding admixtures
- 5. Type E Water reducing and accelerating admixtures

B. Additionally, admixtures for increasing the flowable characteristics of concrete (super plasticizers) may be used, subject to the approval of the Owner for each class and intended use of the concrete. Such admixtures shall meet the applicable requirements of ASTM C 494. The use of a plasticizer shall not change the maximum water requirements for the approved design mix. When approved for use, the admixture shall be introduced into the mix in the manner and quantities recommended by the manufacturer.

C. Additives listed in items A through E above and super plasticizers may only be used with the written approval of the Owner. Before any admixture is approved, the manufacturer of the admixture or the Contractor shall furnish the owner documentary evidence that the material proposed for use has been tested in accordance with the methods of test specified in AASHTO M 194 (or ASTM C 494 for super plasticizers) and meets the requirements of the Specification. Documentary evidence for all additives shall be the results of tests conducted by a testing laboratory inspected at regular intervals by the National Bureau of Standards. The Owner may require a notarized certification from the manufacturer of any additives used stating that the material is identical with that originally approved and has in no way been changed or altered. Even through additives have been approved by the Owner, the Contractor shall be responsible for the successful use of the additives. No reduction in the cement content of the concrete as designed without chemical additives will be made when additives are permitted.

D. Calcium chloride additives will not be permitted.

#### 3.07 CURING MATERIALS.

Curing materials shall be as specified in the various Specification Sections of Division 2 and as specified below:

#### A. Water.

Water used in curing portland cement concrete shall be free from any substance which may be injurious to concrete when applied on the surface as a curing agent.

#### B. <u>Burlap.</u>

Burlap shall conform to AASHTO M 182, Class 3 or Class 4. If Class 1 or Class 2 burlap is permitted, at least two layers shall be use.

#### C. Liquid Membrane-Forming Compounds.

These compounds shall conform to AASHTO M 148. Where applied texture finish is specified, a Type 1-D, Class B, membrane which is compatible with the texture finish shall be used. Type 2 (white pigmented) membrane shall be used in all other applications, unless otherwise specified.

D. White Polyethylene Sheeting.

This material shall conform to AASHTO M 171.

#### 3.08 FLY ASH.

Class C fly ash conforming to the requirements of ASTM C 618-84 may be used as a replacement for portland cement if approved in writing by the Owner. The maximum amount of cement being replaced by fly ash shall not exceed 15 percent. Before any fly ash will be approved for use, the Contractor shall furnish the Owner documentary evidence that the fly ash proposed for use has been tested in accordance with ASTM C 311-7 and meets the requirements of that specification. Documentary evidence shall be the results of tests conducted by a testing laboratory inspected at regular intervals by the National Bureau of Standards. Even though the fly ash has been approved by the Owner, the Contractor shall be responsible for its successful use. When a specific air content has been required and fly ash is being used, the air content shall be tested on each truck load of concrete at the batch plant and the tested value shall be indicated on the ticket.

#### PART 4 – EQUIPMENT

#### 4.01 GENERAL.

Equipment and tools necessary for handling materials and performing all parts of the Work shall be subject to the approval of the Owner. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans and Design Standards or as directed by the Owner.

#### 4.02 BATCHING PLANT AND EQUIPMENT.

#### A. General.

The batching plant shall include bins, weighing hoppers, and scales. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The Contractor shall provide adequate means for cement cut off checks. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The bulk cement storage bin or hopper shall be provided with adequate means for sampling the cement in storage.

#### B. Bins and Hoppers.

Bins with adequate separate compartments for fine aggregates, each size of coarse aggregate, and cement shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the weighing hopper. Means of control shall be provided so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision. A port or other opening shall be provided for removing an overload of any one of the several materials from the hopper. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent spilling under any working conditions.

#### C. Scales.

1. The scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within 0.5 percent throughout the range of use. The value of the minimum graduation on the scale for weighing cement shall not be greater than 5 pounds. The value of the minimum graduation on the scale for weighing amounts of aggregates up to 10,000 pounds or more shall be not greater than 10 pounds. The value of the minimum graduation of scales used in weighing amounts of aggregate 10,000 pounds or more shall be not greater than 0.1 per cent of the nominal capacity of the scales but shall not exceed 50 pounds. When beam type scales are used, provision, 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. The "tell-tale" device on weighing beams shall indicate critical position clearly. Poises shall be designed so that they cannot be easily removed from the beam and can be held firmly in place. The weigh beams and "tell-tale" device shall be in full view of the operator while charging the hopper, and he shall have convenient access to all controls.

2. Scales shall be tested no less than once monthly by a certified scale testing company. Testing shall meet the requirements of applicable City ordinances and State law. The Contractor shall have available not less than 10 standard 50 pound weights meeting the requirements of the U.S. Bureau of Standards for calibrating and testing weighing equipment. The person dispensing weighed material shall certify that the amounts of materials used is in accordance with quantities shown on the delivery ticket.

#### D. Equipment For Structural Concrete.

1. The requirements for batching plants shall be as prescribed above, except that when approved by the Owner, the requirement for storage compartments in addition to weigh bins, for fine and coarse aggregates may be waived, provided the batching tolerances specified in Specification Section 03050 Paragraph 5.02.A are maintained.

2. Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, the chutes shall be equipped with baffle boards or shall be in short lengths that will enable the direction of movement to be reversed. Tremies for placing seal concrete under water shall consist of a water tight tube 10 inches to 14 inches in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

#### 4.03 MIXERS.

#### A. General.

1. Concrete may be mixed at a central point or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum, in terms of mixing and agitating capacity, and the speed of rotation of the mixing drum or blades for both mixing and agitation.

2. Mixers shall be capable of combining the aggregates, cement, additives when specified, and water into a thoroughly mixed and uniform mass within the specified mixing period. They shall have a minimum capacity sufficient to comply with minimum production requirements.

3. Mixers shall be equipped with an approved device for accurately measuring water within a range of error of not more than one percent. The amount of water used in each batch shall be shown by an indicator which is accurately calibrated and easily read.

4. Central plant mixers shall be equipped with an approved batch meter and timing device which will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. This device shall be equipped with a bell or other suitable warning device that will give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing the Contractor furnishes a satisfactory means of determining the mixing time.

#### B. <u>Mixers At Site Of Construction</u>.

Mixers at the site of construction will not be permitted, unless permitted by the Owner.

#### C. Truck Mixers And Truck Agitators.

Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall meet all the applicable requirements under Paragraph A above, and in addition, the manufacturer's plate shall indicate the various uses for which the equipment is designed, the gross volume of the drum, and the minimum and maximum speed of rotation of the drum or blades for charging, mixing and agitating. Trucks equipped for mixing shall be equipped with an approved device for recording the number of revolutions of the drum or blades. Mixers or agitators used to mix and transport paving concrete shall be of the hydraulic drum lift type or other especially designed types which will discharge low slump concrete  $(1 - 2 \frac{1}{2} \text{ inch})$  at a satisfactory rate without segregation.

#### D. Nonagitator Trucks.

Bodies of nonagitator hauling equipment for concrete shall be smooth, mortar tight, metal containers, and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Covers shall be provided when needed for protection of the concrete. Nonagitator trucks may be used only with approval of the Owner.

#### E. Admixture Induction.

A satisfactory method and equipment for setting the dosage for admixtures must be furnished and if admixtures other than air entraining agents are used, they shall be added in the manner and in the dosage recommended by the manufacturer.

#### F. Vibrators.

Vibrators shall be of an approved type and design, and shall operate under load at the rate as recommended by the manufacturer and approved by the Owner. For concrete structures, all concrete to be vibrated shall be compacted by means of approved high frequency internal vibrators or other approved types of vibrators immediately after being deposited in the forms. At least two vibrators in good operating condition and tow sources of power shall be available at the site where more than 25 cubic yards of concrete are to be poured. The use of external vibrators for compacting concrete will be permitted where the concrete is inaccessible for adequate compaction, provided the forms are sufficiently rigid to prevent displacement or damage from external vibrators shall not be less than 3,500 impulses per minute and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators, either hand operated or attached to spreader or finishing machines, are used adjacent to forms, they shall have a frequency not less than 7,000 impulses per minute. For prestressed concrete, all concrete shall be thoroughly compacted with approved high frequency vibrators operating at a minimum of 7,000 vibrations per minute.

#### PART 5 - HANDLING, BATCHING AND MIXING

#### 5.01 STOCKPILING AGGREGATES.

A. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground shall be firm and smooth and well drained. A cover of at least three inches of aggregate shall

be maintained in order to avoid the inclusion of soil or foreign material. The stockpiles shall be built in layers not exceeding four feet in height, and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of aggregate composed essentially of material finer than the No. 4 sieve and base material.

B. Dumping, casting or pushing over sides of stockpiles will be prohibited, except in the case of aggregate for base material and fine aggregate materials.

C. Unless otherwise authorized, aggregates from different sources, different gradings or differing in specific gravity by more than 0.03 shall not be stockpiled together. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or separated by suitable walls or partitions, to prevent the mixing of the aggregates.

D. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpiles, it shall be done in a manner approved by the Owner. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has operated, and failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such stockpiling procedure.

E. Stockpiles shall be maintained in a saturated surface dry condition to the extent possible.

#### 5.02 HANDLING, MEASURING AND BATCHING MATERIAL.

#### A. General.

1. The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the Work.

2. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to maintain a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or non-uniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the Owner. The Owner may require sprinkling of aggregate that has dried to the extent that it absorbs mixing water.

3. The fine aggregate and each size of coarse aggregate shall be separately weighed into the hopper or hoppers in the respective amounts set by the Contractor and approved by the Owner. Cement shall be measured by the sack or weight. Separate scales and hoppers shall be used for weighing the cement. The scales shall be equipped with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks will not be allowed except when bulk cement is used.

4. Batching plants equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type may be used.

5. Batching shall be so conducted as to result in the required weights of each material being within a tolerance of 1.0 percent for cement and 1.5 percent for aggregates.

6. Water may be measured either by volume or by weight. The accuracy of measuring the
water shall be within a range of error of not over 1.0 percent. Unless otherwise permitted, calibrated tanks for measuring water shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

7. The use of chemical additives shall be as prescribed under Paragraph 3.06 of this Specification and they shall be added to the mix using the methods and at the time and in the manner recommended by the manufacturer of the additive, subject to approval by the Owner.

8. Unless specifically provided in the contract, the furnishing and use of approved additives or admixtures and the other precautions necessary to provide satisfactory concrete and concrete products shall be considered subsidiary to the furnishing and placement of the concrete and any and all additional costs related thereto and risks resulting there from shall be borne by the Contractor.

9. Different types of cement shall not be mixed, nor shall they be used alternately. Where it is necessary for the color of the concrete to be uniform, only those cements which will produce similar color in concrete may be used alternately. The Owner shall designate which cements may be used alternately.

10. Air entraining agents shall be added to the mix by an approved procedure and by the use of an approved dispenser to assure an accurate proportioning of the agent.

11. All admixtures shall be measured with an accuracy of plus or minus 3.0 percent.

#### B. Limitations On Concrete Operations.

1. Mixing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours, unless an adequate and approved artificial lighting system is provided and operated.

2. When concrete is being placed during hot weather, appropriate measures shall be taken to reduce the hazards of increased rate of cement hydration and high concrete temperatures. The temperature of the concrete at point of discharge shall not exceed  $90^{\circ}$  F. The Owner may require any or all, but not limited to, the following precautions to reduce the temperature of the concrete:

a. Sprinkle coarse aggregate stockpiles in a manner so as to distribute the water evenly and to prevent a variation of moisture within the stockpile.

b. Use crushed or chipped ice as a portion of the mixing water, or use water cooled by refrigeration or other means. If ice is used, it shall be substituted on a pound for pound basis for water and completely melted before the concrete is discharged from the mixer.

c. The Contractor may employ other means which he may have at his disposal if approved by the Owner. In order to minimize the number and extent of precautions as indicated during the production and use of concrete during hot weather, the Contractor may use approved chemical admixtures for set-retarding purposes, with the Owner's approval. However, the use of such approved set-retarding admixtures shall not relieve the Contractor of the necessity for other precautions deemed necessary to minimize variability of the physical characteristics, strength, and other requirements of the green concrete.

d. Unless authorized in writing by the Owner, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches  $40^{\circ}$ F (if the temperature is expected to reach  $35^{\circ}$ F or below), and not resumed until an ascending air temperature in the shade and away from artificial heat reaches  $35^{\circ}$ F.

e. When concreting at temperatures above  $35^{\circ}$ F, the aggregates or water shall be heated or cooled if necessary prior to being placed in the mixer so that the temperature of the resultant mixture will be not less than  $50^{\circ}$ F nor more than  $90^{\circ}$ F at the time of placement. If heating is required, the apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the concrete.

f. When concreting is authorized at temperatures  $35^{0}$ F or less, the Owner will require the water or the aggregates or both to be heated to not less than  $70^{0}$ F nor more than  $150^{0}$ F. The temperature of the mixed, heated concrete shall be not less than  $50^{0}$ F nor more than  $100^{0}$ F at the time of placement. No concrete shall be placed on frozen grade nor shall frozen aggregates be used in the concrete.

g. When it is expected that the ambient temperature will drop below 35<sup>0</sup>F, the Contractor shall provide sufficient canvas and framework, other types of housing, or to enclose and protect the concrete in such a way that the air surrounding the fresh concrete can be maintained at a temperature of not less than 45<sup>0</sup>F and the temperature of the concrete shall not exceed 80<sup>0</sup>F. The above conditions shall be maintained for a period of 120 hours after the concrete is placed. The Contractor shall be responsible for the quality of concrete placed during cold weather, and any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense. When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before the Owner's permission is granted to begin placement.

# 3.05 MIXING CONCRETE.

# A. <u>General.</u>

1. The concrete may be mixed in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity, and shall comply with the applicable requirements of Paragraph 4.03 of this Specification Section. Mixers shall be cleaned at suitable intervals. Equipment having components made of aluminum or magnesium alloys which would have contact with plastic concrete during mixing, transporting or pumping of portland cement concrete, shall not be used.

2. The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. Mixing time shall be measured from the time all materials except water are in the drum. The flow of water shall be uniform, and all water shall be in the drum buy the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the flow of materials into the drum.

3. When mixed in a central mixing plant, the mixing time shall not be less than 60 seconds nor more than 90 seconds. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers shall be included in the mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

4. The mixer shall be operated at the drum speed recommended by the manufacturer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense. Mixers for central mix plants shall not be operated at a capacity greater than the manufacturer's guaranteed mixing capacity.

5. Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or nonagitating trucks having special bodies. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the Work shall not exceed 30 minutes when the concrete is hauled in nonagitating trucks, nor 60 minutes when hauled in truck mixers or truck agitators. When high early strength concrete is used, agitator trucks only

shall be used and the concrete shall be deposited in place at the site of the Work within 30 minutes from the time water is added to the mix, regardless of the method of transportation, unless otherwise approved by the Owner.

6. Truck mixers and truck agitators used to transport concrete from a central mixing plant and truck mixers used to mix concrete in transit from a central batching plant shall meet all applicable requirements of Paragraph 4.03 of the Specification Section, and in addition, the mixing speed and agitating speed shall be those recommended by the manufacturer of the mixer and the total revolutions at mixing speed shall not be less than 70 nor more than 100. Truck mixers and truck agitators shall be operated within the capacity recommended by the manufacturer.

7. Retempering concrete by adding water or by other means will not be permitted. Concrete that is not within the specified slump limits at time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be used only when provided for in the Contract, or permitted by the Owner. The addition of admixtures to the mix shall be in accordance with the provisions of Paragraph 5.02.A of this Specification Section.

8. Tests for air content shall be made on samples of fresh concrete when and as directed. The air content shall be that specified under Part 6 of this Specification Section and shall be determined in accordance with AASHTO T 152, T 196 or T 199.

# B. <u>Ready Mixed Concrete.</u>

1. Ready mixed concrete shall fully comply with ASTM C 94 for Ready Mixed Concrete and to the requirements of these Specifications. Ready mixed concrete shall be discharged from the mixer within 1 hour after the introduction of water, provided the air temperature or the concrete temperature does not exceed 70°F. When the air temperature or concrete temperature exceeds 70°F, the elapsed time between the addition of water to the mix and discharge shall not exceed 30 minutes. The 30 minute time limit for temperatures exceeding 70°F may be extended to 1 hour, provided an approved admixture is used. The admixture shall be a water reducing and retarding agent meeting the requirements of Paragraph 3.06, Type D of this Specification Section and shall be used in accordance with the provisions of Paragraph 5.02.A of this Specification Section. The ready-mix plant furnishing the concrete shall have been inspected and approved for use as provided for in Part 4 of this Specification Section.

2. The delivery ticket accompanying each load of concrete shall show the class and quantity of concrete, the quantity of cement, aggregates, water, and additive used in the batch, and the time of batching. Materials used in the concrete shall be tested and approved.

# PART 6 – MIX DESIGN AND PROPORTIONING

#### 6.01 GENERAL.

A. A Concrete Classification Table, Table 03050.2 is provided hereinafter to indicate to the Contractor the five classes of concrete to be use. The table contains certain criteria to be met in the design of job mixes for the different classifications of concrete. Data included are the minimum 28 day compressive strength of the concrete (14 day strength for Class B concrete), the range of slum allowed, the minimum cement content of the concrete, and the maximum water allowed. The Contractor shall be responsible for design of the concrete mix to be used for each classification of concrete within the limits of Table 03050.2, and for providing concrete to the City in accordance with the approved design mixes.

B. Unless otherwise specified in the Contract Documents all concrete shall contain an air entraining admixture. The concrete shall contain between 5 percent and 8 percent entrained air. Other admixtures may be used if specifically approved by the Owner. The use of calcium chloride will not be allowed.

C. The Owner may specify differing compressive strengths for the several classifications by notation on the Plans or in the Special Provisions, and those values shall govern over the values of these Specifications.

# **CONCRETE CLASSIFICATION TABLE**

#### Table 03050.2

				(3	3)		(3)		(3)		(3)
Class Of <u>Concrete</u>	Minimum 28-Day Compressive <u>Strength (psi</u> )	Slump In <u>Inches</u>	Min. Cement F Gravel Course <u>Aggregate</u>	Factor-Sacks/CY Limestone Course <u>Aggregate</u>	Min. Cemer Gravel Course <u>Aggregate</u>	nt Factor-#/CY Limestone Course <u>Aggregate</u>	Net Water N Gravel Course <u>Aggregate</u>	lax. Gals./CY Limestone Course <u>Aggregate</u>	Net Wate Gravel Course <u>Aggregate</u>	r Max-#/CY Limestone Course <u>Aggregate</u>	( )
А	3,000	3-5	6.0	5.5	564	517	36	33	300	275	
AS	4,000	3-5	(2)	6.2	(2)	583	(2)	37.2	(2)	310	
В	3,500 <b>(1)</b>	1-2 ½	6.2	5.8	583	545	34.1	31.9	284	266	
С	2,500	2-4	5.0	4.5	470	423	34	30.6	283	255	
Р	5,000	1-3	(2)	7.0	(2)	658	(2)	35.0	(2)	292	

Minimum compressive strength @ 14 days. Minimum flexural strength @ 14 days of 550 psi per AASHTO T 22.
 Gravel Coarse Aggregate no permitted.
 Tabulated valves are for Type I cement conforming to the requirements of AASHTO M 85 only.

# 6.02 MIX DESIGN.

Prior to mixing any concrete for the project, the Contractor shall submit his proposed design mix and reports of tests for each classification of concrete to the Owner for approval. The design mix shall be submitted on a form that indicates the supplier and type of the concrete and materials to be used as well as the amounts of materials per cubic yard for at least the following items and units (based upon saturated surface dry aggregate):

- A. Cement-Pounds
- B. Coarse Aggregate-Pounds
- C. Fine Aggregate-Pounds
- D. Air Entraining Admixture Ounces
- E. Other Admixtures (if allowed) Ounces
- F. Water Pounds
- G. Fly Ash (if allowed) Pounds

#### 6.03 PROPORTIONING.

A. Each class of concrete shall be manufactured by combining the several materials prescribed in the design mix in the proportions necessary to obtain the specified compressive strength for each class. Proportioning shall be based upon the specified cement content, and the amount of water for each class of concrete shall not exceed the quantity shown in Table 03050.2. Below this limit, the quantity of water shall be adjusted to meet the slump requirements. Aggregate weights shown in the Contractor's mix design(s) shall be based on saturated surface dry aggregate; batch weights shall be corrected to compensate for surface moisture on the aggregate in order to determine the amount of water to be added at the mixer.

B. In addition to the requirements specified herein and on Table 03050.2, portland cement concrete for pavement, Class B, (Specification Section 02750) shall have a flexural strength at 14 days of not less than 550 pounds per square inch when tested in accordance with AASHTO T 22.

#### 6.04 CHANGES IN MIX.

A. When approved by the Owner, the ration of coarse and fine aggregate may be adjusted in order to assure better workability or to accommodate placement by pumping. However, in no case shall the fine aggregate exceed 44 percent of the total aggregate.

B. If during the progress of the Work, the specific gravity of one or both of the aggregates change more than plus or minus 0.03 from those shown on the concrete design, the design weights shall be adjusted by a design change to conform to the new specific gravity.

## 6.05 HIGH-EARLY-STRENGTH CONCRETE.

A. High-early-strength concrete may be required in the Plans and Specifications or substituted at the request of the Contractor, subject to the approval of the Owner. When high-early-strength cement concrete is authorized, it shall conform to the requirements of Table 03050.2 except that the 28 day strength (or 14 day strength for Class B concrete) shall be obtained in 7 days. The use of Type I or Type III cement for high-early-strength concrete in lieu of using Type III cement. When type I cement is used, the concrete shall have a minimum of 7.6 sacks (714 pounds) of cement per cubic yard of concrete. If admixtures are used to obtain high-early-strength concrete, such admixtures may only be used if previously approved by the Tennessee Department of Transportation for similar uses of the concrete and if specifically approved for the project by the Owner.

B. The gradation of fine and coarse aggregates shall be the same as that approved for the concrete for which the high-early-strength concrete is substituted. All materials entering into the high-early-strength concrete shall be of the same kind and class as the materials entering into the other part or parts of the facility constructed of the class of concrete for which high-early-strength is being substituted.

C. No additional compensation will be made if the Contractor elects to substitute high-early-strength concrete for any class of concrete. The unit price for the class for which the substitution is made shall be full compensation for the concrete.

# PART 7 – TESTING

### 7.01 TEST SAMPLES.

The Owner shall provide for all test cylinders. All samples shall be cast, cured and tested by the City at its expense. The Contractor will be required to assist the Owner in securing necessary materials for casting the required number of cylinders. Testing ages will be 7 days and 28 days unless otherwise determined by the Owner. Laboratory cylinders shall be used to determine the quality of concrete produced. The number of cylinders to be cast daily for any quantity of concrete and laboratory tested, shall be specified by the Owner. With prior consent of the Owner, the Contractor may prepare field cylinders. These cylinders may be used as a gauge for early safe removal of forms where the Contractor requests earlier removal than set out in the Specifications.

#### 7.02 CEMENT TESTING.

All cement used in the Work shall be pre-tested before use. Cement may be used upon completion of a satisfactory 3 day physical test made in accordance with current ASTM Specifications. Cement shall be tested by an approved commercial testing laboratory at the Contractor's expense.

# 7.03 CORE SAMPLES.

A. If the Owner's testing of cylinders indicates compressive strength less than required in Table 03050.2 for the class of concrete specified, the Contractor may, at his option, elect to drill core samples from the actual concrete placed. If the Contractor elects to drill (or is instructed by the Owner to drill) core samples from the hardened concrete, the costs of obtaining the cores and of repairing the core holes with nonshrinking grout shall be borne by the Contractor.

B. The cores shall be drilled as directed by the Owner, at the same approximate locations from which the test cylinder concrete was obtained. The locations of the drilled cores shall be selected so that the remaining structure will not be impaired or sustain permanent damage after the holes are repaired by the Contractor. The drilled samples shall be tested for compressive strength by the Owner, and the equivalent 28 day strength of the concrete placed and represented by the drilled core samples shall be determined. The Owner shall use the test results of the drilled cores to determine the acceptability of the concrete.

#### 7.04 METHODS OF SAMPLING AND TESTING.

A. Test cylinders cast to determine acceptability for minimum AASHTO strength requirements shall be made and cured in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22. Test cylinders cast to determine when a precast unit or a structure may be put into service or to determine when a tensioning load may be transferred shall be cured by methods identical to those used in curing the concrete member, and tested in accordance with AASHTO T 22.

B. Drilled core samples shall be taken and tested in accordance with AASHTO T 24. Due to possible fracturing effect of the coring operation, drilled core samples having a compressive strength of 85 per cent or more of specified strength will be considered acceptable.

C. Slump shall be determined in accordance with AASHTO T 119 on the job site during each placement.

D. The amount of air entrained shall be determined by pressure or volumetric meters of approved design and in accordance with AASHTO Method T 152 or AASHTO Method T 196, except that AASHTO Method T 199 may be used after the accuracy of the Chace Air Indicator has been determined by comparison tests.

## 7.05 CONCRETE FAILING TO MEET STRENGTH REQUIREMENTS.

A. Concrete which has been mixed and placed in accordance with these Specifications, and which fails to meet the minimum 28 day strength requirements shall be removed and disposed of by the Contractor, at his expense, unless specifically authorized by the Owner, in writing, to remain in place. The removal shall be in such manner as will not cause damage to the remaining concrete or to other structural units or other facilities and property.

B. The Owner may, at his discretion, allow concrete which fails to meet the minimum strength requirement to remain in place. Payment for this concrete will be at a reduced price, to compensate the Owner for loss of durability. The amount of the reduction shall be determined by the Owner and shall be based on the particular circumstances.

# PART 8 - MISCELLANEOUS

# 8.01 CONCRETE MIXED AND/OR BATCHED OFF PROJECT SITE.

Concrete may be mixed and/or batched off the immediate project site, subject to specific approval of the Owner and under the direct supervision of the Contractor. A delivery ticket (certified by the batch plant) showing mix, quantity of cement, quantity of fine and coarse aggregate, moisture content, total water and gallons per cubic yard of concrete shall be furnished to the Owner with each delivery of concrete and the Contractor shall show to the satisfaction of the Owner that the plant is so located and equipped as to produce and deliver concrete fully meeting the specification requirements.

## 8.02 MEASUREMENT AND PAYMENT.

The methods of measurement and payment for concrete shall be as specified in Divisions 2 and 3 of these Specifications for each particular item constructed by the Contractor.

#### END OF SECTION 03050

# PART 1 - SCOPE

1.01 This work shall consist of the construction of all structures, or parts of structures, composed of Portland cement concrete whether plain, reinforced, or a combination of both. Concrete structures shall be constructed of Class A Concrete, unless otherwise specified. They shall be constructed on prepared foundations, at the locations indicated or directed in conformity with the dimensions, lines and grades shown on the Plans or as directed by the Owner and in accordance with these Specifications.

1.02 The concrete used in this construction shall be composed of a mixture or mixtures of Portland cement, aggregates, air-entraining agents, water, and chemical additives when approved, combined by the methods an in the proportions defined for the particular class of concrete designated as shown in Specification Section 03050.

1.03 Parts of a structure, or structures, indicated to be constructed with materials other than Portland cement concrete and concrete reinforcement steel shall be constructed in accordance with the provisions set out in the Specification Section covering the particular type of construction.

# PART 2 – MATERIALS AND EQUIPMENT

### 2.01 MATERIAL

A. Materials used in this construction shall meet the requirements of the applicable Sections or Paragraphs of Specification Section 03050, "Portland Cement Concrete" and the following:

- B. <u>Waterstops</u>.
  - 1. Waterstops shall be of the type, shape, and dimensions shown on the Plans.
  - 2. Metallic.

Metallic waterstops shall be sheet copper conforming to the requirements as specified in the current Specifications for Copper Sheet, Strip, Plate, and Rolled Bar, Type ETP, ASTM Designation B 152. The weight per square foot shall be as specified on the Plans.

3. Nonmetallic

a. Nonmetallic waterstops shall be manufactured from either natural rubber, synthetic rubber, or polyvinylchloride (PVC) at the option of the Contractor. Waterstops shall be produced by such a process that, as supplied for use, they will be dense, homogeneous, and free from holes and other imperfections. The cross-section of the waterstop shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop will be uniform.

b. Rubber Waterstop.

(1) The waterstop shall be fabricated from a high grade thread-type compound. The basic polymer shall be natural rubber or a copolymer of butadiene and styrene, or a blend of both. The compound shall contain no less than 70 percent by volume of the basic polymer, and remainder shall consist of reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers, but shall contain no factice.

(2) Samples taken from the finished waterstop shall meet the following requirements when tested in accordance with the current specified ASTM method of test.

ASTM

<b>Requirement</b>	Method of Test
2500 psi. min.	D 412
450 percent, min.	D 412
60-70	D 2240
1.15 + 0.03	D 297
	(Sec. 17)
5 percent, max.	D 570
80 percent, min.	D 572
	Requirement           2500 psi. min.           450 percent, min.           60-70           1.15 + 0.03           5 percent, max.           80 percent, min.

#### c. Polyvinylchloride Waterstop.

(1) This waterstop shall be extruded from an elastomeric plastic material. The material shall be a plastic compound, the basic resin of which shall be polyvinylchloride. The compound shall contain any additional resins, plasticizers, stabilizers, or other materials needed to insure that when the material is compounded it will meet the performance requirements of this Specification. No reclaimed polyvinylchloride shall be used.

		ASTM
<u>Title</u>	<u>Requirement</u>	Method of Test
Tensile Strength (Die "C")		
Sheet Material	2,000 psi	D 412
Finished Waterstop	1,700 psi	D 412
Ultimate Elongation (Die "C")	·	
Sheet Material	350% Min.	D 412
Finished Waterstop	300% Min.	D 412
Stiffness in Flexure	750 psi Min.	D 747
Accelerated Extraction		CRD C 572
Tensile Strength (Die "C")	1,750 psi	D 412
Elongation (Die "C")	300%	D 412
Effect of Alkali (After 7 Days)		
Change in Weight	-0.1 to +0.25%	
Change in Hardness,		
Shore Durometer	+ or – 5%	
Low Temperature Brittleness	-35°	D 746
Specific Gravity	1.3	D 792

(2) For polyvinylchloride waterstops, the supplier shall submit a certificate stating that all of the performance requirements specified for the sheet material under Polyvinylchloride Waterstops have been complied with. Field splices for Polyvinylchloride waterstops shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations. Waterstops shall be manufactured with an integral cross-section which shall be uniform within plus or minus 1/8 inch in width, and the web thickness or bulb diameter within plus 1/16 inch and minus 1/32 inch.

(3) The Contractor shall furnish the Owner at this request and at no cost to the City a certified test report from an approved laboratory covering each lot or unit of finished waterstops. These test reports shall contain the numerical laboratory test data of the required test.

#### B. Epoxy Resin Systems.

Two Component epoxy resin systems shall conform to the requirements of the appropriate class designation of AASHTO M 200, M 234, M 235, unless otherwise designated on the Plans or in the Contract. The appropriate class designation is determined by the proposed use of the material.

1. Requirements for Specific Uses:

a. Bonding fresh concrete to cured concrete.

Requirements: The material shall meet the compositional specification fo AASHTO M 235, Class I and applicable requirements of the Class III performance specification.

b. Bonding cured concrete to cured concrete.

Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class III performance specification.

c. Binder in epoxy resin concrete and mortar for repairing spalls and other defects in concrete.

Requirements: The material shall meet the compositional specification of AASHTO M 235, Class II and the applicable requirements of the Class III performance specification.

#### C. Bar Reinforcement.

Unless otherwise specified, all steel reinforcement for concrete shall be billet steel bars conforming to the requirements of ASTM A 615.

#### D. Dowel Bars.

Dowel bars shall be plain and shall conform to the requirements of ASTM A 306, Grade 55, 60, 65, or 70.

#### E. Welded Wire Fabric.

Fabric for reinforcement shall conform to ASTM A 185, or as indicated on the Plans, and shall be supplied in mats of the size, design and weight shown on the Plans.

#### 2.02. EQUIPMENT.

A. Equipment and tools necessary for handling materials and performing all parts of the Work shall be subject to approval by the Owner as to design, capacity, and mechanical condition. Equipment shall be on hand sufficiently ahead of the start of construction operations to be examined and approved. The equipment and organization shall be of sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Owner.

B. The requirements for batching plant and mixers shall be as prescribed in Specification Section 03050.

C. Ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms shall be provided. Closed chutes or pipes shall be used when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, the chutes shall be equipped with baffle boards or shall be in short lengths that will enable the direction of movement to be reversed.

D. Vibrators shall be of an approved type and design and shall operate under load at a rate as recommended by the manufacturer and approved by the Owner.

#### PART 3 – CONSTRUCTION REQUIREMENTS

3.01 FORMS.

# A. Construction.

1. Forms shall be mortar-tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other stresses incidental to the construction operations, including vibration. Forms shall be so constructed and maintained as to prevent the opening of joints due to shrinkage of the lumber.

2. The forms shall be built true to line and grade and shall be held in place by means of studs or uprights, and waling, which shall be sufficiently and substantially braced and tied.

3. All forms and studding shall be cut off and capped with not less than a 2 inch by 4 inch piece so that the top of the cap will be at the elevation of the finished exposed surface of the concrete.

4. All edges shall be chamfered with  $\frac{3}{4}$  inch material, unless otherwise specified. All chamfer strips shall be straight, of uniform width, and dressed.

5. Wood devices of any kind used to separate forms shall be removed before placing concrete within 4 inches of such devices.

#### B. Form Lumber.

1. Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be so constructed as to produce mortar-tight joints and smooth, even concrete surfaces.

2. Plywood forms, or forms face-lined with plywood, masonite, or other approved similar material may be used, provided the plywood forms and form linings are substantial, of uniform thickness, and are mortar-tight when in position.

#### C. Metal Ties.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least one inch from the face without injury to the concrete. In case wire ties are permitted, the wires shall be cut back at leas 1/4 inch from the surface of the concrete, and the surface left sound, smooth, even, and uniform in color.

D. <u>Walls</u>.

Sufficient openings shall be provided at intervals along the bottom of wall forms to permit thorough cleaning prior to concrete placement. Such openings shall be closed before placing concrete in the forms.

#### E. Surface Treatment.

Prior to placing reinforcement, all forms shall be treated to prevent the adherence of concrete. Forms not provided with a special treatment shall be treated with an approved oil. Any material that will adhere to or discolor the concrete shall not be used.

F. Metal Forms.

1. The specifications for forms, as regards design, mortar tightness, filleted corner, beveled projections, bracing, alignment, removal, and reuse and oiling apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and revet heads shall be countersunk on the face forming the concrete surface. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or do not line up properly shall not be used. Care shall be exercised to keep metal forms free from rust, grease, or other foreign matter.

2. When the Contractor wishes to utilize a special forming system not specifically authorized in this Specification, he shall submit his design and calculation to the Owner for review and approval.

#### 3.02 FALSEWORK.

A. The falsework used to support the forms and concrete for concrete structures shall be supported on sills resting on rigid foundations composed of piles driven until the bearing capacity of each pile is sufficient to support the load to which it will be subjected, or earth-borne footings as hereinafter provided.

B. Earth-borne footings will be permitted only when, in the opinion of the Owner, the soil can adequately support the superimposed loads and the following conditions are met:

1. Spread footings will only be permitted on stable ground, capable of supporting the superimposed load.

2. The site is graded and so maintained to prohibit ponding of water or erosion of soil in the proximity of the spread footings.

3. The falsework system shall be designed and constructed to preclude exceeding the bearing capacity of the soil but in no case shall exceed 3,000 pounds per square foot.

- 4. The footings shall be designed and constructed to carry the superimposed loads.
- 5. All footings shall be constructed on a level plane.

C. The falsework shall be designed and constructed to support the required loading without distortion or settlement of the forms.

D. The Contractor shall place "tell-tales" for observation of the amount of falsework settlement at locations designated by the Owner.

E. The Owner may require the Contractor to submit detailed falsework plans, together with a soils report, design calculations or any other information necessary for a thorough review. The Contractor is totally responsible for the design and construction of the falsework system and shall repair, or remove and replace, as directed and at his expense, any concrete, other material or portions of the structure which are damaged or destroyed due to failure of the falsework.

#### 3.03 REINFORCEMENT

A. All reinforcement shall consist of deformed steel bars, unless otherwise indicated or directed. Deformed steel bars shall have a net area at all sections equivalent to that of plain round or square bars of the corresponding nominal size.

B. Structural steel shapes shall conform strictly to the shapes indicated or required.

C. Steel wire fabric may be furnished in rolls or sheets.

D. Reinforcing steel shall be stored above the ground surface upon platforms, skids or other supports located without the scope of the active construction operations and shall be protected at all times from injury and damage. All brush and weeds shall be removed from the area immediately prior to storing reinforcing steel thereon.

E. Reinforcing steel, where indicated, shall be accurately bent, without heating, to the forms and dimensions indicated on the Plans. Minimum bend diameters shall be in accordance with the requirements of the American Concrete Institute. Unless otherwise indicated, all bends shall be in one plane. Bars of <sup>3</sup>/<sub>4</sub> inch or less which have only hooks or a single bend may be bent in the field, provided satisfactory equipment for proper and accurate work is used and provided the bending is accomplished true to form and dimensions without damage to the bars. All other bending shall be done in the shop before shipment.

F. Substitution of bars of different sizes from those indicated on the Plans may only be made with the written permission of the Owner. If substitution is permitted, the following shall apply:

1. The total area of steel in any one linear foot in each direction shall not be reduced.

2. For cast-in-place concrete the clear distance between parallel bars in a layer shall not be less than 1.5 bar diameters, 1.5 times the maximum size of the coarse aggregate, nor 1-1/2 inches.

3. Where positive or negative reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with the clear distance between layers not less than 1 inch.

4. Clear distance limitation between bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars.

5. Groups of parallel reinforcing bars bundled in contact to act as a unit shall be limited to 4 in any one bundle. Bars larger than #11 shall be limited to two in any one bundle in beams. Bundled bars shall be located within stirrups or ties. Individual bars in a bundle cut off within the span of a member shall terminate at different points with at least 40 bar diameters stagger. Where spacing limitations are based on bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.

6. In walls and slabs, the primary flexural reinforcement shall be spaced not farther apart than 1.5 times the wall or slab thickness, nor 18 inches.

G. All reinforcement shall be furnished in the full lengths shown on the Plans, unless otherwise approved in writing by the Owner. No splices shall be made unless indicated on the Plans or authorized by the Owner. Splices shall be so arranged and manipulated as to provide a minimum of 2 inches net clearance between the splices and the surface of the complete concrete work, unless otherwise indicated or directed. Splices of tension reinforcement at points of maximum stress shall be avoided. The members at all splices shall be rigidly clamped by means of at least two approved metal clips located approximately 3 inches from the ends of the bars and bolted around them or securely wired in a manner satisfactory to the Owner.

H. Steel shapes shall be spliced only as indicated on the Plans.

I. Steel fabric shall be spliced by overlapping of the sheets by not less than 12 inches; by matching at least three transverse member; and by securely wiring the overlapped sections in a manner satisfactory to the Owner.

J. All reinforcing steel before being placed shall be thoroughly cleaned of mill scale, rust, dirt, paint, oil, or other foreign substances or coating of any character that will reduce the bond. If reinforcement which has been placed becomes dirty, rusty, or spattered with mortar which dries before concrete is placed around it, such reinforcement, or part affected, shall be thoroughly cleaned before being covered with concrete.

K. Reinforcement shall be accurately placed and firmly held in position as indicated on the Plans. Steel bars shall be securely fastened together with metal clips or wire at each intersection, except where spacing is less than on 1 foot in each direction then alternate intersections shall be fastened. All reinforcing steel shall be securely spaced from the forms and between adjacent reinforcement by means of precast mortar blocks, metal spacers or other approved devices or methods, and where possible, all spacer devices shall be so arranged that their use cannot be detected in the completed structure. Spacer blocks shall be cast of mortar mixed in the same proportions as that in the concrete mixture and shall not have a length or width greater than the depth required for proper spacing from the forms or between adjacent reinforcement. The use of gravel, concrete, brick, or wooden blocks is prohibited.

L. All the reinforcing steel necessary for a section of a concrete structure shall be accurately and securely placed and the placement approved by the Owner before any concrete is deposited in the section, and care shall be observed not to disturb it during the placing of the concrete.

M. All dimensions relating to reinforcing bars are to the centers of the bars, unless otherwise indicated.

N. Tolerances for bending and cutting during fabrication shall be in accordance with the "Manual of Standard Practice" published by the Concrete Reinforcing Steel Institute.

#### 3.04 DRAINAGE AND WEEP HOLES

Drainage openings and weep holes shall be constructed using materials in the manner and at the locations shown on the Plans or established by the Owner. Ports or vents for equalizing hydrostatic pressure, when required, shall be placed as directed.

#### 3.05 PLACING PIPES, CONDUITS, ANCHORS, CASTING, AND OTHER APPURTENANCES

A. Pipes, conduits, anchors, castings, bolts, plates, grillage, and other appurtenances which are necessary or desirable to be placed in the concrete of a structure, whether indicated on the Plans or not, shall be placed by the Contractor during construction, as directed. Unless otherwise stipulated, pipes and conduits will be delivered to the Contractor at the site of the structure by the City of by other parties for whose use the pipes and conduits are intended.

B. No compensation will be allowed for placing such pipes, conduits, and other appurtenances, except that no deductions will be made for the volume of concrete displaced by those items.

#### 3.06 EXPANSION JOINTS

A. Expansion devices shall be as indicated on the Plans. The devices shall be securely anchored in correct position. All sliding surfaces shall be true and smooth and shall form complete contact throughout. Movement shall not be impeded by the concrete in which they are embedded.

B. Unless otherwise provided, where portions of concrete bridge superstructure rest on the substructure, the contact area shall be separated by at least two layers of three-ply bituminous-saturated paper.

C. Open joints shall be constructed using forms which will permit removal without injury to the concrete. After removal of the forms, the joints shall be cleaned thoroughly. Filled joints shall be constructed with premolded filler, unless otherwise indicated. Joints requiring a sealant shall be thoroughly cleaned and sealed with one of the specified joint sealing materials before the structure is opened to traffic. Edges of open and filled joints shall be chamfered or edged, as directed. Mortised joints shall be constructed as shown on the Plans or as directed.

#### 3.07 PLACING CONCRETE

# A. General

1. Concrete shall not be placed until forms and reinforcing steel have been checked and approved. The forms shall be clean of all debris and kept wet immediately before concrete is placed. The method and sequence of placing concrete shall be approved by the Owner. Unless otherwise permitted, all concrete shall be placed in daylight, and the placing of concrete in any portion of the structure shall not be started unless it can be entirely completed in daylight. When the placing of concrete is permitted during other than daylight hours, an adequate and approved artificial lighting system shall be provided and operated.

2. All concrete shall be thoroughly worked during the placing by means of tools of approved type. The working shall be such as to force all coarse aggregate from the surface and to bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycomb.

3. If the forms show bulging or settlement while concrete is being placed, the placing shall be stopped until correction has been made.

4. T-beam girders, slabs, arch rings, and all horizontal sections of bridges except curbs and sidewalks shall be constructed monolithically and continuously, unless otherwise permitted. Curbs and sidewalks shall be constructed after the bridge deck is completed, unless otherwise indicated on the Plans.

5. After initial set and prior to final set of the concrete, the forms shall not be jarred, and no strain shall be placed on the ends of the projecting reinforcement. Piles shall not be driven closer than 20 feet to footings less than 7 days old nor to foundations supporting concrete less than 7 days old.

#### B. Railings and Curbing.

1. When constructing curb, careful attention shall be given to the installation of railing steel or anchoring devices.

2. Concrete railings shall not be constructed on any structure until the falsework has been struck.

#### C. Chutes and Troughs

1. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement.

2. All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. The water used for flushing shall be discharged clear of the concrete already in place.

3. Care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the forms and around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

#### D. Vibrating

1. Unless otherwise directed, the concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When required, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction.

2. Vibrators shall be so manipulated as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. Vibrators shall not be used as a means to cause concrete to flow or run into position in lieu of placing. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs.

3. At least on additional standby vibrating unit shall be available for all individual pours in excess of 10 cubic yards.

#### E. Joints

1. Feather-edge construction joints will not be permitted. Transverse or longitudinal joints through spans will not be permitted, except where specified.

2. In no case shall the concreting of any section or layer be stopped or temporarily discontinued within 18 inches of any finished surface, unless the details of the structure provide for a coping having a thickness of less than 18 inches, in which case, at the option of the Owner, the construction joint may be made at the underside of the coping.

3. Layers completing a day's work or placed just prior to temporarily discontinuing operations shall be cleaned of all laitance or other objectionable material as soon as the surface has become sufficiently firm to retain its form.

#### 3.08. BONDING CONSTRUCTION JOINTS

A. Where dowels, reinforcing bars, or other adequate ties are not indicated on the Plans, keys of a directed size shall be made by constructing projections above the concrete and monolithically with the concrete.

B. In resuming work, the forms shall be drawn tightly against the face of the concrete. The entire surface of the concrete to be bonded shall be cleaned thoroughly and roughened with a steel tool. In addition, if directed, the surface to be bonded shall be cleaned and roughened by sandblasting. The surface shall then be soaked with clean water, after which concreting may proceed.

#### 3.09. REMOVAL OF FORMS AND FALSEWORK.

A. Forms for ornamental work, railings, parapets, columns, and vertical surfaces that do not carry loads shall be removed in from 12 to 48 hours, unless otherwise directed by the Owner. In cold, damp, or freezing weather, all vertical forms shall remain in place until the concrete has set sufficiently to withstand damage when the forms are removed. In removing forms, care shall be exercised not to mar the surface of the concrete nor to subject it to any undue pressure.

B. Projecting wires or other metal devices used for holding forms in place and which pass through the body of the concrete shall be removed or cut as specified in Specification Section 03310 Paragraph 3.01.A, and the holes or depressions thus made and all other holes, depressions, and small voids which show upon the removal of the forms shall be filled with cement mortar mixed in the same proportions as that which was used in the body of the concrete which is being repaired.

C. Falsework and supports under slab or girder spans, any length, may be released and removed when representative specimens of the concrete in the spans, cured by the methods and in the manner the concrete which the test specimens represent is cured, attain a compressive strength of 3,000 pounds per square inch. In addition to the above requirement, the concrete

shall have been placed a minimum of 10 days, not counting the days of 24 hours each in which the temperature falls below 40° F., or 21 calendar days, whichever occurs first.

D. For continuous concrete girder or slab units, any length, the falsework and supports shall not be released or removed from any span in the continuous unit until the concrete in all spans in the unit has been placed a sufficient length of time to meet all requirements for the removal of falsework and supports as set forth above.

E. Forms supporting bridge decks between girders and outside curb overhangs may be removed after seven days.

### 3.10. DEFECTIVE CONCRETE

A. Any defective concrete discovered after the forms have been removed shall be removed immediately and replaced. If the surface of the concrete is bulged, uneven, or shows honeycombing which cannot be repaired satisfactorily, the entire section shall be removed and replaced.

B. Concrete having a 28 day strength of less than the minimum specified shall be removed and disposed of by the Contractor, at his expense, unless specifically authorized by the Owner, in writing, to remain in place. The removal shall be in such a manner as will not cause damage to the remaining concrete or to other structural units or other facilities and property.

#### 3.11. FINISHING CONCRETE SURFACES

A. Unless otherwise authorized, the surface of the concrete shall be finished immediately after form removal.

B. All concrete surfaces shall be given a Class 1 finish. The following surfaces of all structures shall be given a Class 2 Finish: roadway face and top of curb, vertical outside face of curb overhang or sidewalk slab, bottom surface of slab overhang, bridge railings, barrier railings, all vertical surfaces of the superstructure of dual bridges exposed to view from either structure, and all surfaces of retaining walls, wingwalls, and end walls which are visible from passing vehicles.

1. Class 1, Ordinary Surface Finish.

a. Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces which are to be exposed or waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, saturated with water, and carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the Class of the concrete being finished. Mortar used in pointing shall not be more than 30 minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

b. All surfaces which cannot be repaired to the satisfaction of the Owner shall be "rubbed" as specified for a Class 2 finish.

2. Class 2, Rubbed Finish.

a. After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a wetted wooden block or a medium coarse carborundum stone.

The carborundum stone shall not be used until the concrete has hardened to the state where the sand will grind, rather than ravel or roll. Rubbing shall be continued until all form marks, projections, and irregularities have been removed; all voids filled; and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place. A brush finish or painting with grout will not be permitted.

b. After all concrete above the surface being finished has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

c. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks.

3. Class 3, Float Finish

a. This finish, for unformed surfaces, except slab surfaces for pavements or bases, shall be achieved by placing an excess of material in the form and removing or striking off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of concave surfaces shall be avoided after the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool of wood, canvas, or cork. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

# 3.12. FINISHING SLAB SURFACES FOR PAVEMENTS OR BASES.

A. Bridge floors or top slabs of structures serving as finished pavements or bases shall be finished either by hand methods or approved mechanical finishing machines.

B. When the hand method is used, the bridge floors or slabs shall be struck off with a screed which is parallel to the centerline of the roadway, resting on bulkheads or screed strips cut or set to the required cross-section of the roadway. This screed shall be so constructed as to have sufficient strength to retain its shape and that the cutting edge may be adjusted to conform to the profile of the roadway. Screeds shall be of sufficient length to finish the full length of spans 40 feet or less in length. Spans over 40 feet in length shall be finished in two or more sections, but no section shall be less than 20 feet in length. Screed strips or headers shall be accurately set to the4 specified grades, checked, and adjusted as necessary prior to the final screeding operation. The screed shall be worked back and forth over the surface until the proper profile and cross-section is obtained.

C. When mechanical finishing machines are used, they shall be approved power driven machines, traveling on rails adjusted to conform to the profile of the roadway. The machines shall be equipped with oscillating or vibrating transverse or longitudinal screeds that may be adjusted to conform to the profile or the required cross-section of the roadway. The screeds shall have sufficient strength to retain their shape after adjustment. The finishing machine shall go over each area of the bridge floor as many times as is required to obtain the required profile and cross-section.

D. Regardless of the method of finishing, the Contractor shall maintain a minimum rate of placement of 20 linear feet of bridge deck per hour when concrete is placed in a longitudinal section.

E. After finishing as described above, the surface shall be checked with a 12 foot straightedge and shall show no deviation is excess of 1/8 inch from the testing edge of the straightedge when placed parallel to the centerline. Deviations in excess of this requirement shall be corrected before the concrete sets.

F. The surface shall be finished by dragging a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap to slightly groove the surface and shall be moved forward with minimum bow of the lead edge. The drag shall be kept damp, clean, and free of particles of hardened concrete. A light broom or brush herring bone finish that leaves a texture similar to that obtained by the burlap drag may be used when permitted by the Owner. For bases, the surface shall be finished by grooving lightly with a wire broom at an angle of 60° with the centerline. All strokes shall begin at the center and end at the edge. After the slab has been finished by the burlap drag, surfaces which will become traffic lanes shall be textured by the formation of transverse grooves. The grooves shall be formed in the surface at an appropriate time during the stiffening of the concrete, so that in the hardened concrete the grooves will be between 0.09 inch and 0.13 inch in width; between 0.12 inch to 0.19 inch in depth; and spaced at random intervals between 0.3 inch and 1.0 inch. The grooves shall terminate approximately 18 inches from curbs, parapets, barrier walls, and other vertical walls. The grooves shall be relatively smooth and uniform; shall be formed without tearing the surface and without bringing pieces of coarse aggregate to the top of the surface; and shall be formed to drain transversely. All areas which do not conform to these requirements shall be corrected at the Contractor's expense by approved methods.

G. As soon as the surface has set sufficiently to withstand damage when walking on it and not later than the morning following the placing of the concrete, it shall be straightedged with the 12 foot straightedge and all variations exceeding 1/8 inch shall be plainly marked. The Contractor shall correct an seal such variations in the same manner as specified for Portland Cement Concrete Pavement.

# 3.13. CURING CONCRETE

A. All concrete surfaces, except those surfaces protected by forms that remain in place seven days or longer as required under the provisions of Specification Section 03310 Paragraph 3.09, "Removal of Forms and Falsework", shall be cured as specified below. Curing shall begin as soon as the concrete has hardened sufficiently to withstand surface damage to unformed surfaces and immediately after the forms have been removed from formed surfaces.

B. When the temperature is expected to fall below 35<sup>°</sup> F., the concrete shall be protected in accordance with the provisions of Specification Section 03310 Paragraph 3.14.

C. The initial curing period for concrete surfaces shall be by the "Water Method" for a period of not less than 24 hours, or until the concrete surfaces have been prepared for the application of curing compound, in accordance with the provisions under B below. During the initial curing period, the concrete shall be protected from the sun by burlap mats or other approved materials and kept completely and continuously moist.

D. The "Water Method" and membrane-forming compound method of curing will be required for all bridge decks, and on all concrete slabs when the temperature exceeds  $90^{\circ}$  F. during placement.

#### 1. Water Method

a. All concrete slabs shall be covered immediately with material suitable for use with the water cure and kept thoroughly wet for at least 120 hours from the beginning of the initial curing period. All surfaces other than slabs shall be protected from the sun and shall be kept wet for a period of at least 72 hours from the beginning of the initial curing period. Curbs, walls, handrails, and other surfaces requiring a Class 2 finish may have the covering temporarily removed for finishing, but the covering shall be restored as soon as possible.

#### 2. Membrane-Forming Compound Method

a. All surfaces shall be given the required surface finish prior to application of the curing compound. Prior to the application of curing compound, the surface shall be kept moist.

b. The rate of application of curing compound shall be as recommended by the manufacturer but shall not be less than one gallon for 150 square feet of concrete surface. The curing compound shall be applied, under pressure, immediately after completion of the initial curing period or acceptance of the concrete finish. If the surface is dry, the concrete shall be thoroughly wet with water and the curing compound applied just as the surface film of water disappears. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. If the application of the compound results in a streaked or blotchy appearance, the method shall be stopped and water curing, as set out above, applied until the cause of the defective appearance is corrected. The coating shall be protected against marring for a period of seven days from date of application. Any coating marred or otherwise disturbed within the seven day period shall be replaced at once.

#### 3.14 PROTECTION OF CONCRETE IN COLD WEATHER

Concrete shall be protected in cold weather a specified in Specification Section 03050.

### 3.15 WATERPROOFING AND WATERSTOPS

A. Waterproofing where indicated on the Plans or directed by the Owner shall be performed in accordance with the requirements of Specification Section 03052.

B. Metallic or nonmetallic waterstops, as specified, shall be installed in accordance with the details shown on the Plans and in conformity with the requirements of these Specifications.

C. Metallic waterstops shall be spliced, welded or soldered, as necessary, to form continuous, watertight joints.

D. Nonmetallic waterstops shall be installed in continuous strips without splices, except that splices will be permitted at changes in direction when necessary to avoid buckling or distortion of the web or flange. All splices of nonmetallic waterstops shall be performed in accordance with the manufacturer's recommendations and in the case of polyvinylchloride waterstops, the heat used shall be sufficient to melt but not char the plastic.

E. Adequate provisions shall be made to support the waterstops during the progress of work and to insure their proper embedment in the concrete. The concrete shall be thoroughly worked in the vicinity of the joints to insure maximum density and imperviousness. Forms shall be so designed that they can be removed without damaging the waterstops. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from mechanical damage.

#### PART 4 – MEASUREMENT

#### 4.01 MEASUREMENT

A. All concrete will be measured for payment as stipulated under the Specification Section specifying each individual type of construction.

B. No allowance will be made for furnishing the material and the construction of drainage openings and weep holes as indicated or as directed, provided such openings are 6 inches in diameter or less, except that no deduction will be made for such openings in the computation of concrete quantities. Allowance will be made for other openings as indicated.

C. No allowance will be made for additional cement used in depositing concrete underwater; for use of calcium chloride or chemical additives; for fillers, sealer, and tar paper used in expansion joints; for dowels or other materials used in bonding construction joints; for waterstops; and for painting metals.

D. No allowance will be made for concrete placed below the foundation elevation shown on the Plans or as directed by the Owner.

E. No additional compensation will be made for high-early-strength concrete substituted by the Contractor.

# PART 5 – PAYMENT

# 5.01 PAYMENT

All concrete will be paid for a stipulated under the Specification Section specifying each individual type of construction.

# END OF SECTION 03310

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS <u>SECTION 05520 HANDRAIL</u>

# PART 1 - SCOPE

This work shall consist of the furnishing and placing handrail for locations other than bridges such as atop retaining walls or at such other locations as shown on the plans. Handrail shall be placed at the locations and in conformity with the lines, grades, and dimensions shown on the plans, the Design Standards, or as directed by the Owner, all in accordance with this specification.

### PART 2 - MATERIALS AND EQUIPMENT

#### 2.01 MATERIALS.

#### A. Pipe for Rails and Posts.

Pipe shall conform to the requirements of ASTM A 120, standard weight.

#### B. Concrete.

Concrete for posts set in individual concrete foundations shall be Class A as specified in Specification Section 03050.

### 2.02 EQUIPMENT.

All equipment necessary for the satisfactory performance of this work shall be on hand and inspected before work will be permitted to begin.

#### PART 3 - CONSTRUCTION REQUIREMENTS

# 3.01 FABRICATION.

Handrail shall be fabricated from pipe for rails and posts as shown on the plans and in the Design Standards. Rails, posts and elbows at corner posts shall be fillet welded according to the Design Standards for Handrails. All welds and joints shall be ground smooth prior to painting. Fabrication shall be done such that, when erected, posts are in a vertical plane, and rails parallel to grade.

#### 3.02 PAINTING.

Painting of handrail shall be in accordance with the requirements of the Design Standard for Handrail.

#### 3.03 ERECTION.

A. When handrail is to be erected on the top of a concrete retaining wall or similar structure, handrail posts shall be set directly in the concrete to the depth shown in the Design Standard, but in no case less than 12 inches, with the posts held plumb until concrete has set. Alternatively, handrail post inserts of the required depth may be set in concrete and the posts set in the inserts after concrete has set. Inserts shall be of the sizes and constructed as specified for fence post inserts in Specification Section 02820 Paragraph 3.01. Where posts are not set directly in concrete and inserts have not been provided, post holes of the same diameter and depth as required for inserts shall be cored in the concrete. Handrail post shall be set in cored holes in the same manner as post set in inserts.

B. Where handrail is to be erected separately from a structure, posts shall be set directly in concrete footing of the dimensions of the dimensions shown on the plans or Design Standard but not less than 8 inch diameter and 24 inch depth. Posts shall be held plumb until concrete is set.

#### PART 4 – MEASUREMENT

#### 4.01 HANDRAIL.

This work shall be measured for payment in linear feet of accepted handrail of the specified height, measured along the top rail, in place.

# CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATIONS <u>SECTION 05520 HANDRAIL</u>

# PART 5 – PAYMENT

### 5.01 HANDRAIL.

This work shall be paid for at the contract unit price per linear foot, which price will be the full compensation for furnishing all materials, fabrication painting and erection, either atop a retaining wall or other structure or separate from a structure including inserts, grouting, coring, excavation, concrete footings, and all other work associated with handrail construction.

#### 5.02 PAYMENT WILL BE MADE UNDER:

 Item No.
 Pay Item

 05520-5.01
 HANDRAIL

 05520-5.01.
 (Ft ) Height Handrail

<u>Pay Unit</u>

Linear Foot Linear Foot

# **END OF SECTION 05520**

#### SECTION 11312 DUPLEX SUBMERSIBLE PUMPS

# PART 1 – GENERAL

# 1.1 SCOPE

- A. This section includes equipment for one duplex submersible pump station to be supplied with integral electric motors, discharge elbows, guide bar brackets, access cover and valves, and electrical control panel assembly, and other miscellaneous installation accessories. All equipment shall be supplied by a single source supplier that adheres to the quality standards established and expressly named in this specification.
- B. The pump station shall be constructed as a triplex submersible pump station but only two of the pumps with controllers are included in this Contract. The third pump with controls and motor shall be installed at a future time under a separate Contract.
- C. Acceptable manufacturers are those who meet this specification in its entirety and that can demonstrate compliance with these specifications through the submittal process outlined in section 2.04 such that no exceptions or deviations are noted (See Paragraph 2.04 Submittal). The System Supplier, for all equipment approved for this project shall meet or exceed all performance, material, service, and warranty requirements of this specification.
  - 1. Acceptable manufacturers are FLYGT, or pre-approved equal.
- D. The Bidder shall be responsible for supplying the equipment specified herein to meet or exceed these specifications as obtained from the System Supplier for this project. The System Supplier shall be an Authorized Distributor of the proposed products and shall be capable of servicing the products with repair service and parts availability within 100 miles of the City of Memphis. The responsive System Supplier shall routinely stock complete pumps, controls, and parts to repair those units in their own facility. All equipment approved for this project shall meet or exceed all performance, service, and warranty requirements of this specification.

# 1.2 QUALITY ASSURANCE

- A. GENERAL The pumps shall be suitable for pumping raw sewage and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40°F to 104°F.
- B. STANDARDS The test code of the American Hydraulic Institute for testing pumps and sound engineering practice shall be used. Where required, all pump performance documentation, including flow/head curves, shall adhere to the Hydraulic Institute Standards and shall allow no negative tolerance on flow, head, hydraulic efficiency or any other criteria deemed by the Engineer to be necessary to evaluate pumping system performance.
- C. ENVIRONMENTAL CONDITIONS All equipment as specified herein shall be so supplied with respect to environmental conditions at the jobsite.
- D. SUBMITTALS Complete equipment and control submittals, complete assembly, foundation support, and installation drawings, together with detailed specifications and data covering pumps, motors, material used, parts, devices and other accessories forming a part of the equipment furnished shall be submitted for approval in accordance with the procedure set forth in the General Conditions.

Data and specifications for the equipment shall include, but shall not be limited to the following: 1. Setting Plans – Setting plans shall include:

- a. Anchor bolt layout
- b. Anchor bolt dimensions
- c. Outline dimensions and weights of pumps, bases, motors, and control enclosures, etc.

- 2. Pumps Data and drawings shall include:
  - a. Manufacturer, type and model number
  - b. Assembly drawing, nomenclature and material list, O & M manual, and parts list
  - c. Type, manufacturer, model numbers, location and spacing of bearings
  - d. Impeller type, diameter, thru-let dimensions, sphere size, number of vanes and identification number
  - e. Complete motor performance data including: rating, voltage/phase/frequency; design type; service factor; insulation class; motor pole number; actual rotation speed when combined with the specified pumps; current, power factor and active input power (kW) as a continuous function of shaft power from no load to at least 115 percent load; start (max. Inrush) current; locked rotor current; NEC code letter; and motor torque as a continuous function through the motor start cycle from no rotation to synchronous speed.
  - f. Complete performance test curve(s) showing full range (shutoff to run- out) head vs. Capacity, NPSHR, hydraulic efficiency, motor active (kW) input power, motor total (kVA) input power (based on measured current and voltage), and shaft power (BHP). See Sec. 1.03 TESTING.
  - g. Location and description of Service Centers and spare parts stock
  - h. Warranty for the proposed equipment.
- 3. Controls Complete Schematics and Documentation shall include:
  - a. Panel layout drawings that show accurate dimensions, location of components, and proper connection of terminations with complete schematics of the proposed equipment.
  - b. Cut sheets on all items to be provided.
  - c. Operation manuals on VFDs or PLCs to be provided.
  - d. The manufacturer shall indicate, by arrows to points on the Q/H curves, limits recommended for stable operation, between which the pumps are to be operated to prevent surging, cavitation, and vibration. The stable operating range shall be as large as possible and shall be based on actual hydraulic and mechanical characteristics of the units and shall meet the hydraulic performance requirements of the proposed system.

## 1.3 TESTING

A. SHOP TESTS FOR PUMPS AND MOTORS – Each pump and motor shall be performance tested as specified hereinafter; all pumps shall be tested with motor cables to be supplied with the pumps.

Each pump shall be tested for performance at the factory to determine the head vs. Capacity, motor total electrical power draw (kVA), and motor active electrical power draw (kW) for the full speed at which the pumps are specified and shown on a performance test curve. The motor and cable on each pump shall be tested for moisture content or insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

- B. ACCEPTANCE TESTS Acceptance tests shall be run to demonstrate that the pumping units, motors and control system meet the following requirements:
  - 1. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.
  - 2. All automatic and manual controls function in accordance with the specified requirements.
  - 3. All drive equipment operates without being overloaded.
  - 4. All testing to be done within 100 miles of jobsite for owner inspection

# PART 2 – PERFORMANCE

# 2.01 SUBMERSIBLE PUMPS

Items (Units) 60 Hertz Operation	Duncan Road Station
Reference Pump Model	Flygt NP 3202 HT 3~ 456
Reference Alarm Unit	Flygt Mini CAS II
Reference Flush Valve	Flygt 4901
Reference Variable Frequency Drive	Danfoss VLT AQUA Drive, Flygt PS 200
Reference Level Regulator	Flygt ENM 10
Reference Level Transmitter	Flygt LTU 801
Reference Controller	Flygt My Connect
Initial Duty Point (GPM/ft.)	950 GPM @ 65 ft.
Long-Term Duty Point	1950 GPM @ 130 ft.
Minimum Shutoff Head (ft.)	Per Manufs Spec
Min Motor Rating (HP) at 40 degrees C	70 HP
Voltage/Cycle/Phase	460V/60/3
Motor Service Factor	Greater than 1.10
Motor Insulation Rating	Class H
Rated Current (A)	79 Amps
Impeller Diameter	326 mm
Discharge Diameter (inches)	6 inches
Operating Speed	1775 rpm

# PART 3 - EQUIPMENT

# 3.1 PUMP DESIGN (WET WELL MOUNTED)

A. The pump shall be capable of handling <u>raw, unscreened sewage</u>. The discharge elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. Pumps shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be removed for the purpose and no need for personnel to enter the pump well. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple linear downward motion of the pumps with the entire weight of the pumping units guided to and pressed tightly against the discharge elbow with a metal-to-metal watertight contact. Sealing of the discharge interface by means of a diaphragm, O-ring or other device is acceptable. No portion of the pump shall bear directly on the floor of the sump, and there shall be no more than one 90-degree bend allowed between the volute discharge flange and sump piping. Guide bars, which shall steer the pump into proper contact with the discharge elbow shall be non-adjustable and shall not bear the weight of the pump.

# 3.2 PUMP CONSTRUCTION

A. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type

stainless steel. All metal surfaces in contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating.

- B. The coating shall be a two-pack oxyrane ester Duasolid 50. Or Carboline 890 two-part epoxy. The total layer thickness should meet or exceed minimum manufacturer recommendation. Zinc dust primer shall not be used.
- C. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
- D. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

# 3.3 CABLE SEAL

A. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Solder blocked epoxy filled entries are acceptable.

# 3.4 COOLING SYSTEM

A. Cooling jackets as per Manufacturer Recommendations are required.

# 3.5 MECHANICAL SEAL

- A. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary silicon-carbide ring and one positively driven rotating silicon-carbide ring. Ceramic or carbon seal faces will not be accepted. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary silicon-carbide ring and one positively driven rotating silicon-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.
- B. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
- C. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
- D. Seal lubricant shall be FDA Approved, nontoxic.

### 3.6 SHAFT

- A. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be AISI type 421 stainless steel.
- B. Shaft sleeves are not acceptable.

# 3.7 IMPELLER

- A. The impeller and volute insert ring shall be cast of ASTM A532, ALLOY IIIA Hi-Chrome Iron, dynamically balanced, semi-open, multi-vane, back-swept, non-clog design and must be capable of passing non-deformable 3" spherical solids. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring.
- B. Use of upward moving or adaptive impellers are not acceptable.
- C. Pump impellers may be of single or two vane design. The impeller vane shall be smooth, finished throughout, and shall be free of sharp edges. Impellers must be capable of passing 3" non-deformable sphere, unless noted otherwise in Part 1-Performance Table.

# 3.8 BEARINGS

A. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two-row angular contact bearing to compensate for axial thrust and radial forces. Sleeve or single row lower bearings are not acceptable.

# 3.9 MOTOR AND PROTECTION DEVICES

- The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type A. design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. Connection between the cable conductors and stator leads shall be isolated made with threaded compression type binding posts permanently affixed to a terminal board or stripped epoxy block. The motor and the pump shall be produced by the same manufacturer.
- B. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.10. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
- C. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

- D. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- E. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor, and activate an alarm.
- F. A leakage sensor shall be used on pumps of 3 Hp and above to detect water in the seal chamber. Primary leak sensor detection within the stator and rotor chamber is not acceptable.
- G. The thermal switches and moisture sensors shall be connected to separate monitoring relays. Use of a proprietary combined monitoring device is not acceptable. Nonproprietary relays are to be mounted in the pump control panel.

## 3.10 GUIDE BARS AND BRACKETS

A. Two AISI 304SS Schedule 40 guide bars and brackets shall be provided for each pump for the purpose of guiding the pump unit in raising and lowering. The guide bars shall not support any portion of the weight of the pump. The lower guide bar holders shall be integral with the discharge elbow. Guide cables shall not be considered equal to guide bars and will not be accepted. The pump unit shall be guided on the bars by a guide bracket which shall be an integral part of the pump.

# 3.11 LIFT CHAINS AND FITTINGS

A. An adequate length of 304 stainless steel lifting chain with shackles & clevis' shall be provided for each pumping unit. The lifting chain shall extend from the pump lifting bale to a point four (4) feet minimum above the wet well top. The working load of the lifting chain shall be 50% greater than the unit weight of the pump.

# 3.12 CONTROLS

- A. The Control system shall be a Flygt My Connect control panel or pre-approved equal. Pump supplier shall supply the control system (including Variable Frequency Drives as required). The Pump control system shall consist of pressure transducer, PLC controlled system, a minimum 7" HMI, with float backups.
- B. The control package shall have the ability to measure level via 4-20mA level sensor and very the speed of the pumps based upon operator adjustable setpoints. In addition to the level control settings the pumps shall alternate via an operator selectable method of time, each start/stop, or via the least runtime.
- C. The pump control system shall operate off of a float backup system in the event of a failure of the PLC, HMI, or level sensor.

#### 3.13 PLC

- A. The PLC shall be and Allen Bradley CompactLogix, Programmable Automation Controller with the appropriate amount of I/O as indicated on the drawings.
- B. The programmable automation controller (PAC) shall be an embedded I/O design, with expansion capability. The available expansion shall be local I/O modules or distributed (remote) I/O connected through a network.
  - 1. A single local chassis shall house CPU, memory, embedded digital I/O, communications interface options and power supply.
  - 2. The PAC shall be DIN rail or panel mounted.
  - 3. All system modules, and local and remote chassis shall be designed to operate in:
    - a. An industrial environment with an ambient temperature of 0° to 60°C (32° to 140°F), and with a relative humidity range of 5% to 95%, non-condensing.
    - b. A free airflow environment (convection cooling only, no fans or other air moving devices shall be required).

- c. Conformal coating of the PAC shall be offered as an option for use in corrosive/hazardous applications.
- 4. All system modules, and local and remote chassis shall be designed and tested to operate in high electrical noise environments.
- C. The system shall support up to 4 local expansion modules.
  - 1. Local expansion modules shall be installed to the right of the embedded I/O modules.
  - 2. The local expansion modules shall mechanically lock together by means of a tongue and groove design and have an integrated communication bus that is connected from module to module by a movable bus connector.
  - 3. Each module shall have a built-in removable terminal block behind a door at the front of the module with a finger-safe cover. I/O wiring shall be routed from beneath the module to I/O sensors and actuators.
  - 4. The manufacturer shall have available a variety of I/O modules, including AC digital, DC digital, contact output, analog, RTD, thermocouple and high-speed counter.
- D. The CPU shall be a self-contained unit, and will be capable of providing control program execution, supporting remote and local programming, controlling all I/O scanning and inter-controller and peripheral communication and diagnostic functions.
  - 1. 32 tasks (100 programs per task):
    - a. Continuous 1 allowed.
    - b. Periodic Run via an interrupt at a user-defined interval in 1  $\mu$ s increments from 1 ms to 2000 s.
    - c. Event Triggered by consumed tag or EVENT instruction.
  - 2. 256 controller connections
  - 3. Network connections:
    - a. 256 EtherNet/IP
    - b. 120 TCP
- E. The PAC shall organize user applications as tasks, which can be specified as continuous, periodic or event based. Tasks can be triggered by input point or instruction.
- F. Programming instructions shall include the following:
  - 1. Relay-Type (bit)
  - 2. High-Speed Counter
  - 3. Counter and Timer
  - 4. Data Comparison (for example: Equal, Greater than or Equal, Less than or Equal)
  - 5. Data Manipulation (for example: Copy, Move)
  - 6. Logical (for example: And, Not, Or)
  - 7. Integer and Floating Point Math (for example: Add, Subtract, Multiply, Log 10)
  - 8. Advanced Math and Trigonometric Functions (for example Sine, Cosine, Tangent)
  - 9. Statistical
  - 10. Matrix and Array (for example: COP, CSP, FIFO)
  - 11. BCD Conversion
  - 12. Program Flow Control (for example: Jump, Subroutine)
  - 13. Application Specific (for example: Sequencer)
  - 14. Diagnostic
  - 15. Communication
  - 16. Recipe
  - 17. Proportional Integral and Derivative (PID)
  - 18. Block Read and Write
  - 19. Immediate I/O and Communication Update
- G. The system must be capable of storing the following data:

- 1. External Output Status
- 2. External Input Status
- 3. Timer Values
- 4. Counter Values
- 5. Boolean Values (0 or 1)
- 6. Short Integer Numbers (-128 to 127)
- 7. Integer Numbers (-32,768 to 32,767)
- 8. Double Integer Numbers (-2,147,483,648 to 2,147,483,647)
- 9. Floating Point Numbers to 8 significant digits (for 8+ digits, conversion to exponential form from ±1.1754944 E -38 to ±3.402823 E +38)
- 10. Long Integer Numbers (-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807)
- 11. Internal Processor Status Information
- 12. Data shall be distinguishable to the CPU by address and sub-element mnemonic.
- 13. Management of the data into memory subsections shall be an automatic function of the CPU operating system.
- 14. Data can be displayed in ASCII, Binary, Octal, Hexadecimal or Decimal.
- 15. Function-specific data such as PID, Axis, Axis Group or Message shall have dedicated displays available that annotate the meaning of specific control bits and words within them and allow for selective control where appropriate.
- H. The front of the CPU shall have a USB port.
- I. The front of the CPU shall have an integrated latching mechanism for securing the Secure Digital (SD) memory card. The PAC shall operate with the memory card removed.
- J. The CPU shall have a Real Time Clock.
- K. The processor module shall have green, red and yellow LED indicators with sequences for OK (module status), Force, Run, SD, I/O (I/O status), NS (network status), Link 1 and Link 2 (EtherNet/IP port status).
- L. The processor module shall have mode switch positions for Remote, Program and Run.

#### 3.14 HMI

- A. The HMI Shall be an Allen-Bradley, Model 2715P Panelview 5510 minimum of 7".
- B. The operator interface terminal shall combine the display, logic communication, and power into one base unit in a fixed hardware configuration.
- C. The operator interface terminal shall be designed to be mounted in space required for similar PanelView models with 7-inch to 19-inch display sizes.
- D. The operator interface terminal shall be designed for the following environmental parameters:
  - Operating temperature range of 0 to 55 °C (32 to 131 °F) [19-inch models to 50 °C (122 °F)].
  - 2. Non-operating temperature range of -25 to +70 °C (-13 to 158 °F).
  - 3. Humidity range of 5 to 95% non-condensing.
- E. The operator interface terminal shall operate on power input of 18 to 30 VDC.
- F. The operator interface terminal shall be provided with clamps for installing the display in the enclosure's cutout. The clamps shall compress the bezel gasket to form a permanent seal against the panel.
- G. The operator interface terminal shall be designed to provide free air flow convection cooling without a fan.

H. At a minimum the HMI shall have the following screens: Overview of Pump/Lift Station, Maintenance, Setpoint screen, VFD configuration screens. Manual pump operation, and Elapsed Time Meters.

#### 3.15 LEVEL SENSOR

A. The level sensor shall be a Flygt ENM 10 level transducer. The sensor shall be suitable for Water and Wastewater applications.

# 3.16 PUMP WARRANTY

- A. Submersible pumps are to be covered by a FIVE-YEAR warranty. Minimum coverage shall be 100% Parts and Labor for the first year of operation. Years 2 thru 5 shall be 100% parts only.
- B. The warranty cannot be limited by operating hours.

# END OF SECTION

#### SECTION 26 0100 GENERAL PROVISIONS - ELECTRICAL

### PART 1 GENERAL

# 1.01 RELATED DOCUMENTS

- A. Drawings and the General Conditions, Instructions to Bidders, and all other general requirements of these specifications shall be considered a component of this division of the specifications.
- B. This section of the specifications includes general provisions applicable to all work of Division 26 and Division 27.
- C. This Contractor shall examine all other divisions of the specifications and all drawings for the project and shall familiarize himself with all features of the project that may affect his work.

# 1.02 RELATED WORK

- A. Refer to the other sections of the specifications for requirements other than these listed in these electrical specifications including but not limited to:
  - 1. Instructions to Bidders.
  - 2. Construction Agreement.
  - 3. Special Conditions.
  - 4. Project Coordination Meetings.
  - 5. Submittals.
  - 6. Quality Control Services.
  - 7. Construction Facilities and Temporary Controls.
  - 8. Project Closeout.
  - 9. Project Record Documents.
  - 10. Operating and Maintenance Data.
  - 11. Painting.
  - 12. Cast-In-Place Concrete.

#### 1.03 SCOPE

- A. Includes the furnishing of all labor, supervision, materials, equipment, tools, etc., required for the complete installation of electrical systems for the referenced facility, as outlined in these specifications and/or indicated on the accompanying drawings.
- B. The following specifications sections as applicable for this project are a part of the construction documents:
  - 1. Section 26 0519 Low Voltage Electrical Power Conductors and Cables.
  - 2. Section 26 0526 Grounding and Bonding for Electrical Systems.
  - 3. Section 26 0533.16 Boxes for Electrical systems.
  - 4. Section 26 2100 Low-Voltage Electrical Service Entrance.
  - 5. Section 26 2200 Low-Voltage Transformers
  - 6. Section 26 2416 Panelboards.
  - 7. Section 26 5600 Exterior Lighting.

#### 1.04 WORK BY OTHERS

- A. The following work related to work under this division of the specifications will be provided by Others:
  - 1. Painting, except repair of factory applied finishes on electrical equipment.
  - 2. All formed concrete pads for electrical equipment.

# 1.05 CODES AND PERMITS

- A. All work under Division 26 shall be installed in accordance with the requirements of the National Electrical Code as approved by authority having jurisdiction (AHJ), and the latest edition of all local or state codes, laws, and ordinances, and the requirements of the local electric utility.
- B. This Contractor shall apply for, obtain, and pay for all permits required. At the conclusion of the installation, he shall secure a Certificate of Inspection, properly signed by the controlling building department, which shall state that all rules have been complied with and that the work is satisfactory.
- C. This contractor shall comply with Personal Protection Requirements of NFPA 70E when working in the vicinity of existing and new electrical equipment that is energized.
- D. Should any part of the plans or specifications be found to be in conflict with applicable codes or ordinances, the Contractor shall notify the Architect/Engineer before submitting his bid.

# 1.06 SEISMIC QUALIFICATIONS AND RESTRAINTS

- A. The individual specifications listed have seismic qualifications requirements. The manufacturer is required to perform the necessary design and testing and provide proof documentation for seismic qualification of equipment and devices.
  - 1. Section 26 2200 Low-Voltage Transformers.
  - 2. Section 26 2416 Panelboards.

# 1.07 TRADE NAMES AND EQUALS

- A. Manufacturer's trade names or catalog numbers used in these specifications and indicated on the drawings denote type, size, quality, and design of equipment required.
- B. Where equipment is specified as "or equal," or "approved equal," it shall mean equal in the opinion of the Architect/Engineer. This Contractor is free to offer substitutions for consideration as equal after the contract is signed; however, he shall be prepared to furnish specified materials where substitutions are not approved.
- C. Electrical equipment shall be furnished as specified; however, alternates to the specified equipment may be submitted with a listing on a one for one basis of the specified item and equivalent item complete with required features and specified options. If there are items not acceptable, the original specified items shall be provided.

#### 1.08 MATERIAL AND EQUIPMENT

- A. All materials and equipment shall be new and of the quality specified.
- B. Material or equipment that has been stored outdoors unprotected for long periods of time or otherwise damaged is not acceptable as new material.
- C. Conductors to be considered new shall be manufactured within one calendar year prior to Notice to Proceed for this contract or after the Notice to Proceed date.
- D. Apparatus and materials used in this work which are subject to approval of Underwriters Laboratories (UL) shall bear the UL label, or be Underwriters listed.

#### 1.09 SUBMITTALS AND SHOP DRAWINGS

A. Electronic PDF submittals shall be provided by the contractor through normal submittal channels, the electronic review comments will be attached to the returned electronic documents. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

- B. The Engineer's review of submittals and shop drawings is only for the limited purpose of checking the same for conformity with design concept of the work as established in the contract documents, and is not intended to be for the purpose of determining the accuracy of other matters that may be contained in such submittals.
- C. The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- D. Submit shop drawings on any fabricated equipment.
- E. Submit manufacturer's descriptive literature on any proposed substitute items.
- F. All items shall be submitted at one time in an indexed, bound brochure, except that fabricated items requiring specially prepared shop drawings may be submitted separately. A list of items requiring a separate submission shall be provided with submittal documents.

# 1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIAL AND EQUIPMENT

- A. The Contractor shall be responsible for the purchase, delivery, and storage of all materials and equipment indicated to be supplied under this section of the specifications, and it shall be his responsibility to schedule the delivery of materials and equipment at such stages of the work as will permit uninterrupted construction of all phases of the work.
- B. The Contractor shall make the Architect/Engineer aware of any materials and equipment requiring long lead times that may conflict with the construction schedule. The Contractor shall offer substitutions for consideration in a timely manner for approval by the Engineer to maintain the construction schedule.
- C. Where Owner furnished equipment is to be turned over to this Contractor for installation, it shall be the responsibility of this Contractor to receive such equipment and store in a safe, dry location.
- D. This Contractor shall do all required rigging, hoisting, transporting, etc., of all equipment furnished under this contract, and shall further furnish any additional structural members, as may be required, for the proper support of any and all equipment furnished hereunder.

#### 1.11 ACCURACY OF DATA

- A. The drawings are generally diagrammatic, and except where dimensions are shown, are not intended to show the exact locations of outlets, conduits, switches, fixtures, etc. All work shall be installed as nearly as possible in the locations indicated, with only such minor adjustments as will be required to avoid interferences with structure or the work of other trades.
- B. Should any structural or mechanical interferences prevent the installation of power and lighting panelboards, running of conduit, setting of junction boxes and cabinets, arrangement of lighting fixtures and method of suspension, etc., in the locations indicated on the drawings, the necessary deviations therefrom, as determined by the Engineer, must be made without additional cost to the Owner, where relocation is not over five (5) feet from the location shown on the drawings.
- C. The drawings are further not intended to show all junctions or pull boxes, fittings and connections, and details of work to be done. This Contractor shall supply all necessary boxes, fittings, and connections for complete installation in a satisfactory manner.
- D. Any offsets in conduit required or necessary to avoid interferences with structure, or the work of other trades, etc., shall be made at no additional cost to the Owner.
- E. Refer to architectural and structural drawings for all dimensions of building spaces.
- F. This Contractor shall prepare shop drawings, as necessary, for his use in coordinating the work to avoid interference.
- G. The drawings and specifications are complementary to each other, and what is called for by one shall be as binding as if called for by both.
- H. Before conduit runs are located in the building, this Contractor shall request and obtain from the Owner the latest equipment installation drawings and coordinate all conduit and other electrical work to avoid interferences with existing or new equipment. Any offsets or relocation of electrical conduit or equipment required to avoid interference with the existing or new equipment shall be done by this Contractor at no additional cost to the Owner.
- I. Electrical requirements for equipment shown on the drawings has been obtained from other designers or the Owner and used as design data. Where the actual electrical requirements are different than those shown on the drawings or specified herein, this Contractor shall make the necessary adjustments without additional charges to the Owner.

### 1.12 COORDINATION

- A. The Electrical Contractor shall coordinate his work with that of other subcontractors on the job and also with that of the Owner in order that there be no delay in the proper installation and completion of the several parts of the work.
- B. This Contractor shall use every precaution to protect the work of others, and he will be held responsible for all damage done by his workers to the work of other trades. He shall also protect his work from danger of breakage, dirt, foreign materials, etc., and shall replace all work so damaged.
- C. In areas where limited space exists for all trades to complete their work the Contractor shall hold a coordination meeting with all trades and develop the necessary coordination drawings to ensure each trade has sufficient space to install their work. Failing to coordinate amongst all trades shall result in relocation of materials and equipment at no additional cost to the Owner.

## 1.13 MANUFACTURER'S RECOMMENDATIONS

A. Unless specifically indicated otherwise, all equipment and materials shall be installed in accordance with the best recommendation of the manufacturer. A copy of the manufacturer's installation recommendations shall be kept in the Job Superintendent's office and shall be available to the Owner's representative at all times.

## 1.14 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching required for the installation of his work, and he shall employ workers skilled in the trades required for all cutting and patching work.
- B. This Contractor shall be responsible for the proper location of all chases, recesses, and openings required for his work, and shall advise the Engineer of the sizes and locations, and furnish the necessary drawings of those required for his work in sufficient time to allow for provision of same.
- C. This Contractor shall provide all sleeves, etc., required for the introduction and placement of his work, and shall be responsible for the correct location of same.
- D. Beams or columns shall not be pierced without permission of the Engineer, and then only as directed. If any conduit is required through walls or floors where no sleeve has been provided, the hole shall be core drilled, as directed by the Engineer, to avoid all unnecessary damage and structural weakening.
- E. Openings around electrical penetrations through walls, partitions, floors, etc., shall be fire stopped using UL approved fire stop caulking material or other approved methods, as required by code.

### 1.15 PAINTING

- A. Painting of materials and equipment furnished under the electrical portion of the contract, if required, will be done under a separate section of these specifications. The Electrical Contractor shall, however, refinish and restore to the original condition and appearance, all electrical equipment which has sustained damage to manufacturer's finish paint.
- B. All electrical equipment shall be provided with factory applied prime and finish paint, unless otherwise specified.

### 1.16 SPECIAL REQUIREMENTS FOR SERVICE INTERRUPTION

- A. It is essential that work under this contract not interfere with the Owner's normal operations, and this Contractor will be held responsible for damage he may cause as a result of his operating practices.
- B. Normal services shall not be interrupted at any time without prior approval from the Owner's Project Manager.
- C. No extra allowance will be made for prime time work required after regular working hours. This Contractor shall include in his bid an adequate allowance to cover work requiring service shut down on weekends.
- D. All requests for power interruption, of any type, shall be made and documented at least two (2) weeks prior to the actual date of the interruption. This is necessary in order to permit the Project Manager to properly coordinate the power interruption with operating personnel.

### 1.17 RECORD DRAWINGS

A. The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. The record drawings shall be submitted to the Architect/Engineer immediately after receiving substantial completion notification.

#### 1.18 MAINTENANCE MANUALS

- A. Contractor shall provide three (3) copies of operational and maintenance manuals for all equipment installed under this division of the specifications. The manuals shall include a list of spare parts and proper operational and maintenance procedures.
- B. The manuals shall be organized and fully indexed. Manuals shall consist of three-ring, hard back binders with appropriate dividers for each part.
- C. Manual contents shall include, but shall not be limited to the following:
  - 1. Name and address of Contractor, equipment manufacturer and supplier
  - 2. Set of approved shop drawings or approved submittal data
  - 3. Wiring diagrams and installation drawings
  - 4. Spare parts and replacement parts lists as recommended by the manufacturer
  - 5. Installation and operational manuals
  - 6. Maintenance and service manuals
  - 7. Proper operational procedures and maintenance procedures
  - 8. Copy of warranties and guarantees
- D. Operating and maintenance manuals shall be submitted to the Architect/Engineer for approval, and shall become the property of the Owner before final payment will be made.
- E. It shall be the responsibility of this Contractor to maintain, warrant, clean, etc., any equipment supplied by this Contractor until all installation and operating and maintenance manuals are turned over to the Owner.

## 1.19 TEMPORARY POWER AND LIGHTING ELECTRICAL SERVICE

- A. A temporary electrical service for construction power and lighting shall be obtained by the Contractor in the name of the Contractor, who will pay all power and energy charges. Any cost for the temporary service connection shall be paid by the Contractor and not the owner. Upon project completion, this service shall be removed and equipment removed from the site.
- B. All temporary wiring for construction shall conform to Article 305 of the National Electrical Code and all applicable rules and regulations of OSHA.
- C. Temporary lighting shall be furnished for the duration of construction activities for all trades. Where construction activities occur in public areas the contractor shall measure the preconstruction light levels with a meter and maintain those light levels with temporary lighting.
- D. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120 volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.

### 1.20 CONSTRUCTION REVIEW

- A. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.
- B. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.
- C. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

#### **1.21 TESTS**

- A. The entire building wiring system shall be thoroughly tested and defects corrected. All electrical wiring shall be tested for continuity, shorts, improper grounds and insulation resistance. Motors shall be checked for proper rotation and branch circuit and overload protection. Panelboards and switchboards shall be checked for balanced loading. Panelboards, switchboards, motor control centers, and busways shall be checked for correct phase rotation. Discrepancies shall be corrected. This Contractor shall furnish test equipment and material, and shall be responsible for replacement or repair of damage due to test failures.
- B. All wiring, both branch circuits and feeders, shall be tested with a megger for proper insulation resistance, as determined by the Architect/Engineer. Tests shall be made both phase-to-phase and phase-to ground.
- C. After installation is complete, voltage measurements shall be made. The phase-to-phase and phase-to-neutral voltage of all distribution centers and all panelboards shall be recorded and turned over to the Engineer. Voltage shall be measured under load conditions where possible.
- D. After all tests have been completed and approved by the Architect/Engineer, this Contractor shall clean all the fixtures and replace any lamps used for temporary lighting. All equipment and conduit shall be cleaned and left in working order. All debris created by the execution of the electrical work shall be removed by this Contractor. Contractor shall take all necessary precautions to keep panels, especially circuit breaker handles, clean during construction.

### **1.22 GUARANTEE**

A. The Contractor shall guarantee to the Owner all work performed under this contract to be free from defects in workmanship and material for a period of one (1) year from date of final acceptance. Defects arising during this period will be promptly remedied by the Contractor at his own expense upon notice by the Owner. All lamps for lighting fixtures shall be excluded from this guarantee, but one (1) complete and operative set of 10% added lamps for lighting fixtures with a minimum of two of each type and wattage shall be in place at the time of final acceptance.

### SECTION 26 0519 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 GENERAL

### **1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.
- H. Types of wire, cable, and connectors:
  - 1. Copper building wire.
  - 2. Fixture wire.
  - 3. Terminal connectors.
  - 4. Splice connectors.
- I. Applications for wire, cable, and connectors:
  - 1. Power distribution circuitry.
  - 2. Lighting and outlet circuitry.
  - 3. Appliance and equipment circuitry.
  - 4. Motor-branch circuitry.
  - 5. Grounding.

#### 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

### 1.03 REFERENCE STANDARDS

- A. ASTM B3 Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM D3005 Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- G. FS A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation) 2008a (Validated 2019).
- H. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- I. NEMA WC 70 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- J. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

- K. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 83 Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- N. UL 183 Manufactured Wiring Systems Current Edition, Including All Revisions.
- O. UL 486A-486B Wire Connectors Current Edition, Including All Revisions.
- P. UL 486C Splicing Wire Connectors Current Edition, Including All Revisions.
- Q. UL 486D Sealed Wire Connector Systems Current Edition, Including All Revisions.
- R. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.
- S. UL 1277 Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.
- T. UL 1569 Metal-Clad Cables Current Edition, Including All Revisions.

## 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  - 3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

## 1.05 SUBMITTALS

- A. See Section 26 0100 General Provisions Electrical, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
- D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

## **1.06 QUALITY ASSURANCE**

- A. Comply with NEC as applicable to construction and installation of electrical wire, cable and connectors.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

### 1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

### PART 2 PRODUCTS

2.01 ALL PRODUCTS AND MANUFACTURERS LISTED IN THIS SPECIFICATION ARE ESTABLISHING A BASIS OF DESIGN. OTHER PRODUCTS AND MANUFACTURERS OF EQUAL QUALITY MAY BE SUBMITTED FOR REVIEW AND APPROVAL. THE INTENT IS NOT TO LIMIT PRODUCTS AND MANUFACTURERS USED TO THOSE IDENTIFIED IN THESE SPECIFICATIONS.

### 2.02 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is permitted only where specifically indicated on the contract drawings.
- D. Nonmetallic-sheathed cable is not permitted.
- E. Underground feeder and branch-circuit cable is not permitted.
- F. Underground feeder and branch-circuit cable is permitted only where specifically indicated on the contract drawings.
- G. Service entrance cable is not permitted.
- H. Service entrance cable is permitted only where specifically indicated on the contract drawings.
- I. Armored cable is permitted only as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet.
- J. Metal-clad cable is not permitted.
- K. Metal-clad cable is permitted only where specifically indicated on the contract drawings.
- L. Manufactured wiring systems are permitted only as follows:
- M. Manufactured wiring systems are permitted only where specifically indicated on the contract drawings.

## 2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories, Inc. as suitable for the purpose intended.

- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Comply with FS A-A-59544 where applicable.
- G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- I. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- J. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- K. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- L. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- M. Conductor Material:
  - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
- N. Minimum Conductor Size:
  - 1. Branch Circuits: 12 AWG. Increase branch circuit conductors in size where necessary to compensate for voltage drop, in accordance with NEC requirements. Generally, the following criteria can be used to determine sizing for various lengths of normally loaded branch circuits protected at 20 amps with evenly distributed loads:
    - a. 120/208 Volts, #12 AWG, 0 85 ft.
    - b. 120/208 Volts, #10 AWG, 85 140 ft.
    - c. 120/208 Volts, #8 AWG, 140 220 ft.
    - d. 120/208 Volts, #6 AWG, 220 320 ft.
    - e. 277/480 Volts, #12 AWG, 0 140 ft.
    - f. 277/480 Volts, #10 AWG, 140 220 ft.
    - g. 277/480 Volts, #8 AWG, 220 350 ft.
    - h. 277/480 Volts, #6 AWG, 350 500 ft.
- O. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- P. Conductor Color Coding:
  - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  - 2. Color Coding Method: Integrally colored insulation.
    - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
  - 3. Color Code:
    - a. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.

- 2) Phase B: Orange.
- 3) Phase C: Yellow.
- 4) Neutral/Grounded: Gray.
- b. 208Y/120 V, 3 Phase, 4 Wire System:
  - 1) Phase A: Black.
  - 2) Phase B: Red.
  - 3) Phase C: Blue.
  - 4) Neutral/Grounded: White.
- c. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
  - 1) Phase A: Black.
  - 2) Phase B (High-Leg): Orange.
  - 3) Phase C: Blue.
  - 4) Neutral/Grounded: White.
- d. 240/120 V, 1 Phase, 3 Wire System:
  - 1) Phase A: Black.
  - 2) Phase B: Red.
  - 3) Neutral/Grounded: White.
  - 4) Equipment Ground, All Systems: Green.
- e. Equipment Ground, All Systems: Green.
- f. Isolated Ground, All Systems: Green with yellow stripe.
- g. Travelers for 3-Way and 4-Way Switching: Pink or Purple.
- h. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction. Where no color code exists, new work shall be in accordance with color codes described in these specifications.
- i. For control circuits, comply with manufacturer's recommended color code.
- j. Because no color code has been established for the different control systems and the addressable fire alarm system conductors are red-jacketed, all conductors shall be identified by the use of adhesive numbers. These conductors shall be identified at their origin, each junction box and at their termination.

#### 2.04 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. Cerro Wire LLC: www.cerrowire.com.
    - b. Encore Wire Corporation: www.encorewire.com.
    - c. Southwire Company: www.southwire.com.
    - d. Approved equal.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 10 AWG and Larger: Stranded.
  - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below. a. Size 4 AWG and Larger: Type THHN/THWN or THHN/THWN-2.
    - b. Installed Underground in raceway: Type THHN/THWN or THHN/THWN-2.

c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Type SA for luminaires with labeled maximum temperature greater than 90 degrees C.

### 2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  - 2. Connectors for #4 and larger conductors shall be color keyed long barrel type. Lugs shall have two (2) holes for connection to terminals or busses.
  - 3. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  - 4. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  - 5. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  - 6. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  - 7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
  - 8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
  - 1. Manufacturers:
    - a. 3M: www.3m.com.
    - b. Ideal Industries, Inc: www.idealindustries.com.
    - c. NSI Industries LLC: www.nsiindustries.com.
    - d. Approved equal.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com.
    - b. Ilsco: www.ilsco.come.
    - c. Thomas & Betts Corporation: www.tnb.com.
    - d. Approved equal.
- I. Compression Connectors: Provide circumferential type, hex type, or indentor type crimp configuration.

- 1. Manufacturers:
  - a. Burndy LLC: www.burndy.com.
  - b. Ilsco: www.ilsco.com.
  - c. Thomas & Betts Corporation: www.tnb.com.
  - d. Approved equal.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com.
    - b. Ilsco: www.ilsco.com.
    - c. Thomas & Betts Corporation: www.tnb.com.
    - d. Approved equal.
- K. Motor Terminations: Motor terminations for 600 volts or less.
  - 1. Manufacturers:
    - a. Thomas & Betts Corporation: Type MSC; www.tnb.com.
    - b. Raychem: Type MCK;
    - c. Approved equal.
- 2.06 WIRING ACCESSORIES
  - A. Electrical Tape:
    - 1. Manufacturers:
      - a. 3M: www.3m.com.
      - b. Plymouth Rubber Europa: www.plymouthrubber.com.
      - c. Approved equal.
      - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
      - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
      - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
      - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
      - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, allweather vinyl backing; minimum thickness of 90 mil.
  - B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
    - 1. Manufacturers:
      - a. 3M: www.3m.com.
      - b. Burndy LLC: www.burndy.com.
      - c. Thomas & Betts Corporation: www.tnb.com.
      - d. Approved equal.
  - C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
    - 1. Manufacturers:
      - a. Burndy LLC: www.burndy.com.
      - b. Ideal Industries, Inc: www.idealindustries.com.

- c. Ilsco: www.ilsco.com.
- d. Approved equal.
- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
  - 1. Manufacturers:
    - a. 3M: www.3m.com.
    - b. American Polywater Corporation: www.polywater.com.
    - c. Ideal Industries, Inc: www.idealindustries.com.
    - d. Approved equal.
- E. Cable Ties: Material and tensile strength rating suitable for application.
  - 1. Manufacturers:
    - a. Burndy LLC: www.burndy.com.
    - b. Approved equal.

# PART 3 EXECUTION

# 3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

## 3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

## 3.03 INSTALLATION

- A. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated without specific routing, determine exact routing required.
  - 3. Arrange circuiting to minimize splices.
  - 4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
  - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and powerlimited circuits in accordance with NFPA 70.
  - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  - Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
     a. Size raceways, boxes, etc. to accommodate conductors.
  - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
  - 9. Provide oversized neutral/grounded conductors where indicated and as specified below.
    - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
    - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
  - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
  - 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 6 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
- L. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies. All conductors shall be continuous from outlet to outlet or from panel to outlet or device. No splices will be permitted in conduit runs.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  - 2. Do not remove conductor strands to facilitate insertion into connector.
  - 3. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
  - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

- a. For taped connections, first apply adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
- 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
  - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
  - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- 3. Wet Locations: Use heat shrink tubing.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Identify conductors and cables in accordance with Section 26 0553.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- R. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary, for proper interface.
- S. Wire shall be protected during storage and handling and shall be in first class condition when installed.
- T. No grease of any kind and no compound other than a neutral lubricant as approved by the wire or cable manufacturer shall be used as a pulling compound.
- U. Use pulling means, including fish tape, cable, or rope which cannot damage raceway.
- V. Torque all bolted lugs and connectors to torque values recommended by the equipment manufacturer. Where torque values are not given, use applicable torque values given by UL Standards #486A and #486B. If studs are copper or steel, or if steel bolts are used, use a Belleville dished washer with a wide series, heavy flat washer. Tighten the connection until the Belleville is flat. Do not retighten later.

#### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.3.2., required as follows:
  - 1. 480 Volt power cables shall be given a meg-ohmmeter test using a 1000 Volt instrument. Test shall be maintained until readings are steady.
  - 2. Prior to energization, test all lighting, power, control and special circuits and associated electrical equipment for low insulation resistance, grounds and short circuits.
  - 3. Give the Architect/Engineer sufficient notice prior to any test so that his representative can be present to observe the testing.
  - 4. Furnish and set up all meters, instruments, equipment and labor required to make tests, as indicated.
  - 5. Promptly replace any work found to be defective under test. After replacement, test work again. Final acceptance of work depends on successful completion of operational tests on all equipment to show that the equipment will perform the functions for which it was designed.
  - 6. Repair and/or replace at Contractor's expense, any equipment damaged in the process of conducting the tests.

- 7. Test results shall show values no smaller than those recommended by the NEC, IPCEA, IEEE, ANSI and NEMA.
- 8. Make meg-ohmmeter tests on power cables between each conductor and ground with other conductors connected to the same ground.
- 9. Make meg-ohmmeter tests from circuit conductor to circuit conductor and from circuit conductor to ground for branch circuits and feeders, and from control circuit conductor to ground of all control wiring, including spares.
- 10. Perform continuity tests on all power and control circuits, including spare conductors. Check phase identification on power cables.
- 11. Check all control and interlocking wiring for proper operations. Perform operational tests with Architect/Engineer to assure that control wiring has been properly installed.
- 12. Record the insulation resistance readings of all feeder and motor circuits and submit test results to the Architect/Engineer.
- 13. Control cables shall be checked for continuity and identification and given a megohmmeter test with a 500 Volt meg-ohmmeter.
- E. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- F. Correct deficiencies and replace damaged or defective conductors and cables.

### SECTION 26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### **1.01 SECTION INCLUDES**

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Types of grounding:
  - 1. System and enclosure grounding for electrical distribution systems.
  - 2. Separately derived electrical systems.
  - 3. Enclosures bonding.
  - 4. Equipment grounding and bonding.

### 1.02 RELATED REQUIREMENTS

- A. Section 26 0519 Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
  - 1. Includes oxide inhibiting compound.
- B. Section 26 5600 Exterior Lighting: Additional grounding and bonding requirements for polemounted luminaires.

### 1.03 REFERENCE STANDARDS

- A. IEEE 81 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
- B. NECA 1 Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA GR 1 Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2022.
- D. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 780 Standard for the Installation of Lightning Protection Systems 2023.
- G. UL 467 Grounding and Bonding Equipment Current Edition, Including All Revisions.
- H. UL 869A Reference Standard for Service Equipment; Current Edition, Including All Revisions.

## 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

## B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

# 1.05 SUBMITTALS

A. See Section 26 0100 - General Provisions – Electrical for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
  - 1. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections where not visible after construction.

# 1.06 QUALITY ASSURANCE

- A. Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment, and wiring. Provide grounding products which are UL listed and labeled.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

# 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

# PART 2 PRODUCTS

## 2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
  - 1. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  - 2. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

- a. Provide continuous grounding electrode conductors without splice or joint.
- b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
- 2. Metal Underground Water Pipe(s):
  - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
  - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
  - c. Provide bonding jumper around water meter and Reduced Pressure Backflow Preventer of sufficient length to permit removal of devices without disconnecting jumper.
- 3. Metal In-Ground Support Structure:
  - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
- 4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- G. Service-Supplied System Grounding:
  - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
  - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Separately Derived System Grounding:
  - 1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
  - 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame or common grounding electrode conductor.
  - 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
  - 4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
  - 5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- I. Bonding and Equipment Grounding:
  - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

- 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
- 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
- 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
- 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
- 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
  - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
  - b. Metal gas piping.
- 8. Provide bonding for metal building frame.
- 9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
- J. Pole-Mounted Luminaires: Also comply with Section 26 5600.

## 2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
  - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories, Inc. (UL) or Intertek (ETL) as suitable for the purpose intended.
  - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
  - 1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors or bare tinned copper conductors where installed underground in direct contact with earth.
- C. Connectors for Grounding and Bonding:
  - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
  - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
    - a. Exceptions:
      - 1) Use exothermic welded connections for connections to metal building frame.
  - 4. Manufacturers Mechanical and Compression Connectors:
    - a. Harger Lightning & Grounding: www.harger.com.
    - b. Thomas & Betts Corporation: www.tnb.com.
    - c. Approved equal.
  - 5. Manufacturers Exothermic Welded Connections:
    - a. Cadweld, a brand of Erico International Corporation: www.erico.com.
    - b. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com.
    - c. Approved equal.
- D. Ground Rod Electrodes:
  - 1. Comply with NEMA GR 1.

- 2. Material: Copper-bonded (copper-clad) steel.
- 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
- 4. Manufacturers:
  - a. Erico International Corporation: www.erico.com.
  - b. Galvan Industries, Inc: www.galvanelectrical.com.
  - c. Harger Lightning & Grounding: www.harger.com.
  - d. Approved equal.
- E. Oxide Inhibiting Compound: Comply with Section 26 0519.

### PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
  - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
  - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. A continuous (green) equipment grounding conductor shall be provided with all feeders and branch circuits. This grounding conductor shall be insulated same as required for 600 volt phase conductors and shall be green in color, where possible. Grounding conductor shall be sized in accordance with Article 250-95 of the NEC and shall terminate by means of compression lugs at each ground bus, panelboard grounding bar, pull boxes, disconnect switches, starters, motors, and other devices.
- F. Install electrical grounding systems in accordance with applicable portions of NEC, with NECA "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

- G. Coordinate with other electrical work, as necessary, to interface installation of electrical grounding system with other work.
- H. Furnish and install system, enclosure, and equipment grounding for all electric wiring in full compliance with the requirements of local codes and the NEC. All grounding conductors shall be copper.
- I. System and enclosure grounding shall be provided at the building service entrance panelboard or disconnecting means and shall consist of a system and equipment bond with connection to the building steel by exothermic weld, or equal. The size of the grounding conductor shall be as indicated on the drawings or, where not indicated, as per Article 250-94 of the NEC. Also, provide grounding electrode conductor, outdoor ground rod installation, as required by code.
- J. Where short lengths of flexible steel conduit are used between outlet boxes in hung or furred ceiling and flush lighting fixtures, the lighting fixture shall be grounded by means of a separate #12 AWG copper (green) colored insulated grounding wire run with the circuit conductors in the flexible steel conduit and bonded to the outlet box and to the fixture enclosure by means of an approved solderless grounding lug or connector.
- K. At all metal conduit terminations at junction boxes, transformers, or other enclosures, the end of the conduit shall be equipped with an insulated metallic grounding and bonding bushing T&B #3870, or equal. Provide code size copper bonding jumper from grounding bushing to enclosure with lug termination bolted to the enclosure. Grounding type bushings are not required for conduit terminations at cast metal enclosures having screwed hub conduit terminations.
- L. Each dry type transformer installation shall have system and enclosure grounding in accordance with the requirements of Article 250-26 of NEC. A bonding jumper, sized in accordance with Article 250-79(c) of the NEC, shall be used to connect the neutral and enclosure of the secondary side of the transformer at the XO terminal.

## 3.03 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### SECTION 26 0533.16 BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Underground boxes/enclosures.

## 1.02 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 Specifications for Underground Enclosure Integrity; 2023.
- I. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

## 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  - 6. Coordinate the work with other trades to preserve insulation integrity.

- 7. Coordinate the work with other trades to provide walls suitable for installation of flushmounted boxes where indicated.
- 8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.04 SUBMITTALS

- A. See Section 26 0100 General Provisions Electrical, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
  - 1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 26 0100 General Provisions Electrical, for additional provisions.
  - 2. Keys for Lockable Enclosures: Two of each different key.

### 1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

## 2.01 BOXES

- A. General Requirements:
  - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
  - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

- 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
- 4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
- 5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
- 6. Use suitable concrete type boxes where flush-mounted in concrete.
- 7. Use raised covers suitable for the type of wall construction and device configuration where required.
- 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
- 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
- 10. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
- 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- 12. Minimum Box Size, Unless Otherwise Indicated:
  - a. Wiring Devices: single gang, 2.5" depth.
  - b. Exposed wiring, 4" square, 2-1/4" minimum depth.
- 13. Manufacturers:
  - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
  - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
  - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
  - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
  - e. Thomas & Betts Corporation: www.tnb.com/#sle.
  - f. Approved equal..
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
  - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    - a. Indoor Clean, Dry Locations: Type 1, painted steel.
    - b. Outdoor Locations: Type 3R, painted steel.
  - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
  - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    - b. Back Panels: Painted steel, removable.
    - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
  - 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
  - 6. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
    - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
    - d. Approved equal..
- D. Underground Boxes/Enclosures:

- 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
- 2. Size: As indicated on drawings.
- 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
- 4. Provide logo on cover to indicate type of service.
- 5. Applications:
  - a. In Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
  - b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
- 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
  - a. Manufacturers:
    - 1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
    - 2) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
    - 3) Approved equal.
  - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

# PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
  - 1. Unless dimensioned, box locations indicated are approximate.
  - 2. Locate boxes as required for devices installed under other sections or by others.
  - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
  - 3. Locate boxes so that wall plates do not span different building finishes.
  - 4. Locate boxes so that wall plates do not cross masonry joints.
  - 5. In all cases, where two or more devices are installed in gang boxes, gang plates with suitable openings shall be provided.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

- 7. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points26 0533.13.
- I. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction.
  - 2. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
- J. Box Mounting:
  - 1. Before installation, check proposed location of each outlet box with the architectural, structural, and mechanical drawings and locate each outlet box so that they will be accessible and interference free in the finished project.
  - 2. Set each concealed box flush with finished surfaces, and so that exposed finished surface will not be marred.
  - 3. Install each wall switch on the strike side of the door involved unless otherwise indicated. Before placing each wall switch box, verify the applicable door swing with the architectural drawings, and locate the wall switch box accordingly.
  - 4. Where exposed flexible cords serve equipment, locate the outlet box as near as practicable to the equipment connection point, to minimize flexible cord length.
  - 5. All outlet boxes in or on ceilings shall be supported from the tee bar or ceiling support member with a hanger designed for this purpose that secures it to the tee bar or ceiling support. Neither the box nor the device attached to that box shall be supported by the ceiling material. The hanger shall be secured to the tee bar or ceiling support with a screw run through the vertical part of the tee bar or support and hanger at each point at which it attached.
  - 6. All outlet boxes in or on gypsum board and stud walls shall be secured to the studs or bracing. The gypsum board material shall not support the boxes.
- K. Install boxes plumb and level.
- L. Flush-Mounted Boxes:
  - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
  - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- M. Install boxes as required to preserve insulation integrity.
- N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
- P. Underground Boxes/Enclosures:
  - 1. Install enclosure on gravel base, minimum 6 inches deep.
  - 2. Flush-mount enclosures located in concrete or paved areas.
  - 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
  - 4. Provide cast-in-place concrete collar constructed in accordance with Section 03 3000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
  - 5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

- Q. Close unused box openings.
- R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- S. Provide grounding and bonding in accordance with Section 26 0526.
- T. Use temporary covers at all outlet box locations during construction to prevent entrance of dirt, plaster, etc. before wiring device is installed.
- U. Where multiple feeders are located in the same general area, each feeder shall be provided with separate junction or pull boxes. The practice of combining several feeders in a common pull box or junction box will not be permitted. Where parallel conductors are used on the same feeder circuit, they may be combined within a common pull box, or junction box.

### 3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

### 3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

### SECTION 26 0553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 2 PRODUCTS

### 1.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
  - 2. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    - a. Service equipment.
    - b. Industrial control panels.
    - c. Motor control centers.
    - d. Elevator control panels.
    - e. Industrial machinery.
- B. Identification for Conductors and Cables:
  - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
  - 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

## 1.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
  - 1. Materials:
- B. Identification Labels:
  - 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

#### 1.03 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
  - 1. Materials:
  - 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or selfadhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
  - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

### SECTION 26 2200 LOW-VOLTAGE TRANSFORMERS

#### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. General purpose transformers.

### 1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with placement of supports, anchors, etc. required for mounting.

### 1.03 SUBMITTALS

- A. See Section 26 0100 General Provisions Electrical, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
  - 1. Vibration Isolators: Include attachment method and rated load and deflection.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
  - 1. Small Power Centers: Include panel arrangements.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Maintenance Data: Include recommended maintenance procedures and intervals.
- H. Project Record Documents: Record actual locations of transformers.

## 1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
- E. Transformers shall be designed for continuous operation as rated kVA, 24 hours per day, 365 days per year with normal life expectancy as defined by ANSI C57.96.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

### 1.06 SEISMIC QUALIFICATIONS

- A. Provide Seismic tested equipment that comply with all applicable seismic requirements of the International Building Code with seismic value as indicated on structural sheet S0.0.
- B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
  - 1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
  - 2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. General Electric Company: www.geindustrial.com
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.
- E. Source Limitations: Provide transformers produced by single manufacturer and obtained from single supplier.

#### 2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
  - 1. Altitude: Less than 3,300 feet.
  - 2. Ambient Temperature:
    - a. Greater than 10 kVA: Not exceeding 104 degrees F.
    - b. Less than 10 kVA: Not exceeding 77 degrees F.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

- Provide system and enclosure grounding at the secondary side of the transformer in accordance with NEC requirements for separately derived systems (See Art. 250-26 of NEC). This must include a grounding conductor from system neutral and enclosure grounding point to building steel (See Section 26 0526 - Grounding and Bonding for Electrical Systems).
- J. After wiring systems are connected, adjust transformer tap settings for proper secondary voltage at transformer terminals under normal transformer load conditions.
- K. Demonstrate compliance with specifications, including compliance with sound level requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

## 2.03 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
  - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
- E. Limit terminal compartment temperature to 70 degrees C when transformer is operating continuously at rated load with ambient temperature of 40 degrees C.
- F. Provide wiring connectors suitable for 75 degrees C insulated copper wiring.
- G. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- H. Winding Taps:
  - 1. Less than 3 kVA: None.
  - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
  - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
  - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- I. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- J. Sound Levels: Standard sound levels complying with NEMA ST 20
- K. Mounting Provisions:
  - 1. Less than 15 kVA: Suitable for wall mounting.
  - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
  - 3. Larger than 75 kVA: Suitable for floor mounting.
- L. Transformer Enclosure: Comply with NEMA ST 20.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 2. Construction: Steel.
    - a. Less than 15 kVA: Totally enclosed, non-ventilated.
    - b. 15 kVA and Larger: Ventilated.
  - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
  - 4. Provide lifting eyes or brackets.

# PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure
- F. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- G. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- H. Provide seismic restraints.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- K. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.
- L. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.

## 3.02 FIELD QUALITY CONTROL

- A. See Section 01 4000 Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.
  - 1. 167 kVA single phase, 500 kVA three phase and smaller:
    - a. Perform turns ratio tests at all tap positions.

## 3.03 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

## 3.04 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

### SECTION 26 2416 PANELBOARDS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

### 1.02 DESCRIPTION OF WORK

- A. Extent of panelboard and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include the following:1. Lighting and appliance panelboards.
- C. Refer to the drawings and other Division 26 sections for cable/wire, connectors and electrical raceway work required in conjunction with panelboards and enclosures.

### 1.03 RELATED REQUIREMENTS

A. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

## 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

## 1.05 SUBMITTALS

- A. See Section 26 0100 General Provisions Electrical, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
  - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  Panelboard Keys: Two of each different key.

### 1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

#### 1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
  - 2. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

#### 1.09 SEISMIC QUALIFICATIONS

- A. Provide Seismic tested equipment that comply with all applicable seismic requirements of the International Building Code with seismic value as indicated on structural sheet S0.0
- B. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
  - 1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil/structural engineer in the state of the project. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
  - 2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

## PART 2 PRODUCTS

## 2.01 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com/#sle.
- B. Schneider Electric: www.se.com/#sle.
- C. Siemens Industry, Inc: www.new.siemens.com/#sle.
- D. General Electric Company: www.geindustrial.com.
- E. Approved equal.
- F. Source Limitations: Provide panelboards and associated components produced by single manufacturer and obtained from a single supplier.

### 2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
    - b. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating as indicated on the drawings.
  - 2. Listed series ratings are not acceptable.
  - 3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Type 3R.
  - 2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
    - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.

- Provide painted steel boxes for surface-mounted panelboards, finish to match fronts. C.
- 3. Fronts:
  - Fronts for Surface-Mounted Enclosures: Same dimensions as boxes. a.
  - Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise b. indicated.
- 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Load centers are not acceptable.

### 2.03 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- Products: B.
  - Square D Company; Type "NF' or NQOD". 1.
  - Eaton Corporation; Type "PRL 1a, 2a, or 3a. 2.
  - 3. General Electric Company; Type "AE" or "AQ".
  - Substitutions: See Section 26 0100 General Provisions Electrical 4.
  - Approved equal. 5.
- C. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
  - Main and Neutral Lug Type: Mechanical. 2.
- D. Bussing:
  - Phase Bus Connections: Arranged for sequential phasing of overcurrent protective 1. devices.
  - 2 Phase and Neutral Bus Material: Copper.
  - Ground Bus Material: Copper. 3.
- E. Circuit Breakers: Thermal magnetic bolt-on type.
- F. Enclosures:
  - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
  - Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent 2. protective device handles without exposing live parts.
  - Provide metal circuit directory holder mounted on inside of door. 3.
- G. Provide column-width panelboards where indicated.

## 2.04 OVERCURRENT PROTECTIVE DEVICES

- A. **Fusible Switches:** 
  - Description: Quick-make, quick-break, dead-front fusible switch units complying with 1. NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
  - 2. Fuse Clips: As required to accept indicated fuses.
    - Where NEMA Class R fuses are installed, provide rejection feature to prevent a. installation of fuses other than Class R.
  - Provide externally operable handle with means for locking in the OFF position. Provide 3. means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
  - 4. Conductor Terminations:

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- a. Provide mechanical lugs unless otherwise indicated.
- b. Lug Material: Copper, suitable for terminating copper conductors only.
- B. Molded Case Circuit Breakers:
  - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
  - 2. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      - 2) 14,000 rms symmetrical amperes at 480 VAC.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - 3. Conductor Terminations:
    - a. Provide mechanical lugs.
    - b. Lug Material: Copper, suitable for terminating copper conductors only.
  - 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
    - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
    - b. Provide interchangeable trip units where indicated.
  - 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
    - a. Provide the following field-adjustable trip response settings:
      - 1) Long time pickup, adjustable by setting dial.
      - 2) Long time delay.
      - 3) Short time pickup and delay.
      - 4) Instantaneous pickup.
      - 5) Ground fault pickup and delay where ground fault protection is indicated.
    - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
    - c. Provide communication capability where indicated: Compatible with system indicated.
  - 6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
  - 7. Provide the following circuit breaker types where indicated:
    - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
    - b. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
  - 8. Provide listed switching duty rated circuit breakers with SWD marking where indicated.
  - 9. Do not use handle ties in lieu of multi-pole circuit breakers.
  - 10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
  - 11. Provide the following features and accessories where indicated or where required to complete installation:
    - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

12. All panelboard covers shall have a means to accommodate all lock out/tag out equipment. In addition, doors shall have key locking device with all locks using identical keys on the project.

## 2.05 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

# PART 3 EXECUTION

## 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

## 3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Install panelboards plumb.
- F. Feeders to 3-phase panelboards shall be connected so as to provide A-B-C phase relationship at panel bus, (left-to-right, when facing the front of the panel).
- G. Install panelboards where indicated on the drawings.
- H. Anchor surface mounted panels to the building structure by means of U-channel strut system, or approved equal.
- I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- J. Provide grounding and bonding in accordance with Section 26 0526.
  - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
- K. Install all field-installed branch devices, components, and accessories.
- L. A fuse identification label, showing type and size of fuse, shall be obtained from the fuse manufacturer and placed inside the door of each fusible switch unit at all power distribution panelboards.
- M. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- N. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- O. Set field-adjustable circuit breaker tripping function settings as indicated, as directed, or to minimum settings.
- P. Set field-adjustable ground fault protection pickup and time delay settings as indicated, or to minimum setting.
- Q. Provide filler plates to cover unused spaces in panelboards.

## 3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 where required. Tests listed as optional are not required, except for the following:
  - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
  - 2. Test functions of the trip unit by means of secondary injection.
- D. Test GFCI circuit breakers to verify proper operation.
- E. Test AFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

### 3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

### 3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

## END OF SECTION

### SECTION 26 2816.16 ENCLOSED SWITCHES

#### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Enclosed safety switches.

## 1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

### 1.03 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA KS 1 Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A Reference Standard for Service Equipment; Current Edition, Including All Revisions.

## **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

## 1.05 SUBMITTALS

- A. See Section 26 0100 General Provisions Electrical, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
- D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

### 1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

### PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com/#sle.
- B. Schneider Electric: www.se.com/#sle.
- C. Siemens Industry, Inc: www.new.siemens.com/#sle.
- D. General Electric Company: www.geindustrial.com.
- E. Substitutions: See Section 26 0100 General Provisions Electrical.
- F. Approved equal.
- G. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

### 2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.

- F. Short Circuit Current Rating:
  - 1. Minimum Ratings:
    - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
    - b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
    - c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
    - d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
  - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
  - 1. Products:
    - a. Match panelboard manufacturer.
    - b. Substitutions: See Section 26 0100 General Provisions Electrical.
  - 2. Comply with NEMA KS 1.
  - 3. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Provide compression lugs where indicated.
    - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 4. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

## PART 3 EXECUTION

## 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

## 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).

- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Install enclosed switches plumb.
- E. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- F. Provide grounding and bonding in accordance with Section 26 0526.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

### 3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

### 3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

# END OF SECTION

### SECTION 26 5600 EXTERIOR LIGHTING

## PART 1 GENERAL

### **1.01 SECTION INCLUDES**

- A. Exterior luminaires.
- B. Poles and accessories.

### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 Boxes for Electrical Systems.

## 1.03 REFERENCE STANDARDS

- A. IEEE C2 National Electrical Safety Code(R) (NESC(R)); 2023.
- B. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA/IESNA 501 Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- D. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1598 Luminaires; Current Edition, Including All Revisions.

## 1.04 ADMINISTRATIVE REQUIREMENTS

## 1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

## 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

## 1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

# PART 2 PRODUCTS

## 2.01 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

### 2.02 POLES

- A. Manufacturers:
- B. All Poles:
  - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.

### PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

## 3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires in accordance with NECA/IESNA 501.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Pole-Mounted Luminaires:
  - 1. Maintain the following minimum clearances:
    - a. Comply with IEEE C2.
    - b. Comply with utility company requirements.
  - 2. Foundation-Mounted Poles:
    - a. Provide cast-in-place concrete foundations for poles as indicated03 3000.
      - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
      - 2) Position conduits to enter pole shaft.
    - b. Install foundations plumb.
    - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
    - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
    - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
    - f. Install anchor base covers or anchor bolt covers as indicated.

- 3. Embedded Poles: Install poles plumb as indicated.
- 4. Grounding:
  - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
  - b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
- 5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
- G. Install accessories furnished with each luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.

### 3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.
- D. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.

### 3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Engineer.

#### 3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

#### 3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

## 3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

# END OF SECTION