PROJECT MANUAL

SEPTEMBER 14, 2026

Tomball Athletic Improvements

TOMBALL ISD

TOMBALL, TEXAS

VLK Project No.

25-0158.00

OWNER:

TOMBALL INDEPENDENT SCHOOL DISTRICT

310 S. Cherry St.

Tomball, Texas 77375

OWNER

Tomball
Independent School District
310 S. Cherry St.
Tomball, Texas 77375

ARCHITECT

VLK
Jander Ortiz
20445 State Hwy 249, Suite 350
Houston, Texas 77070
Phone: 281.671.2300
www.vlkarchitects.com



09/14/2026

STRUCTURAL ENGINEER

Matrix Structural
Firm Registration Number: F-2640
Jaynool Khayrattee, P.E.
5177 Richmond Avenue, Suite 670
Houston, Texas 77056
Phone: 713.664.0130
www.matrixstructural.com

Matrix Structural Engineers
TBPE Firm Registration No. F-2640



09.14.2026

CIVIL ENGINEER

Adico Consulting Engineers
Firm Registration Number F-16423
Phasith Nanthavong, P.E.
205 E Edgewood Dr.
Friendswood, Texas 77546
Phone: 832.895.1093
www.adico-llc.com



09-14-2026

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SEPTEMBER 14, 2026

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MEP ENGINEER

DBR Engineering
Firm Registration Number: F-223
Adam C. Jones, P.E.
9990 Richmond Avenue, South
Building, Suite 300
Houston, Texas 77042
Phone: 713.914.0888
www.dbrinc.com



PROGRAM MANAGER

LAN Inc.
3700 West Sam Houston Parkway
South, Suite 400
Houston, Texas 77042
Phone: 713.266.6900
https://lan-inc.com/

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SEPTEMBER 14, 2026

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NOT USED

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NONE IN THIS PROJECT

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NONE IN THIS PROJECT

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NONE IN THIS PROJECT

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NOT USED

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INSTRUCTIONS TO PROPOSERS

PART 1 - GENERAL

1.1 DOCUMENTS

A. Reference DOCUMENT 00 11 19 - REQUEST FOR COMPETITIVE SEALED PROPOSALS for instructions on attaining Proposal Documents.

1.2 DEFINITIONS

A. All definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, 2017 Edition and Section 01 42 16 - DEFINITIONS, are applicable to these Instructions to Proposers.

B. Proposal documents include the Request for Proposals, Instructions to Proposers, the Proposal Forms and the proposed Contract Documents including Addenda issued prior to receipt of proposals.

C. Addenda are written or graphic instruments issued prior to the execution of the Contract which modify or interpret the proposal documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction Contract is executed.

D. “VLK” will be hereafter referred to in this Project Manual as “Architect” and correspondence shall be addressed to: 20445 SH 249, Suite 350, Houston, TX 77070.

1.3 EXAMINATION OF DOCUMENTS AND SITE

A. Each proposer, by making his Proposal, represents that he has read and understands the Proposal Documents.

B. Each proposer, by making his Proposal, represents that he has visited the site, performed investigations and verifications as necessary and familiarized himself with the local conditions under which the Work is to be performed and will be responsible for errors in his proposal resulting from his failure to do so.

C. Each proposer by making his proposal represents that his proposal is based upon the materials, systems and equipment required by the Proposal Documents without exception.

1.4 QUESTIONS

A. Proposers shall submit questions about the Proposal Documents to the Architect in writing not later than ten days prior to the date of receipt of the proposals. Replies will be issued to proposers as an addendum to the Proposal Documents and shall become a part of the Contract. The Architect and Owner will not be responsible for oral clarification.

1.5 SUBSTITUTIONS

A. Each proposer represents by submitting their proposal that their proposal is based upon the materials and equipment described in the proposal documents.

1.6 PROPOSAL SECURITY

A. A certified check; cashier's check; signed, dated and embossed proposal bond in an amount equal to 5% of the largest possible total proposal and made payable to the Owner must accompany each proposal. This shall be considered as the amount of liquidated damages which the Owner will sustain by failure or refusal of the proposer to execute and deliver the contract and the statutory performance and payment bonds should the Contract be awarded him.

B. If the proposer defaults in executing and delivering the Contract and the statutory performance and payment bonds within ten days after written notification from the Architect of the award of Contract to him, then the check or proposal bond shall become the property of the Owner, not as a penalty, but as liquidated damages, as payment for damages due to excess costs, delay and other inconveniences.

C. Proposals shall remain in effect for a period of 30 days after the time established for receipt thereof, and during this time the Owner may accept or reject the proposals as they so elect. If the proposal is not accepted within 30 days after the time set for submission of proposals, or if the successful proposer executes and delivers said contract and the performance and payment bonds, then the check or proposal bond will be returned.

D. Proposal Bond shall be executed by a Surety Company that is:
   1. Approved by the school district, and duly authorized and admitted to do business in the State of Texas as determined by the State Board of Insurance.
   2. Listed by the United States Department of the Treasury in that issue of the "Federal Register" covering the date on which the bond was executed and the date that Surety Company has obtained reinsurance, if applicable, from a reinsurer that is authorized and admitted as a reinsurer in this state and is the holder of a certificate of authority from the United States secretary of the treasury.

E. Facsimiles or copies of Proposal Bond will not be acceptable. Submit fully executed originals of required documents.

1.7 STATUTORY PERFORMANCE BOND AND STATUTORY LABOR AND MATERIAL PAYMENT BOND

A. A Statutory Performance Bond and a Statutory Labor and Material Payment Bond will be required of the successful proposer and shall be executed by a surety company acceptable to the Owner and authorized to do business in the State of Texas. Each bond shall be in an amount equal to one hundred percent (100%) of the contract price. The Performance Bond and the Labor and Material Payment Bond may be in one or separate instruments in accord with local law and are to be delivered to the Owner no later than the date of execution of the contract. Failure or neglecting to deliver said bonds, as specified, shall be considered as having abandoned the contract and the proposal security will be retained as liquidated damages.

B. Bonds shall be executed by a Surety Company that is:
   1. Approved by the school district, and duly authorized and admitted to do business in the State of Texas as determined by the State Board of Insurance.
   2. Listed by the United States Department of the Treasury in that issue of the "Federal Register" covering the date on which the bond was executed and the date that Surety Company has obtained reinsurance, if applicable, from a reinsurer that is authorized and admitted as a reinsurer in this state and is the holder of a certificate of authority from the United States secretary of the treasury.

1.8 SUBMITTAL

A. Submit proposals in accordance with the Request for Proposals.

B. Preparation of Proposals: Proposals shall be submitted on unaltered proposal forms furnished by the Architect. Fill in all blank spaces. If there are entries (blank spaces) on the proposal form which do not apply to a particular proposer, these entries shall be marked "N.A." (Not Applicable) by the proposer. No proposals will be considered that are amended or are qualified with conditional clauses, alterations, items not called for in the proposal, or irregularities of any kind which, in the Owner's opinion, may disqualify the proposer.

C. Each proposer shall submit one original, one duplicate copy, and one digital copy saved on a USB Flash Drive of each of the following. All shall be submitted in a single sealed envelope. Electronic signatures are acceptable.**:**
   1. Proposal Form
   2. A completed and up-to-date AIA Form A305 Contractor's Qualification Statement
   3. HB 89/SB 252 Certification Form (Reference form attached to the end of this Section)
   4. Non-collusion Affidavit
   5. Felony Conviction Notice (Reference form attached to the end of this Section)
   6. Certification of Criminal History Record Information Review by Contractor-Employer
   7. Conflict-of-interest Questionnaire
   8. Any other information that responds to the Selection Criteria listed.

1.9 MODIFICATION AND WITHDRAWAL

A. No proposal may be changed, amended or modified after submittal. Proposers may withdraw proposals prior to proposal opening.

1.10 DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

A. In determining the Selected Offeror, the Owner will evaluate the information derived from the Offeror's (Contractor's) Qualification Statement required herein, the information submitted on the Proposal Form, and other selection criteria including the following Selection Criteria:

B. The Selection Committee consisting of Tomball ISD administrators, architects, consultants and other staff will make an initial evaluation of the proposals. The committee's recommendation will be considered by the Tomball ISD Board of Trustees ("Board"). The District reserves the right to review the recommendation with others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposals rests with the full Board. Decision-making authority has not been delegated to any person or entity other than the Board.

C. The District will make such investigations as it deems necessary to determine the ability of the offeror to perform the Work, and the offeror shall furnish all such information and data for this purpose as may be requested. The District reserves the right to reject any proposal if the evidence submitted by, or investigation of, such offeror fails to satisfy the District that such offeror is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.

D. The District reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of the District.

E. A decision regarding determination of the successful Offeror will be made by the District as soon as practical.

1.11 EXECUTION OF CONTRACT

A. The Owner reserves the right to accept any proposal, to reject any and all proposals, or to negotiate contract terms with the various proposers, when such is deemed by the Owner to be in his best interest.

B. Notwithstanding delays in the preparation and execution of the formal contract agreement, each proposer shall be prepared, upon written notice of proposal acceptance, to commence work on or before a date stipulated in an official written order of the Owner to proceed.

C. The accepted proposer shall assist and cooperate with the Owner in preparing the formal contract agreement, and within 5 days following its presentation shall execute same and return it to the Owner.

D. Form for the contract agreement will be AIA Document A101, Standard Form of Agreement Between Owner and Contractor, Stipulated Sum, 2007 Edition.

E. Proposals shall be submitted on unaltered proposal forms furnished by the Architect. Fill in blank spaces. If there are entries (blank spaces) on the proposal form which do not apply to a particular proposer, these entries shall be marked "N.A." (Not Applicable) by that proposer. No proposals will be considered that are amended or are qualified with conditional clauses, alterations, items not called for in the proposal, or irregularities which, in the Owner's opinion, may disqualify the proposer.

1.12 TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. The contract date will be established as the number of consecutive calendar days as set out on the proposal form from the "Notice-to-proceed" date issued by the Owner.

B. Failure of the Contractor to complete the Work by the contract date will result in damages being sustained by the Owner. Such damages are, and will continue to be, impracticable and extremely difficult to determine. Due consideration will be given to delays falling within 8.3 of the General Conditions.

C. The Contractor will pay the Owner the amount indicated on the Proposal Form and in the General Conditions for each calendar day of delay in finishing the Work in excess of time specified for completion, plus authorized time extensions. Execution of the Contract under these specifications shall constitute agreement by the Owner and Contractor that the amount indicated is the minimum value of the costs and actual damage caused by failure of the Contractor to Substantially Complete the Work within the allotted time, that such sum is Liquidated Damages and shall not be construed as a penalty, and that such sum may be deducted from payments due the Contractor if such delay occurs.

1.13 SALES TAX EXEMPTION

A. The Owner qualifies for exemption from State and Local Sales Taxes as set forth in the Supplementary Conditions.

END OF SECTION

SECTION 00 31 32

GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 LOG OF BORINGS/CONTRACTOR RESPONSIBILITY

A. A copy of the locations and log of borings is bound herein.

B. Subsurface soil data derived from test borings are given only for the convenience of the Contractor, and neither the Owner nor the Architect assumes responsibility for the accuracy of or for the Contractor's interpretation of the data.

C. Contractor is responsible for any conclusions drawn from the boring data and is responsible for the work without extra compensation irrespective of whether or not the subsurface conditions encountered agree with the boring data.

1.2 REPORT

A. The full geotechnical report prepared by the Owner's independent geotechnical and testing laboratory is available for inspection by the Contractor through one of the following avenues:
   1. Contractor Reviews Report Through a Digital Link: The Architect will provide the Contractor with an expiring, one-time use link to the read-only report.

B. This geotechnical report is not a part of the Contract Documents.

END OF SECTION

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BORING LOCATION DIAGRAM



Appendix B

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Boring Number: B-01

PROJECT Creekside Park JHS Athletic Improvements **GENERAL LOCATION** The Woodlands, TX

PROJECT NUMBER H260940 **LATITUDE** - **LONGITUDE** -

DATE STARTED 03/31/2026 **DATE COMPLETED** 03/31/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger from 0 to 10 feet

ELEVATION N/A **DEPTH** 10' **DURING DRILLING** 6' **AFTER DRILLING** N.M.

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		POORLY GRADED SAND (SP) FILL - Light brown with roots. 0.33								2					
		SANDY LEAN CLAY (CL) FILL - Hard, dark brown. 2				4.5+				23	33	13	20	68	
		SILTY SAND (SM) - Medium dense, brown with clay pockets. 4			32					12					
5		POORLY GRADED SAND (SP) - Medium dense to dense, light brown. 8			32					11	NV	NP	NP	11	
					37					12					
		SILTY SAND (SM) - Dense, light gray. 10			36					13					
10		End of Boring													

DRAFT

Boring Number: B-02

PROJECT Creekside Park JHS Athletic Improvements **GENERAL LOCATION** The Woodlands, TX

PROJECT NUMBER H260940 **LATITUDE** - **LONGITUDE** -

DATE STARTED 03/31/2026 **DATE COMPLETED** 03/31/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger from 0 to 10 feet

ELEVATION N/A **DEPTH** 10' **DURING DRILLING** 6' **AFTER DRILLING** N.M.

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		POORLY GRADED SAND (SP) FILL - Light brown 0.33								1					
		LEAN CLAY WITH SAND (CL) FILL - Firm, dark brown.				1.50				25	42	15	27	74	
		2													
		POORLY GRADED SAND (SP) - Medium dense to dense, light gray.			26					9					
					32					11					
5		6													
▽		SILTY SAND (SM) - Dense, light brown.			37					12					
					36					14					
10		10													
		End of Boring													

DRAFT

Boring Number: B-03

PROJECT Creekside Park JHS Athletic Improvements **GENERAL LOCATION** The Woodlands, TX

PROJECT NUMBER H260940 **LATITUDE** - **LONGITUDE** -

DATE STARTED 03/31/2026 **DATE COMPLETED** 03/31/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger from 0 to 20 feet

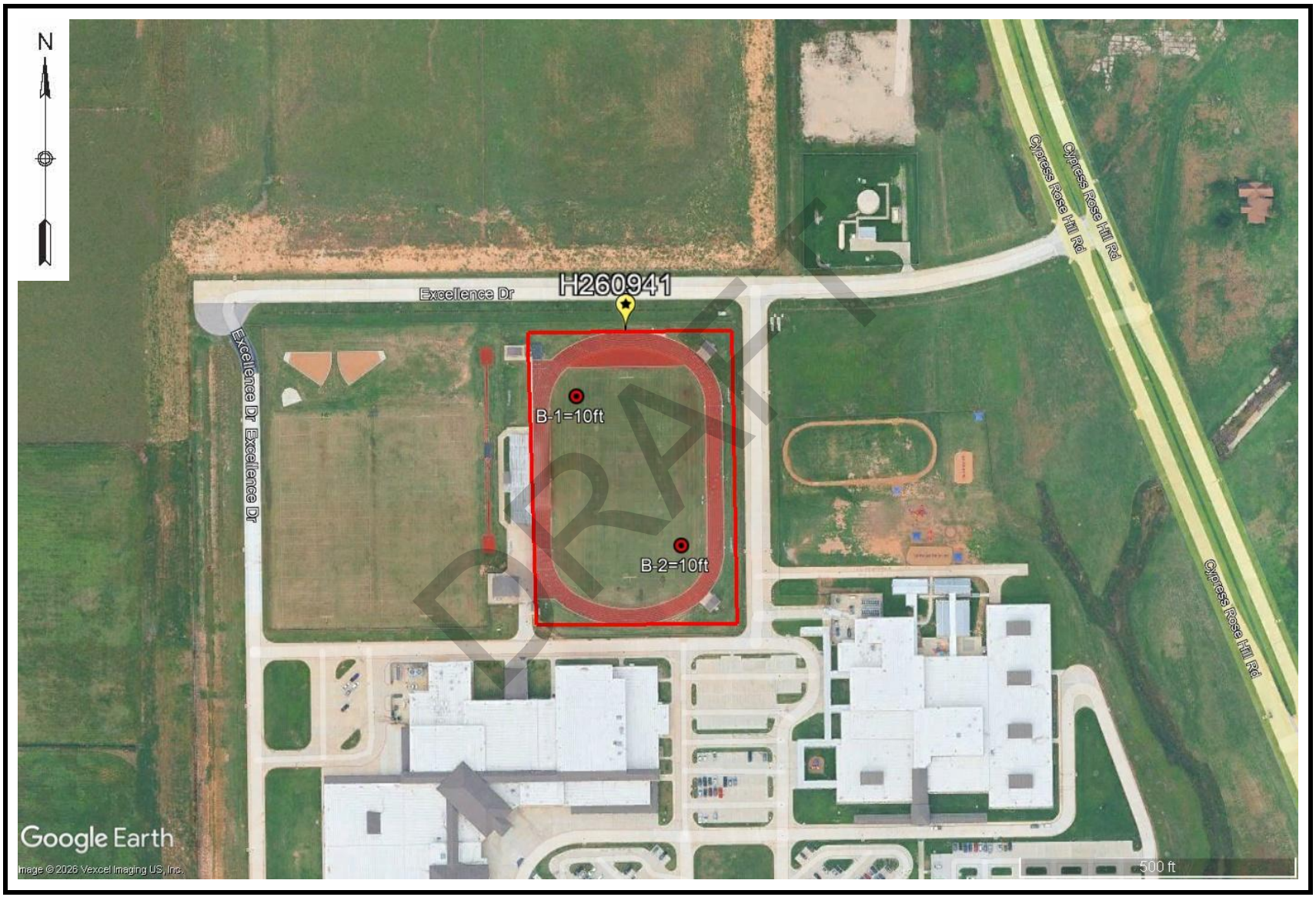
ELEVATION N/A **DEPTH** 20' **DURING DRILLING** 18' **AFTER DRILLING** 17'

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		POORLY GRADED SAND (SP) - Light brown with roots								2					
		0.25				2.50				9	17	13	4	38	
		CLAYEY SAND (SC) FILL - Stiff, dark brown, light brown with root fibers.													
		2													
		POORLY GRADED SAND (SP) - Medium dense to dense, light brown.			27					5					
5					34					9					
					36					10					
		8													
		SILTY SAND (SM) - Medium dense to dense, light brown.			37					9	NV	NP	NP	17	
10															
		Light brown from 13 to 20 feet.			40					9					
15															
▼															
▽					21					16					
20		20													
		End of Boring													

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BORING LOCATION DIAGRAM



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Appendix B

DRAFT

Boring Number: B-01

PROJECT Grand Lakes JHS Athletic Improvements
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260941
LATITUDE - **LONGITUDE** -
DATE STARTED 04/01/2026
DATE COMPLETED 04/01/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger from 0 to 10 feet
ELEVATION N/A **DEPTH** 10'
DURING DRILLING N/A **AFTER DRILLING** N/A
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Dark brown with clay pockets. 2								11	15	13	2	42	
		SILTY SAND (SM) - Medium dense, dark brown with clay pockets. 4			30					12					
5		SANDY LEAN CLAY (CL) - Stiff to very stiff, light gray, brownish yellow with ferrous nodules. With gravel from 4 to 6 feet.				4.00				15					
						2.50				14	32	12	20		0.0
						4.00				14					
10		10 End of Boring													

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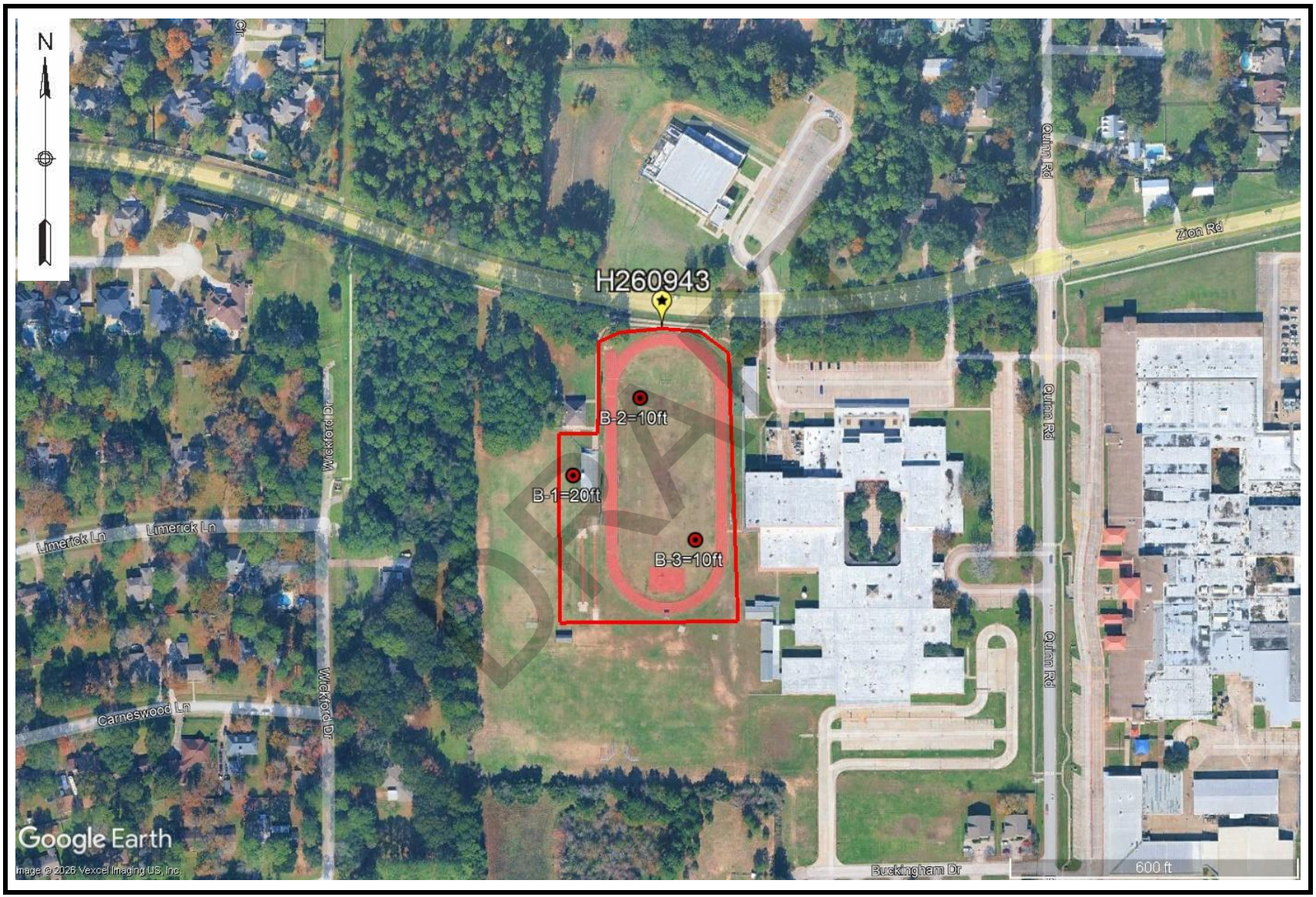
Boring Number: B-02

PROJECT Grand Lakes JHS Athletic Improvements
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260941
LATITUDE - **LONGITUDE** -
DATE STARTED 04/01/2026
DATE COMPLETED 04/01/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger from 0 to 10 feet
ELEVATION N/A **DEPTH** 10'
DURING DRILLING N/A **AFTER DRILLING** N/A
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Dark brown with clay pockets.								10					
		SANDY LEAN CLAY (CL) - Stiff to very stiff, light brown, brownish yellow with ferrous nodules.				2.50				15					
5		Light gray, brownish yellow from 4 to 10 feet.				2.00				16	35	14	21	59	
		With gravel from 6 to 8 feet.				4.00				16					
						4.50				15					
10		End of Boring													

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BORING LOCATION DIAGRAM



Appendix B

DRAFT

Boring Number: B-01

PROJECT Tomball JHS Athletic Improvements **GENERAL LOCATION** Tomball, TX

PROJECT NUMBER H260943 **LATITUDE** - **LONGITUDE** -

DATE STARTED 04/02/2026 **DATE COMPLETED** 04/02/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger from 0 to 20 feet

ELEVATION N/A **DEPTH** 20' **DURING DRILLING** N.E. **AFTER DRILLING** N.M.

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown.								3	NV	NP	NP	22	
		2													
		CLAYEY SAND (SC) - Very dense, reddish brown.			55					8					
		4													
		SANDY LEAN CLAY (CL) - Stiff to hard, light gray, brownish yellow, reddish brown, with sand seams.				3.50				14					
5						3.75				14	30	11	19		0.0
						3.00	0.9	0	112	14					
10															
						4.50+	3.4	0	116	15					
15															
		Reddish brown from 18 to 20 feet.				4.50+				16					
20		20													
		End of Boring													

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Boring Number: B-02

PROJECT Tomball JHS Athletic Improvements
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260943
LATITUDE - **LONGITUDE** -
DATE STARTED 04/02/2026
DATE COMPLETED 04/02/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger from 0 to 10 feet
ELEVATION N/A **DEPTH** 10'
DURING DRILLING N.E. **AFTER DRILLING** N.M.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown.								9					
		2													
		CLAYEY SAND (SC) - Dense to very dense, reddish brown, brown.			40					7					
		Reddish brown from 4 to 6 feet			56					9	23	13	10	37	
5		6													
		SANDY LEAN CLAY (CL) - Very stiff, brownish yellow, reddish brown, light gray with sand seams and ferrous nodules.				3.50				16					
						3.50				17					
10		10													
		End of Boring													

DRAFT

Boring Number: B-03

PROJECT Tomball JHS Athletic Improvements **GENERAL LOCATION** Tomball, TX

PROJECT NUMBER H260943 **LATITUDE** - **LONGITUDE** -

DATE STARTED 04/02/2026 **DATE COMPLETED** 04/02/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger from 0 to 10 feet

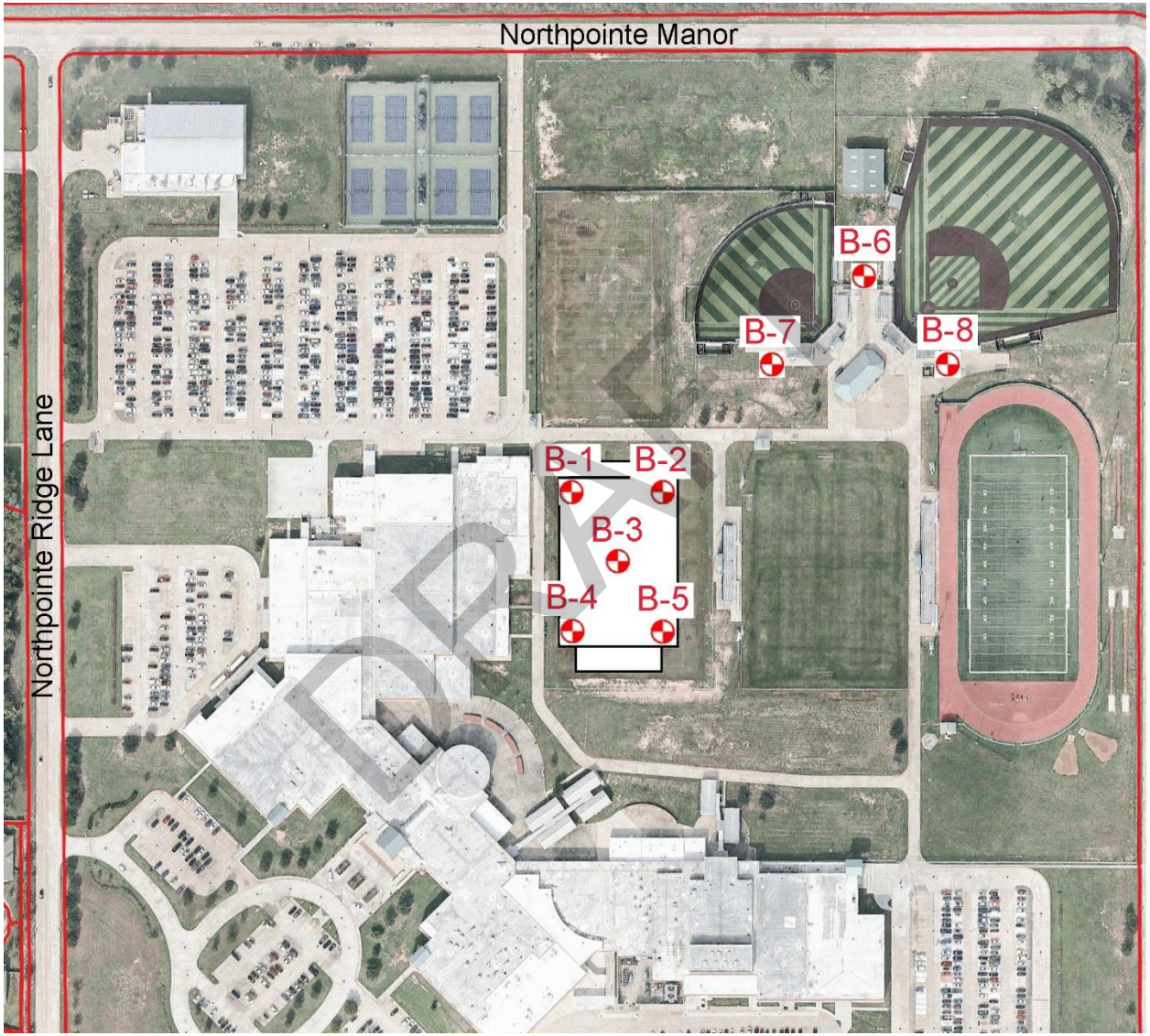
ELEVATION N/A **DEPTH** 10' **DURING DRILLING** N.E. **AFTER DRILLING** N.M.

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - brown. 2								5					
		SILTY SAND (SM) - Dense, reddish brown.			34					7	NV	NP	NP	19	
		Light brown from 4 to 6 feet. 6			36					7					
		SANDY LEAN CLAY (CL) - Stiff, brownish yellow, light gray, with sand seams.				2.75				16					
10		10				2.50				15	23	13	10		0.0
		End of Boring													

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BORING LOCATION DIAGRAM



UES Project No. H260944

Tomball Memorial HS Multi-Purpose Activity Center

Appendix B

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Boring Number: B-01

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/25/2026
DATE COMPLETED 04/25/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 50 ft
ELEVATION N/A **DEPTH** 50'
DURING DRILLING 35' **AFTER DRILLING** 33'
COMMENTS -

Depth (ft)	Material Description	Sample Graphic	REC (%) / RQD (%)	N-Value / Refusal / TCP	Pocket Pen (TSF)	Compressive Strength (TSF)	Confining Pressure (PSI)	Dry Density (PCF)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	% Swell
	SANDY LEAN CLAY (CL) FILL - Very stiff to hard, brown, reddish brown, light gray with root fibers and sand seams.				4.50				12	34	14	20	64	
					4.50+				16					
	Gray, brownish yellow from 2 to 4 feet. 4													
5	LEAN CLAY (CL)/SANDY LEAN CLAY (CL)/LEAN CLAY WITH SAND - Stiff to hard, gray, brownish yellow, with sand seams.				2.00				18	26	12	14	71	
					4.50+	4.1	0	113	20					
	Wet from 4 to 6 feet.				4.50+				14	41	14	27	76	
10	Light gray, brownish yellow, reddish brown from 6 to 8 feet.													
	Reddish brown, brownish yellow, light gray from 8 to 18 feet.				4.50+				15					
15														
	Light gray, brownish yellow from 18 to 30 feet.				4.25	3.5	16	114	13					
20														
					4.50				14					
25														
					4.50+				13					
30	CLAYEY SAND (SC) - Medium dense, brownish yellow, light gray.													
				20					15					
35														
	38													
	LEAN CLAY WITH SAND (CL)/SANDY LEAN CLAY (CL) - Stiff to hard, reddish brown, brownish yellow, light gray.			26					16					
40														
				44					16					
45														
				64					16					
50	50													

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Boring Number: B-02

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/01/2026
DATE COMPLETED 04/01/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 30 feet
ELEVATION N/A **DEPTH** 30'
DURING DRILLING N.E. **AFTER DRILLING** N.M.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown with clay pockets and root fibers. 2								8	NV	NP	NP	19	
		SANDY SILTY CLAY (CL-ML) FILL - Dark brown. 4			8					11					
5		SANDY LEAN CLAY (CL) - Stiff to hard, light brown, brownish yellow, with sand seams.				4.50+	2.5	4	113	14					
		Light brown, brownish yellow, reddish brown from 6 to 23 feet.				4.50+				14	38	14	24		0.0
10						4.00	2.0	0	119	15					
15						4.50+				15					
20						4.50+				15					
25		Light gray, brownish yellow from 23 to 30 feet.				4.50+				13					
30		30				3.00	3.8	0	123	14					
		End of Boring													

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Boring Number: B-03

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/18/2026
DATE COMPLETED 04/18/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 50 feet
ELEVATION N/A **DEPTH** 50'
DURING DRILLING 35' **AFTER DRILLING** 33'
COMMENTS -

Depth (ft)	Material Description	Sample Graphic	REC (%) / RQD (%)	N-Value / Refusal / TCP	Pocket Pen (TSF)	Compressive Strength (TSF)	Confining Pressure (PSI)	Dry Density (PCF)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	% Swell
	SANDY LEAN CLAY (CL) FILL - Very stiff, dark brown, dark gray with root fibers, gravel and sand seams. 2				4.00				13					
	SANDY SILTY CLAY (CL-ML) FILL - Stiff, dark gray. 4				4.50				13	17	12	5		0.0
5	SANDY SILTY CLAY (CL-ML) - Very stiff, brown, gray, brownish yellow. 6				3.00				16					
	SANDY LEAN CLAY (CL) - Stiff to hard, brownish yellow, reddish brown, with sand seams.				3.75				17					
	Light brown, brownish yellow from 8 to 28 feet.				2.50	1.0	0	119	15	27	11	16	60	
10														
					3.50				14					
15														
	With ferrous nodules from 18 to 28 feet.				4.50+				12					
20														
					4.50+				14					
25														
	Light gray, brownish yellow from 28 to 45 feet.				4.50+				12					
30														
					3.00	3.5	0	123	14					
35														
					4.50+				13					
40														
				32					13					
	45													
45	CLAYEY SAND (SC) - Dense, light gray, brownish yellow.													
				34					15					
	50													
50														

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Boring Number: B-04

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/01/2026
DATE COMPLETED 04/01/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 30 feet
ELEVATION N/A **DEPTH** 30'
DURING DRILLING N.E. **AFTER DRILLING** N.M.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown. 2								6					
		SANDY SILTY CLAY (CL-ML) FILL - Firm, dark brown. 4			7					9					
5		LEAN CLAY WITH SAND (CL)/SANDY LEAN CLAY (CL) - Stiff to very stiff, dark gray, gray, brownish yellow with sand seams.				4.25				16	35	13	22		
						4.50				15					
		Brownish yellow from 8 to 13 feet.				3.00	1.9	0	119	15					
10															
		Reddish brown, light brown, brownish yellow from 13 to 18 feet.				4.50				17					
15															
		Reddish brown, brownish yellow from 18 to 28 feet.				4.25				17					
20															
						3.25				15					
25															
		Light gray, brownish yellow, reddish brown from 28 to 30 feet. 30				3.75	2.6	24	116	14					
30		End of Boring													

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Boring Number: B-05

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/25/2026
DATE COMPLETED 04/25/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 50 ft
ELEVATION N/A **DEPTH** 50'
DURING DRILLING 35' **AFTER DRILLING** 33'
COMMENTS -

Depth (ft)	Material Description	Sample Graphic	REC (%) / RQD (%)	N-Value / Refusal / TCP	Pocket Pen (TSF)	Compressive Strength (TSF)	Confining Pressure (PSI)	Dry Density (PCF)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	% Swell
	SANDY LEAN CLAY (CL) FILL - Very stiff to hard, brown, brownish yellow, reddish brown, with sand seams.				4.50				13	42	16	26	66	
					4.50+				14					
4														
5	LEAN CLAY WITH SAND (CL)/SANDY LEAN CLAY (CL) - Very stiff to hard, gray, brownish yellow, with sand seams.				3.25	1.2	0	112	15					
					4.50				16	30	13	17		0.0
	Brownish yellow, reddish brown, light gray from 8 to 18 feet.				4.50+				14					
10														
					4.50+				15					
15														
	Light gray, brownish yellow from 18 to 30 feet.				4.50+				14					
20														
					4.50+	3.5	20	122	14					
25														
					4.50+				14					
30	CLAYEY SAND (SC) - Dense to very dense, light gray, brownish yellow.													
				50					13	23	12	11	27	
35														
				37					13					
40														
43														
	SANDY LEAN CLAY (CL) - Very stiff to hard, reddish brown, light gray, brownish yellow.			40					20					
45														
				62					15					
50														

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Boring Number: B-06

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/10/2026
DATE COMPLETED 04/10/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 20 feet
ELEVATION N/A **DEPTH** 20'
DURING DRILLING 10' **AFTER DRILLING** N.E.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown with root fibers. 2								6					
		SANDY LEAN CLAY (CL) - Soft to very stiff, dark brown, with sand seams.				1.00				13	23	12	11	57	
5		Gray brownish yellow with ferrous nodules from 4 to 8 feet.				2.00				19					
		Light gray, brownish yellow from 8 to 10 feet.				2.50				18					
		Wet from 8 to 10 feet.			10					17	29	11	18		
▽ 10															
		Brownish yellow, reddish brown, light brown from 13 to 20 feet.				4.00	1.7	0	119	15					
15															
		With ferrous nodules from 18 to 20 feet. 20				3.25				15					
20		End of Boring													
25															
30															

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Boring Number: B-07

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/10/2026
DATE COMPLETED 04/10/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 20 feet
ELEVATION N/A **DEPTH** 20'
DURING DRILLING N.E. **AFTER DRILLING** N.M.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SILTY SAND (SM) FILL - Brown with root fibers. 2								7					
		SANDY SILTY CLAY (CL-ML) - Soft, Dark brown 4				1.00				9					
5		SANDY SILT (ML) - Medium dense, dark brown. 6			12					9	15	13	2		
		FAT CLAY WITH SAND (CH) - Very stiff, brown, brownish yellow with sand pockets. 8				4.00				20	50	19	31	70	
10		LEAN CLAY WITH SAND (CL) - Very stiff to hard, gray, brownish yellow, with sand seams.				4.25				19					
15		Light gray, brownish yellow, reddish brown from 13 to 20 feet.				4.50+				16					
20		20				4.00				15					
		End of Boring													
25															
30															

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Boring Number: B-08

PROJECT Tomball Memorial HS MPAC and Athletic
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260944
LATITUDE - **LONGITUDE** -
DATE STARTED 04/10/2026
DATE COMPLETED 04/10/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 20 feet
ELEVATION N/A **DEPTH** 20'
DURING DRILLING N.E. **AFTER DRILLING** N.M.
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		CONCRETE PAVEMENT - 5 inches thick 0.416													
		SOIL BASE MATERIAL - 3 inches thick, CLAY. 1.09				1.50				14					
		SANDY LEAN CLAY (CL) FILL - Firm, dark brown. 2													
		SANDY SILTY CLAY (CL-ML) - Firm, dark brown, dark gray. 4				1.50				10					
5		SANDY LEAN CLAY (CL)/LEAN CLAY WITH SAND (CL) - Stiff to very stiff, brownish yellow, gray, with sand seams.				3.00	1.6	0	111	19	42	17	25		0.0
		Light gray, brownish yellow, reddish brown from 6 to 13 feet.				3.00				19					
10						2.00				18					
		Light brown, brownish yellow with ferrous nodules from 13 to 20 feet.				4.00				15					
15															
		20				4.25				16					
20		End of Boring													
25															
30															

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BORING LOCATION DIAGRAM



Appendix B

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Soil Boring Number: B-01

PROJECT Willow Wood JHS Athletic Improvements **GENERAL LOCATION** Tomball, TX

PROJECT NUMBER H260953 **LATITUDE** - **LONGITUDE** -

DATE STARTED 03/30/2026 **DATE COMPLETED** 03/30/2026

HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches **METHOD** Auger 0 - 20 feet

ELEVATION N/A **DEPTH** 20' **DURING DRILLING** N/A **AFTER DRILLING** N/A

COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SANDY LEAN CLAY (CL) FILL - Hard, reddish brown, brown with ferrous nodules and sand seams.				4.50+				12	46	17	29	64	
		2													
		SANDY SILT (ML) - Medium dense, brown.			12					8					
		4													
5		SANDY LEAN CLAY (CL) - Stiff to very stiff, brown, with sand seams.				4.00				11					
		Reddish brown from 6 to 8 feet.				3.00				10	24	12	12		0.00
						4.00				10					
10															
		Reddish brown from 13 to 15 feet.				4.00	4.0		124	9					
15															
		Brownish yellow, reddish brown from 13 to 15 feet.				2.00				14					
		20													
20		End of Boring													

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Soil Boring Number: B-02

PROJECT Willow Wood JHS Athletic Improvements
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260953
LATITUDE - **LONGITUDE** -
DATE STARTED 03/30/2026
DATE COMPLETED 03/30/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 10 feet
ELEVATION N/A **DEPTH** 10'
DURING DRILLING N/A **AFTER DRILLING** N/A
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SANDY LEAN CLAY (CL) FILL - Stiff, reddish brown, brown, light gray, with sand seams.				2.50				12	28	11	17		
		SANDY SILT (ML) - Medium dense, brown.			12					8	15	13	2		
5		SANDY LEAN CLAY (CL) - Stiff, brown, reddish brown, with sand seams.				2.00				11					
						3.00				10					
		Brown from 8 to 10 feet.				3.00				11	36	13	23	57	
10		End of Boring													
15															
20															

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Soil Boring Number: B-03

PROJECT Willow Wood JHS Athletic Improvements
GENERAL LOCATION Tomball, TX
PROJECT NUMBER H260953
LATITUDE - **LONGITUDE** -
DATE STARTED 03/30/2026
DATE COMPLETED 03/30/2026
HAMMER WEIGHT 140 lbs **HAMMER DROP** 30 inches
METHOD Auger 0 - 10 feet
ELEVATION N/A **DEPTH** 10'
DURING DRILLING N/A **AFTER DRILLING** N/A
COMMENTS -

Depth (ft)	Graphic Log	Material Description	Samples: Sample Graphic	Samples: REC (%) / RQD (%)	Samples: N-Value / Refusal / TCP	Samples: Pocket Pen (TSF)	Lab: Compressive Strength (TSF)	Lab: Confining Pressure (PSI)	Lab: Dry Density (PCF)	Lab: Moisture Content (%)	Lab: Liquid Limit	Lab: Plastic Limit	Lab: Plasticity Index	Lab: % Fines	Lab: % Swell
		SANDY LEAN CLAY (CL) FILL - Stiff, brown with root fibers and sand seams. 2				3.00				10					
		SANDY SILT (ML) - Medium dense, brown. 4			10					7					
5		SANDY LEAN CLAY (CL) - Stiff to very stiff, brown, with sand seams.				2.00				12	32	12	20	54	
						3.50				12					
		Light gray, brownish yellow, reddish brown with ferrous stains from 8 to 10 feet. 10				4.00				14					
10		End of Boring													
15															
20															

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SECTION 00 45 19

NON-COLLUSION AFFIDAVIT

Tomball Athletic Improvements
Tomball ISD

By submission of this bid or proposal, the undersigned certifies that:

A. The bid or proposal has been independently arrived at without collusion with any other bidder or with any other competitor;
B. This bid or proposal has not been knowingly disclosed and will not be knowingly disclosed, to any other bidder or competitor or potential competitor, prior to the opening of the bids, or proposals for this project;
C. No attempt has been or will be made to induce any other person, partnership or corporation to submit or not submit a bid or proposal;
D. The undersigned certifies that they are fully informed regarding the accuracy of the statements contained In this certification, and that the penalties herein are applicable to the bidder as well as to any person signing on their behalf.

_____ _____
Authorized Agent (Print Name) Date

_____
Signature

_____
Company Name

_____
Company Address

_____
City State Zip

END OF SECTION

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SECTION 00 45 20

FELONY CONVICTION NOTIFICATION

STATE OF TEXAS LEGISLATIVE SENATE BILL NO. 1, SECTION 44.034, NOTIFICATION OF CRIMINAL HISTORY, SUBSECTION (A) STATES "A PERSON OR BUSINESS ENTITY THAT ENTERS INTO A CONTRACT WITH A SCHOOL DISTRICT MUST GIVE ADVANCE NOTICE TO THE DISTRICT IF THE PERSON OR OWNER OR OPERATOR OF THE BUSINESS ENTITY HAS BEEN CONVICTED OF A FELONY." THE NOTICE MUST INCLUDE A GENERAL DESCRIPTION OF THE CONDUCT RESULTING IN THE CONVICTION OF A FELONY.

SUBSECTION (B) STATES "A SCHOOL DISTRICT MAY TERMINATE A CONTRACT WITH A PERSON OR BUSINESS ENTITY IF THE DISTRICT DETERMINES THAT THE PERSON OR BUSINESS ENTITY FAILED TO GIVE NOTICE AS REQUIRED BY SUBSECTION (A) OR MISREPRESENTED THE CONDUCT RESULTING IN THE CONVICTION. THE DISTRICT MUST COMPENSATE THE PERSON OR BUSINESS ENTITY FOR SERVICES PERFORMED BEFORE THE TERMINATION OF THE CONTRACT."

THIS NOTICE IS NOT REQUIRED OF A PUBLICLY-HELD CORPORATION.

PLEASE COMPLETE THE INFORMATION BELOW.

I, THE UNDERSIGNED AGENT FOR THE FIRM NAMED BELOW, CERTIFY THAT THE INFORMATION CONCERNING NOTIFICATION OF FELONY CONVICTIONS HAS BEEN REVIEWED BY ME AND THE FOLLOWING INFORMATION FURNISHED IS TRUE TO THE BEST OF MY KNOWLEDGE.

OFFEROR'S NAME: _____

NAME OF AUTHORIZED COMPANY OFFICIAL (PLEASE PRINT OR TYPE):

_____

A. MY FIRM IS A PUBLICLY-HELD CORPORATION; THEREFORE, THIS REPORTING REQUIREMENT IS NOT APPLICABLE.

SIGNATURE OF AUTHORIZED COMPANY OFFICIAL:_____

DATE

B. MY FIRM IS NOT OWNED NOR OPERATED BY ANYONE WHO HAS BEEN CONVICTED OF FELONY.

SIGNATURE OF AUTHORIZED COMPANY OFFICIAL: _____

DATE

C. MY FIRM IS OWNED OR OPERATED BY THE FOLLOWING INDIVIDUAL(S) WHO HAS/HAVE BEEN CONVICTED OF A FELONY:

NAME OF FELON(S): _____

_____

DETAILS OF CONVICTIONS(S): _____

_____

_____

SIGNATURE OF AUTHORIZED COMPANY OFFICIAL: _____

DATE

END OF SECTION

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SECTION 00 45 25

CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION

REVIEW BY CONTRACTOR-EMPLOYER

Certifying Affidavit submitted to:

Name of School District: Tomball ISD

Mailing Address: 310 S. Cherry Street

Project: Tomball Athletic Improvements

STATE OF TEXAS §
COUNTY OF §

(1) The undersigned representative, on behalf of the contracting firm identified below, swears and affirms to Tomball ISD (the "District") that such firm has obtained, reviewed and verified, from a law enforcement or criminal justice agency or a private entity that is consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681 et seq.) the criminal history record information of all employees hired before January 1, 2008, who (a) have or will have continuing duties related to the contracted services, and (b) have or will be on school campuses. Such employees are identified by name on Schedule A attached hereto. The undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule A have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(2) The undersigned representative, on behalf of the contracting firm identified below, swears and affirms to the District, that such firm has obtained, reviewed and verified, from the Texas Department of Public Safety criminal clearinghouse, the national criminal history record information of all employees hired on or after January 1, 2008, who (a) have or will have continuing duties related to the contracted services, and (b) be on school campuses. Such employees are identified by name on Schedule B attached hereto. The undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule B have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(3) The undersigned firm swears and covenants that no present or future employee will provide services to the Project that involve direct contact with students unless and until such employee's national criminal history record information has been reviewed and cleared as required by Paragraph (2) above, and an updated Certification has been submitted by the contracting firm to the District with an updated Schedule B identifying such employees. In the event of an emergency, an employee who has not been previously certified may only provide services that involve direct contact with students if such employee is escorted by a District representative.

(4) The undersigned firm swears and covenants that, upon receipt of information, directly or indirectly, that any employee of the contracting firm has been convicted of an offense identified in Section 22.085 of the Texas Education Code, the contracting firm will immediately remove such employee from the Project and notify the District.

(5) Furthermore, the name, driver's license number, date of birth, and any other information required by the DPS will be submitted to the District for any person on either Schedule A or Schedule B for the purposes of subscribing to and issuing a District badge.

_____ , being duly sworn, affirms and certifies that he/she is the

_____(position) of _____ (contracting firm), and that all statements and acknowledgements contained herein are true and correct, and that he/she has the authority to bind such firm to the covenants set out above.

_____

SUBSCRIBED AND SWORN TO BEFORE ME this _____ day of _____, 20_____.

Notary Public _____ State of _____

My Commission Expires: _____

END OF SECTION

SECTION 00 45 46

CONFLICT OF INTEREST QUESTIONNAIRE

for vendor or other person doing business with local governmental entity

The attached questionnaire is being filed in accordance with chapter 176 of the Local Government Code by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session, which became effective September 1, 2015. This form was adopted by the Texas Ethics Commission, November 30, 201

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CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. *See* Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of vendor who has a business relationship with local governmental entity.**

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 **Name of local government officer about whom the information is being disclosed.**

_____

Name of Officer

4 **Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 **Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.**

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

_____ _____ _____

Name of signatory Signature Date

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

(A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;

(B) a transaction conducted at a price and subject to terms available to the public; or

(C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

***

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds $2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than $100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

SECTION 00 61 13.13

PERFORMANCE BOND FORM

(Penalty of this bond must be 100% of contract amount) **Bond No.: _____**

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, and
a corporation organized and existing under the laws of the State of _____ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____

_____

(hereinafter called the Obligee) in the amount of _____

_____

Dollars($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.
WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated this _____ day of _____, _____.

Tomball Athletic Improvements
Tomball ISD
Tomball, Texas

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, _____.

_____(Seal)
_____ Principal

_____
Surety Address By: _____

_____(Seal)
_____ Surety
Surety Telephone Number

By: _____
Attorney-in-Fact

END OF SECTION

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SECTION 00 61 13.16

PAYMENT BOND FORM

(Penalty of this bond must be 100% of contract amount)

Bond No.:

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal,

a corporation organized and existing under the laws of the State of _____ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____

_____

(hereinafter called the Obligee) in the amount of _____

Dollars($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.
WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated this _____ day of _____, _____.

Tomball Athletic Improvements
Tomball ISD
Tomball, Texas

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond to all such claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, _____.

_____
Witness: Principal (Seal)

_____ By: _____
Witness

_____
Surety (Seal)

_____ By: _____
Attorney-in-Fact

_____ _____
Surety Address Surety Telephone Number

END OF SECTION

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SECTION 00 65 00

RELEASE OF LIEN DOCUMENTS

APPENDIX INDEX:

1. CONDITIONAL WAIVER FOR PROGRESS PAYMENTS

2. UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS

3. CONDITIONAL WAIVER FOR FINAL PAYMENT

4. UNCONDITIONAL WAIVER FOR FINAL PAYMENT

[Note: the attached forms are duplicated verbatim (without editing) from HB 1456.]

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENTS

* * * * * * *

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: Tomball Athletic Improvements

Job No.: 25-0158.00

On receipt by the signer of this document of a check from _____
_____
(maker of check) in the sum of $ _____
payable to _____
(payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____
_____
(owner) located at (location) to the following extent: _____
_____
_____
_____(job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____
_____(Company name)
By_____(Signature)
_____(Title)

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS

* * * * * * *

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: Tomball Athletic Improvements

Job No.: 25-0158.00

The signer of this document has been paid and has received a progress payment in the sum of $_____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of_____ (owner) located at_____ (location) to the following extent:_____ _____ _____ (job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:_____ _____ _____

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in **full** all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____
_____(Company name)
By_____(Signature)
_____(Title)

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENT

* * * * * * *

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: Tomball Athletic Improvements

Job No.: 25-0158.00

On receipt by the signer of this document of a check from_____
_____
_____(maker of check) in the sum of
$_____payable to
_____
_____(payee of payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of_____
_____
(owner) located at_____
_____
(location) to the following extent:_____
_____
_____(job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____
_____(Company name)
By_____(Signature)
_____(Title)

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENT

* * * * * * *

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: Tomball Athletic Improvements

Job No.: 25-0158.00

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to_____
_____
(person with whom signer contracted) on the property of_____
_____(owner) located at_____
_____
_____(location) to the following extent_____
_____
_____(job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____
_____(Company name)
By_____(Signature)
_____(Title)

END OF SECTION

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SECTION 00 73 50

WEATHER TABLE

MONTH	AVERAGE DAYS RAIN (1)	INCHES RAINFALL (2)	SNOW/ICE PELLETS (3)
JANUARY	10.0	3.76	0.0
FEBRUARY	8.8	2.97	0.0
MARCH	8.8	3.47	0.0
APRIL	7.3	3.95	0.0
MAY	8.6	5.01	0.0
JUNE	10.0	6.00	0.0
JULY	9.1	3.77	0.0
AUGUST	8.5	4.84	0.0
SEPTEMBER	8.4	4.71	0.0
OCTOBER	7.7	5.46	0.0
NOVEMBER	7.6	3.87	0.0
DECEMBER	9.6	4.03	0.1
ANNUALLY	104.4	51.84	0.1

(1) Mean number of days rainfall, 0.01" or more.
(2) Average normal precipitation, in inches.
(3) Mean number of days 1.0" or more.
* Less than 0.05".

This table is based on information reported from Houston Intercontinental Airport, Texas. Latitude 29.9800° N, Longitude -95.3600° W, elevation (ground) 95 feet.

Means are based on records covering a period of 30 years. Normals based on record for the 1991-2020 period.

END OF SECTION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY AND DESCRIPTION

A. The work comprises the construction of Tomball Athletic Improvements for Tomball ISD, Tomball, Texas, as shown on the drawings and described in the specifications. The work will be done under one lump sum contract.

B. Indication on the drawings or mention in the specifications of articles, materials, operations or methods requires that the Contractor provide each item indicated or mentioned of the quality or subject to the qualifications noted, and perform according to the conditions stated each operation described and provide therefor all necessary labor, equipment, services and incidentals.
   1. Subcontractors are responsible for examining the architectural drawings for structural, mechanical, electrical, and plumbing items. Items shown on these drawings shall be furnished by the appropriate subcontractor.

C. Related Requirements:
   1. Document 00 21 16 - INSTRUCTIONS TO PROPOSERS.
   2. Document 00 70 00 - GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION: Provisions for use of site; Owner occupancy; Relations of Contractor - subcontractors.
   3. Section 01 32 16 - CONSTRUCTION PROGRESS SCHEDULES Format of work schedule.
   4. Section 01 45 23 - TESTING AND INSPECTION SERVICES.
   5. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.

1.2 CONDITIONS OF THE CONTRACT

A. The General Conditions Modified bound herewith as preceding portions of these specifications, form a part thereof and shall govern the work under each section.

1.3 EXISTING SITE CONDITIONS

A. Visit and examine the site. Upon award of the Contract, the Contractor shall accept the condition of the site before beginning the work required.

1.4 SPECIAL REQUIREMENTS

A. The present building houses an operating facility that must continue in operation during the construction period, except as the Architect and Owner may otherwise direct. Plumbing, heating, ventilating, electrical and telephone systems shall continue to function with a minimum of interruptions in service. Do not block required fire exits.

B. Assume responsibility for the protection of areas of work and provide and maintain protections required. Protect existing surfaces of the building and equipment, both interior and exterior, as required during the construction period. Provide necessary dust screens, drop cloths and temporary walls and/or coverings as may be required for protection. Existing surfaces that are damaged due to construction shall be patched or replaced to original condition.

C. Where designated on the drawings, salvage, relocate and reinstall certain items. Existing items so designated shall be properly installed, securely fastened as required, set plumb and level and left complete and operational. Exercise extensive care in relocating such items so as to prevent damage. Other existing building materials indicated to be removed or demolished, unless noted otherwise or claimed by the Owner shall become property of the Contractor and shall be removed from the site immediately.

D. Execute Certificate of Substantial Completion for each designated portion of work prior to Owner occupancy. Following execution of a Substantial Completion Certificate for a designated portion of the work, the Contractor shall permit:

1. Access for Owner personnel.
2. Use of parking facilities for the benefit of the Owner.
3. Operation of electrical systems for the benefit of the Owner.

Despite partial Owner occupancy, the Contractor shall remain responsible for portions of the work which have not attained Substantial Completion and for which a Substantial Completion Certificate, which shall designate the date on which the Owner shall become responsible for utilities, maintenance, security, damage to the work and insurance, has not been executed.

1.5 CONTRACTOR USE OF PREMISES

A. Limit use of premises for work, for storage and for access, to allow for Owner occupancy.

B. Coordinate use of premises under direction of Owner.

C. Assume full responsibility for protection and safekeeping of products under this contract.

D. Obtain and pay for use of additional storage or work areas needed when required for operations under this Contract.

E. During construction the Owner will continue to perform normal activities in and around the adjacent existing building. Proper and safe access to the Owner-occupied areas shall be maintained. Interruption of mechanical and electrical services to the building shall be only at such times and for lengths of time as approved by the Owner.

F. There shall be no storage of materials or equipment in the occupied portions of the existing building. There shall be no fires on the site or in the building. There shall be no dumping on Owner's property.

G. Worker Identity Badging Requirements: Provide construction personnel (including subcontractors and suppliers regularly visiting the project site) with identification badges, with photograph. Identification badges shall be worn visibly by construction personnel on the construction site or on Owner’s property. NO EMPLOYEE WILL BE PERMITTED ON SITE WITHOUT THIS BADGE DISPLAYED ON THE EMPLOYEE. Contractor must assure that the Crisis Management contact information is provided on the reverse side of each worker’s badge. Temporary or visitor badges will be provided for persons who are identified as having an infrequent or temporary legitimate business need for access to the site.

1.6 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed on the project site during normal business working hours of 6:00 a.m. to sundown, Monday through Friday or City ordinance whichever is more restrictive.
   1. Weekend Hours: Comply with City ordinance restrictions for weekend work. No work shall be performed on Sundays, unless specifically allowed by City and Owner.
   2. Early Morning Hours: Comply with City noise ordinances for restriction of early-morning concrete pours and other noisy construction activities. Owner’s testing laboratory personnel will be available only during on-site work hours listed above.

B. Work Restrictions within Existing Building: Work shall be generally performed inside the existing building during the summer break and after normal school classes Monday through Friday. During student holidays when the faculty and staff may be on campus, extent of work and utility interruption shall be coordinated with the Owner in advance. On dates designated as STAAR testing days, work within the existing building is not allowed and work in other areas may need to be limited to keeping down the amount of noise and distraction for the students. Work on these days shall be coordinated with the Owner in advance.

1.7 OWNER-FURNISHED PRODUCTS

A. Contractor Responsibilities
   1. Protect products from damage.
   2. Repair or replace items damaged by Contractor.

1.8 COORDINATION

A. Drawing details and other sections of these specifications covering work connected with or relating to that specified under a specific heading shall be examined for conditions which may affect that part of the work. Failure to do so will not relieve those furnishing materials and/or labor under a specification heading from supplying materials or performing work reasonably necessary to properly coordinate their work with that of other trades.

1.9 LAYING OUT WORK, MEASUREMENTS

A. Employ a competent engineer or surveyor to establish and maintain lines and levels. Establish and maintain at least two elevation bench marks remote from each other and located outside the building area. Set alignment and location stakes.

B. Verify measurements at the building. No extra compensation will be allowed for differences between actual dimensions and dimensions indicated on the drawings. Figured dimensions and measurements taken at the site shall take precedence over scaled dimensions.

1.10 DISCREPANCIES

A. In case of discrepancies within the drawings, within the specifications, or between the drawings and specifications, the better quality and greater quantity, in the opinion of the Architect, shall be furnished and installed.

1.11 PIPING

A. Should active piping or conduit be encountered below grade within the building structure and be found at variance with the known conditions indicated by the drawings and specifications, said piping and/or conduit shall be relocated as required by the Architect, and the contract sum shall be fairly adjusted on the basis of the cost of labor and materials. The Contractor shall provide temporary support of active piping and conduit encountered in the excavations until permanently supported or removed. The Contractor shall cut off and cap or plug abandoned lines at least 3 ft. outside the building lines. Conform to the applicable requirements of the locality or governing agency.

1.12 PROTECTION

A. General: Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy in adjacent spaces and around the site.
   1. Confine operations to areas within Contract limits indicated. Portions of the building which are outside the areas construction operations are indicated, are not to be disturbed.
   2. Keep driveways and entrances serving the premises clear and available to the Owner and the Owner's employees. Do not use these areas for parking or storage of materials without prior approval. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
   3. Do not dispose of organic and hazardous material on site, either by burial or by burning. Disposable material and trash must be removed properly.

B. Assume responsibility for the premises and provide and maintain protections required by the governing laws, regulations and ordinances. The Contractor shall be responsible for loss or damage caused by him or his workmen to the property of the Owner or to the work or materials installed, and shall make good loss, damage or injury without cost to the Owner.

C. The protection of adjacent property shall include but will not necessarily be limited to the erection and maintenance of shoring, underpinning and fences as necessary to protect and support existing work to be left in place.

D. Trees and shrubs on the site which do not have to be removed for the new work shall be protected against damage. No Contractor shall remove or trim trees and shrubs in the area without the express approval of the Architect.

E. Send proper notices, make necessary arrangements and perform other services required for the care, protection and maintenance of Public Utilities, including fire plugs and wires and other items of this character on and around the building site.

F. Maintain accessible building exits required by the City during construction. Protection of these exits shall include dust-proof enclosures, illumination and exit lighting required.

G. While school is in session, provide appropriate measures to control the migration of dust and odors into occupied areas of the school.

1.13 CUTTING AND PATCHING

A. Cutting and chasing of existing construction for relocation of mechanical and electrical work and for installation of pipes and ducts will be done by the trades concerned. Patching and finishing shall be done by the Contractor. This work shall be done with proper tools and by careful workmen of the particular trade to which such work belongs and shall be done without extra cost to the Owner.

1.14 RECORD DRAWINGS

A. Maintain a complete clean set of drawings and Project Manual in the project field office for the sole purpose of recording "installed" conditions. Installed conditions shall include addendum items, change orders, or other items which come up during the construction phase which deviate from the Construction Documents. Changes made in these drawings and Project manual in connection with the final construction and installation shall be neatly made in red ink. Upon completion of the project, the marked set of drawings and Project Manual shall be delivered to the Architect for subsequent transmittal to the Owner. These drawings shall be maintained to reflect the current conditions of the work and changes shall be reviewed on a monthly basis with the Architect’s representative. The Contractor's updating of the "installed" condition drawings and Project Manual shall be a prerequisite to the monthly review of the Contractor's payment request by the Architect's representative.

1.15 INSTRUCTIONS CONCERNING ASBESTOS

A. In the event the Contractor encounters on the site material reasonably believed to be asbestos which has not been rendered harmless, the Contractor shall immediately stop work in the area affected and report the condition to the Owner in writing. If, in fact the material is asbestos and has not been rendered harmless, the work in the affected area shall not thereafter be resumed until the asbestos has been removed or rendered harmless by the Owner. The work in the affected area shall be resumed in the absence of asbestos, or when it has been rendered harmless, by written agreement of the Owner and Contractor.

B. The Contractor will not be required to perform without consent work relating to asbestos.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included:
   1. Identification and description of alternate work.
   2. The amount shown in the proposal form for each alternate shall include all overhead, profit, insurance and other costs incidental to the performance under the alternate.

B. Related Requirements:
   1. Proposal Form: Quotation of cost of each alternate.
   2. Contract Form: Alternates accepted by Owner for incorporation into the work.
   3. Section of specifications identified in each alternate.

1.2 PROCEDURES

A. Proposers are required to submit alternate amounts to add work or to deduct work from the base proposal as described below. Failure to submit alternate amounts in spaces provided on proposal form shall be basis for disqualification of proposal.

B. The successful proposer shall not modify, withdraw or cancel any of the alternate proposals or any part thereof for 30 days after date of receipt of proposals, unless specifically noted otherwise.

C. Contractor shall be responsible for any changes in the Work affected by acceptance of alternates. Claims for additional costs or time extensions resulting from changes to the Work as a result of the Owner's election of any or all alternates will not be allowed.

D. Refer to drawings and technical specifications sections for items of work affected by alternates.

E. Election of alternates will be exercised at the option of Owner.

F. Coordinate related work and modify or adjust surrounding work as required to complete the Work, including changes under each alternate.
   1. Include as part of each alternate, miscellaneous devices, accessory objects and similar items incidental to, or required for, a complete installation whether or not indicated as part of alternate.
   2. Cost listed for each alternate include cost of related coordination, modification, or adjustment.

G. Notification: Immediately following the award of contract, Contractor shall prepare and distribute to each entity or person to be involved in the performance of the Work, a notification of the status of each alternate scheduled herein. Indicate which alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates, if any.

H. Where alternates are requested, they shall be fully vetted and approved by the Architect/Engineer/Consultant, and then by the Owner.

I. Alternates shall be a complete turnkey scope of work requiring no further adjustment in cost, work or schedule and containing no further required markup so as to be 100% additive or deductive.

J. When pricing is provided it shall include identification of cost and schedule impact.

1.3 SELECTION AND AWARD OF ALTERNATES

A. Indicate variation in base proposal amount as a result of the prices for the alternates described below and listed on the proposal form document or any supplement to it, by adding to, or deducting from, the base proposal amount or by indicating " No Change."

B. Indicating “No Proposal” as an alternate is unacceptable and is reason for rejection of proposal.

1.4 SCHEDULE OF ALTERNATES

A. **Alternate No. 1:** State in the proposal form the amount to be added to the base proposal for providing Outfield wall padding located at both the Baseball & Softball fields. Refer to the construction documents for Tomball Memorial High School for locations and proposed design.

B. **Alternate No. 2:** State in the proposal form the amount to be added the base proposal for providing LED Light Fixture Upgrades at Soccer Field and Tennis Courts. Refer to the construction documents for Tomball Memorial High School.

C. **Alternate No. 3:** State in the proposal form the amount to be added to the base proposal for providing Synthetic Turf Upgrade at Baseball & Softball Bullpens. Refer to the construction documents for Tomball Memorial High School for the four locations.

D. **Alternate No. 4:** State in the proposal form the amount to be added to the base proposal for providing Pre-Engineered Metal Building Storage Shed Addition(s). Refer to the construction documents for Tomball Memorial High School, Creekside Park Junior High School, Willow Wood Junior High School and Tomball Junior High School for locations and quantity at each campus.

E. **Alternate No. 5:** State in the proposal form the amount to be added to the base proposal for providing Scoreboard and Required Footing Addition. Refer to specification 11 68 00 Scoreboards and the construction documents for Tomball Junior High School, Willow Wood Junior High School and Creekside Park Junior High School.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Applications and Certificates for Payment.
2. Change Order Procedures.
3. Schedule of Values: Submit to the Architect the Schedule of Values allocated to various portions of the work within five days after "Notice-to-Proceed". Upon request of Architect, support values with data which will substantiate their correctness.

B. Related Requirements:
1. Conditions of the Contract for Construction.
2. Section 01 32 16 - CONSTRUCTION PROGRESS SCHEDULES.
3. Section 01 77 00.00 - CLOSEOUT PROCEDURES.
4. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

1.2 REFERENCE STANDARDS

A. AIA G702 - Application and Certificate for Payment; 1992.

B. AIA G703 - Continuation Sheet; 1992.

1.3 APPLICATIONS AND CERTIFICATES FOR PAYMENT

A. Provide a separate Application for Payment for each school.

B. Progress payments shall be made as the work proceeds at intervals stated in the Contract.

C. Work covered by progress payments shall, at the time of payment, become the property of the Owner.

D. Form of Application and Certificate for Payment shall be notarized AIA Document G702 (AIA G702) - Application and Certification for Payment, supported by AIA Document G703 (AIA G703) - Continuation Sheet. Submit two hard copies. Architect will retain a digital copy and return signed hard copies to the Owner and Contractor.
1. Pay Applications shall be submitted concurrently is draft form to all parties, the Architect and the Program anager Team via Project Mates unless agreed to during the kick-off meeting. Do not assume anything other than what is provided.
2. The Architect is responsible for certifying the final approval, therfor the Architect shall ensure that all numbers are correct, and no change in costs are indicated from previous applications for payment. Where stored materials are being requested for approval, all required items are included but a minimum, ensure there is proof of specific insurnace noting serial numbers, photographs, physical address, a statement that there is no additional charge or schedule impact from this process, and proof of approval is attached to the final approved application.
3. A Payment Applications and Invoices submitted for payment after all comments have been addressed shall include at the top of the page, the TISD PO number. Failure to provide this number may cause the Payment Application to be rejected for noncompliance or at a minimum delay the process.
4. Any application for payment shall include all items listed within the specifications but at a minimum:
a. CSP
1) Partial lien releases for current billing and full lien releases for all past billing.
2) A current updated project schedule showing the impact of the current billing and work complete with adjustments to other pending work.

E. Conditions governing regular schedule for applications, payment and retainage are as stated in the Contract.

F. With each Application for Payment, Contractor shall certify that such Application for Payment represents a just estimate of cost reimbursable to Contractor under terms of Contract.

G. Stored Materials: Include in Application for Payment amounts for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
   1. Application for payment of materials and equipment stored off-site will only be considered if such payment application has been approved in advance by the Owner, and:
      a. Items are suitably stored off the site at a location agreed upon in writing;
      b. Items are stored locally for verification by the Architect;
      c. Certificate of insurance for storage facility has been provided;
      d. Evidence of transfer of title to Owner has been provided;
      e. Consent of surety to payment for materials stored off-site has been provided; and
      f. Compliance by Contractor has been attained for any other procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on materials stored off-site.
   3. No application for payment may be submitted for raw materials stored off-site.

1.4 CONSTRUCTION CHANGE ORDER PROCEDURES

A. Contractor to submit to Architect within five days of execution of Owner/Contractor Agreement name of individual authorized to accept changes on behalf of Contractor, and to be responsible for informing others in Contractor's employ of changes in the work.

B. Change Order forms will be furnished and issued by Architect.

C. Contractor Documentation of Changes:
   1. Maintain detailed records of work done on an accounting basis acceptable to Architect and Owner. Provide full information required for evaluation of proposed changes.
   2. Document each quotation for a change in cost or time with sufficient data to allow evaluation of quotation.
   3. On request, provide additional data to support computations:
      a. Quantities of products, labor and equipment.
      b. Insurance and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   4. Support each request for additional costs, and for work proposed on a time and material basis, with description of products, equipment, cost of labor and subcontracts, completely documented.
   5. Computation for changes in work will be computed in one of the manners described in the Conditions of the Contract.

D. Initiation of Changes:
   1. Architect may submit Proposal Request which includes detailed description of change with supplementary or revised drawings and specifications.
   2. Contractor may initiate a proposed change by submittal of a request to Architect describing proposed change with statement of reason for change, and proposed effect on Contract Sum and Contract Time with full documentation and a statement of the effect on work of separate contractors. Document any requested substitutions in accordance with SECTION 01 62 00 - PRODUCT OPTIONS. Submission of such requests and receipt of same by Architect does not mean acceptance, or approval of proposed change.

E. Authorization:
   1. The Owner may request, through the Architect, a Construction Change Directive, in writing, instructing Contractor to proceed with changes of all or in part of work, for subsequent inclusion in a Change Order that is pending. Directive will propose basis for necessary adjustments, if any, to Contract Sum or Time.

2. Changes that affect Contract Sum and/or Contract Time will require a Change Order signed by the Owner and the Architect. Contractor's signature indicates agreement. Other orders, written or oral, by the Owner through the Architect or by the Architect shall be treated as a Change Order only if Contractor gives Owner proper written notice as described in Conditions of Contract.
3. Promptly execute the change in work only upon receipt of approved Change Order or Owner's written Construction Change Directive.

F. Execution:
1. Architect will issue Change Orders for signatures of parties as provided in Conditions of Contract.
2. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust Contract Sum as shown on Change Order.
3. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by Change, and resubmit Schedule.
4. Promptly enter Changes in Project Record Documents.

1.5 SCHEDULE OF VALUES FORM AND CONTENT

A. Provide a separate Schedule of Values for each school and provide a breakdown between additions and renovations for major items of work.
1. A Schedule of Values (SOV) shall be presented within 45 days of Notice too Proceed. The SOV will be reviewed by both the Architect and program management team until approved.
2. At the contractor's option, Application for Payment #1 may show General Conditions, Insurance and Bonds listing the remainder of the accepted cost as a single line item.
3. No applications for payment will be allowed until the SOV is approved.
4. Listing of required breakdowns are as noted in the specifications or as requested by the Owner.
5. At a minimum, all major materials shall be broken out, indicating material and labor for specific disciplines, materials, and scope of work.
6. Change Proposal Requests (CPR) shall be issued by the A/E/Consultant for pricing and indicated what brought about the need for the CPR, (Owner Requested, Architect Requested, Contractor Requested, Unforrseen Condition, Documents/Site Conflict). DO NOT LIST THE OWNER UNLESS THE OWNER REQUESTS THE CHANGE.
7. A CPR, when submitted for approval, shall include all backup and related information showing the evolution of the CPR. This includes subcontractor backup, Requests for Information (RFI), Architect's Supplemental Instruction (ASI) and full drawing sheets and specification with the changes clouded in red for ease of identification.

B. Type schedule on 8-1/2" x 11" white paper; Contractor's standard forms and automated printout will be considered for approval by Architect upon Contractor 's request. Identify schedule with:
1. Title of project and location.
2. Architect and Architect's project number.
3. Name and address of Contractor.
4. Contract designation.
5. Date of submission.

C. Follow the table of contents of this project manual as the format for listing component items.
1. Identify each line item with the number and title of the respective major section of the specifications.

D. For each major line item list sub-values of major products or operations under the item.

E. For the various portions of the work:
1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
2. For items on which progress payments will be requested for stored materials, break down the value into that listed above differentiating between stored on-site and stored off-site:
a. Cost of the materials, delivered and unloaded, with taxes paid.
b. Total installed value.
3. Submit a subschedule for each separate stage of work in SECTION 01 11 00 - SUMMARY OF WORK.

F. The sum of values listed in the schedule shall equal the total contract sum.

G. Indicate separate value associated with materials and labor.

H. Re-submittal: After review by Architect, revise and resubmit schedule as necessary.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Coordination of work of the contract.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK: Sequence of construction and Owner occupancy.
2. Section 01 31 19.00 - PROJECT MEETINGS.
3. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Architect's project management system.
4. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Architect's project management system.
5. Section 01 62 00 - PRODUCT OPTIONS.
6. Section 01 73 29 - CUTTING AND PATCHING.
7. Section 01 77 00.00 - CLOSEOUT PROCEDURES: Closeout submittals.

1.2 DESCRIPTION

A. Coordinate scheduling, submittals and work of the various sections of specifications to ensure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.

B. The District has engaged the services of a Program Manager.
1. The Program Manager shall act as the Owner's representative and all communication with the district shall flow through the Program Manager team.
2. In some instances, there may be a need to communicate directly with the district for efficiency or technical clarity. In this case the A/E will be directed to do so.
3. The A/E may be contacted directly by a TISD employee. Should this happen a protocol for how and what is required of you post conversation will be established but it is the A/E's responsibility to bring this to the attention of the PM. Conversations with other than the Project Manager regarding cost, schedule and quality shall always include the Project Manager.
4. No one at the district has authority to authorize a change in work, design, aesthetic selection, material change, physical change, or any other conceptual change except for the named contact for TISD or the Superintendent of Schools. All approvals should come through the PM.
5. Any meeting between the A/E and the General Contractor where cost, schedule, process or alternative solutions are discussed, the entity facilitating the meetings shall invite the Program Manager. At the Program Manager's option, a written meeting report shall suffice. Where these meeting occure without notification, the entities making the decisions regarding a change shall be wholly responsible for any cost or schedule impact. It is the responsibility of all parties to provide adequate notice of such meeting for the notice to be considered as waiving this responsibility.

C. Coordinate sequence of work to accommodate Owner occupancy as specified in SECTION 01 11 00 - SUMMARY OF WORK.

1.3 MEETINGS

A. In addition to progress meetings specified in SECTION 01 31 19.00 - PROJECT MEETINGS, hold coordination meetings and pre-installation conferences with personnel and subcontractors to ensure coordination of work.

1.4 COORDINATION OF SUBMITTALS

A. Schedule and coordinate submittals specified in SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Coordinate work of various sections having interdependent responsibilities for equipment, such as installing, connecting to and placing in service.

C. Coordinate requests for substitutions to ensure compatibility of space, of operating elements and effect on work of other sections.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified. Reference 01 50 00 - TEMPORARY FACILITIES AND CONTROLS for Architect's project management system.
   1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
   2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
   3. Contractor shall always include a proposed solution along with the RFI.
   4. RFI's submitted to the Contractor by subcontractors, vendors, suppliers, or other parties to the Work shall be reviewed by the Contractor prior to submission to the Architect. If the Architect deems that such RFI requests have not been adequately reviewed by the Contractor, such requests will be returned to the Contractor for further action.
   5. RFI requests are limited to a request for interpretation or clarification of the requirements of the Contract Documents. Interpretations provided by the Architect shall not change the requirements of the Contract or the Contract Documents. If the Contractor determines that the Architect's response to an RFI gives cause for a change in the Contract or the Contract Documents, the Contractor shall promptly, within 5 working days, give written notice to the Architect of request for adjustments. Requests for adjustments to the Contract shall be submitted in a manner consistent with the terms and conditions of the Contract Documents.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Owner name.
   3. Owner's Project number.
   4. Name of Architect.
   5. Architect's Project number.
   6. Date.
   7. Name of Contractor.
   8. RFI number, numbered sequentially.
   9. RFI subject.
   10. Specification Section number and title and related paragraphs, as appropriate.
   11. Drawing number and detail references, as appropriate.
   12. Field dimensions and conditions, as appropriate.
   13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   14. Contractor's signature.
   15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
      a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.

1.6 COORDINATION OF SPACE

A. Coordinate use of project space and sequence of installation of mechanical and electrical work which is indicated diagrammatically on drawings. Follow routings shown for pipes, ducts and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance and for repairs.

B. In finished areas, except as otherwise shown, conceal pipes, ducts and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.

1.7 COORDINATION OF CONTRACT CLOSEOUT

A. Coordinate completion and cleanup of work of separate sections in preparation for substantial completion of portions of work designated for Owner partial occupancy.

B. After Owner occupancy of premises, coordinate access to site by various sections for correction of defective work and work not in accordance with contract documents, to minimize disruption of Owner's activities.

C. Assemble and coordinate closeout submittals specified in SECTION 01 77 00.00 - CLOSEOUT PROCEDURES.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 31 19.00

PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Scheduling and administration of progress meetings.
2. Pre-installation conferences.

B. Related Requirements:
1. Section 01 31 00 - PROJECT MANAGEMENT AND COORDINATION.
2. Section 01 31 19.13 - PRECONSTRUCTION MEETINGS: Owner's preconstruction conference and pre-mobilization conference.
3. Section 01 32 16 - CONSTRUCTION PROGRESS SCHEDULES.
4. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
5. Section 01 45 00 - QUALITY CONTROL.
6. Section 01 78 23 - OPERATION AND MAINTENANCE DATA
7. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

1.2 PROGRESS MEETINGS

A. The Contractor will schedule monthly construction progress meetings, throughout progress of work. They will prepare agenda and distribute notice of each meeting to participants

B. Contractor shall make physical arrangements.

C. Contractor will preside at meetings and issue meeting minutes.

D. Location of Meetings: Contractor's field office**.**

E. Attendance: Contractor, job superintendent, and Architect. Owner and professional consultants will attend as appropriate. Subcontractors and suppliers shall attend as Architect or Contractor sees necessary to agenda.

F. Anticipated Agenda:
1. Review of any outstanding old business from prior meeting minutes.
2. Review of Contractor's updated Construction Schedule, including minimum two-week look ahead schedule.
3. Review of work in-progress.
4. Field observations and decisions.
5. Status of correction of deficient items.
6. Review of outstanding RFI’s.
7. Identification of problems which impede planned progress.
8. Review of submittal schedule and status of submittals, including pending submittals and resubmittals.
9. Review of off-site fabrication and delivery schedules.
10. Corrective measures to regain projected schedules if project is behind schedule.
11. Review of quality and work standards.
12. Review of Proposal Request and Change Proposal Logs, including any known pending changes.
13. Effect of proposed changes on progress schedule and coordination.
14. Review of Contractor’s updates to Project Record Documents.
15. Review and signing of formal Application for Payment, as applicable.
16. For Construction Manager projects, discuss variances between actual and estimated GMP costs.
17. Other business relating to work.

1.3 PRE-INSTALLATION CONFERENCES

A. When required in individual specification section, convene a pre-installation conference at work site prior to commencing work of the section.

B. Require attendance of entities directly affecting, or affected by, work of the section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda, preside at conference, record minutes and distribute copies within two days after conference to participants.

E. Review conditions of installation, preparation and installation procedures and coordination with related work.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 31 19.13

PRECONSTRUCTION MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Contractor participation in preconstruction meetings.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK: Administrative provisions.
2. Section 01 31 00 - PROJECT MANAGEMENT AND COORDINATION:
3. Section 01 31 19.00 - PROJECT MEETINGS.

1.2 PRECONSTRUCTION MEETING

A. Architect will schedule meeting within 15 days after notice of award.

B. Attendance: Owner, Architect, Contractor and representatives of major subcontractors.

C. Agenda
1. Submittal of executed bonds and insurance certificates.
2. Execution of Owner-Contractor Agreement.
3. Distribution of Contract Documents.
4. Submittal of list of subcontractors, list of products, schedule of values and progress schedule.
5. Designation of responsible personnel.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal requests, change orders, allowances and Contract closeout procedures.
7. Scheduling.
8. Use of premises by Owner and Contractor.
9. Owner's requirements and occupancy.
10. Temporary facilities.
11. Survey and building layout.
12. Security and housekeeping procedures.
13. Procedures for testing.
14. Procedures for maintaining record documents.
15. Requirements for startup of equipment.
16. Accessibility Issues.
17. Inspection and acceptance of equipment put into service during construction period.
18. Notice to proceed.
19. Color samples.
20. Procedures for site meetings.
21. Site access and security.
22. Procedures and processing of TEA “Certification of Project Compliance” form.
23. Substantial and final project completion procedures.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Procedures for preparation and submittal of digital construction progress schedules and periodical updating.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK: Work sequence.
2. Section 01 29 00 - PAYMENT PROCEDURES: Schedule of Values.
3. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.2 SUBMITTALS

A. Within 21 days of the contract date, Contractor shall prepare and submit a digital Critical Path construction schedule for the work. After review, resubmit required revised data within 5 days.

B. Submit revised digital Critical Path Construction Schedule monthly with each Application for Payment.

C. Submit under transmittal letter specified in SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 WORK SCHEDULE FORMAT

A. The schedule shall not exceed time limits current under the Contract Documents and shall be subject to the approval of the Architect. The Contractor shall prosecute the work vigorously and make every effort to start and complete each phase of the work on or before the dates stated.

B. Should actual construction of project vary from the Critical Path schedule, Contractor shall take whatever actions are necessary to improve progress as quickly as possible in order to meet pre-determined milestones. Revise and re-submit schedule not less than every 30 calendar days. Presentation of the existing or updated Critical Path schedule, in three copies, along with the Certificate of Payment Request shall be a prerequisite to the monthly review of the payment request by the Architect's representative.

C. Sequence of Listings: The chronological order of the start of each item of work.

D. Scale and Spacing: To provide space for notations and revisions.

E. Sheet Size: Minimum 11" x 17".

1.4 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by major specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Provide sub-schedules for each stage of work identified in SECTION 01 11 00 - SUMMARY OF WORK.

E. Provide sub-schedules to define critical portions of entire schedule.

F. Show accumulated percentage of completion of each item, and total percentage of work completed, as of the first day of each month.

G. Provide separate schedule of submittal dates for shop drawings, product data and samples, including Owner furnished products and products specified under Allowances, and dates reviewed submittals will be required from Architect. Show decision dates for selection of finishes.

H. Show delivery dates for Owner furnished products and products specified under Allowances.

I. Coordinate content with SECTION 01 29 00 - PAYMENT PROCEDURES, Schedule of Values.

1.5 REVISIONS TO SCHEDULES

A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.

B. Identify activities modified since previous submittal, major changes in scope and other identifiable changes.

C. Provide narrative report to define problem areas, anticipated delays and impact on Schedule. Report corrective action taken, or proposed and its effect.

1.6 DISTRIBUTION

A. Distribute copies of reviewed schedules to job site file, subcontractors, suppliers and other concerned entities.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Digital submission of shop drawings.

B. Related Requirements:
1. General Conditions of the Contract for Construction: Definitions and basic responsibilities of entities.
2. Section 01 31 00 - PROJECT MANAGEMENT AND COORDINATION: Coordination of submittals.
3. Section 01 32 16 - CONSTRUCTION PROGRESS SCHEDULES: Schedules for submittals.
4. Section 01 45 00 - QUALITY CONTROL: Mockups and samples for testing.
5. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Project management software.
6. Section 01 62 00 - PRODUCT OPTIONS.
7. Section 01 78 23 - OPERATION AND MAINTENANCE DATA.
8. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

1.2 GENERAL

A. Refer to General Conditions, Paragraph 3.1 (Shop Drawings, Product Data and Samples - A201 or A201/CMA).

B. Digital Submittals: Submit to the Architect shop drawings, product data, and samples required by specification sections. Do not submit illegible fax copies nor carbon copies of shop drawings and product data.
1. Submit using the Architect’s Autodesk Construction Cloud (ACC) project management program. Prepare submittals as .pdf files, with a single file for each submittal, and upload to the Architect’s project management program. Enter required data in program to fully identify submittal in accordance with the required submittal numbering format.

C. Within 30 days of the contract date Contractor shall prepare and submit with the Schedule of Values a comprehensive schedule of shop drawings, product data and samples. This schedule shall include products which are proposed for substitution. Also include the estimated date of each submittal and anticipated date of submittal return. Allow the Architect reasonable time to review submittals.
1. The schedule shall be submitted as an action submittal using the “Submittal” feature in the Architect’s Autodesk Construction Cloud (ACC) project management program.

D. Prepare schedule on basis of each specification section.

E. For products specified under reference standards, include with listing of each product:
1. Name and address of manufacturer.
2. Trade name.
3. Model or catalog designation.
4. Manufacturer's data, including performance and test data, reference standards.

F. School district submittal reviews is intended to be limited to case-by-case situations except that Food Service, Door Hardware, Technology will participate. Other areas may be included on case by case basis. (To the Architect - Please ask regarding need for district review as these items are submitted and note timelines may vary for Ownewr review.)

G. Some items which may be considered:
1. Any Food Service Equipment.
2. Technology items such as Camera placement layouts, wiring diagrams. most equipment, security and other items which may arise.

H. AHJ Required Approvals:

1. Within 90 days of permit approval, City of Tomball Building department requires stamped and licensed shop drawings for review and approval before construction begins on following items.
   a. Pre-Engineered Metal Building.
   b. Pre-Fabricated Press Box, Platform & Steps and required structural support.

1.3 SHOP DRAWINGS

A. Prepared by a qualified detailer. Prepare project-specific information, drawn accurately to scale. Do not base shop drawings on reproductions of the contract documents or standard printed data. Include supplier's / detailer's / manufacturer's title block.

B. Identify details by reference to sheet and detail numbers shown on Contract Documents.

C. Present in a clear and thorough manner original drawings which illustrate the portion of the work showing fabrication, layout, setting, or erection details, prepared by a qualified detailer. Title each drawing with Project and Contract name and number; identify each element of drawings by reference to sheet number and detail, schedule, or room number of Contract Documents.

1.4 PRODUCT DATA

A. Manufacturer's standard schematic drawings and diagrams:
   1. Modify drawings to delete information which is not applicable to the work.
   2. Supplement standard information to provide additional information specifically applicable to the work.

B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
   1. Clearly mark each copy to identify pertinent materials, products or models.
   2. Show dimensions and clearances required.
   3. Show performance characteristics and capacities.
   4. Show wiring or piping diagrams and controls.

C. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to specification section and Article number. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

1.5 SAMPLES

A. Office samples shall be of sufficient size and quantity to clearly illustrate:
   1. Functional characteristics of product or material, with integrally related parts and attachment devices.
   2. Full range of color samples.

B. Color Selections & Samples: Provide two (2) samples for the Architect's review and record. Provide cut sheet when applicable.
   1. Samples for Initial Selection: Submit one (1) full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected. In addition to the physical samples required above, submit a .pdf file of photographs of the actual color samples and identifying labels.
   2. Samples for Verification: Submit two (2) full-size units or Sample of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection. In addition to the physical samples required above, submit a .pdf file of photographs of the actual color samples and identifying labels. Architect will retain physical samples.

a. After Color Board has been delivered to the project site, submit one (1) sample for verification in lieu of two (2). One will be retained by Contractor for mounting on Color Board after approval by Architect.

C. Field Samples and Mock-ups:
1. Erect at project site at location acceptable to Architect.
2. Construct each sample or mock-up complete, including work of all trades required in finish work.
3. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

D. Digital Samples: In addition to the physical Office Samples and Field Samples/Mock-ups, submit a .pdf file of photographs of the actual samples/mock-ups using the “Submittal” feature in the Architect’s Autodesk Construction Cloud (ACC) project management program.

E. Submit full range of manufacturer's standard finishes except when more restrictive requirements are specified, indicating colors, textures and patterns, for Architect selection.

F. Submit samples to illustrate functional characteristics of products, including parts and attachments.

G. Approved samples which may be used in the work are indicated in the specification section.

H. Label each sample with identification required for transmittal letter.

1.6 CONTRACTOR REVIEW

A. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, quantities and details, manufacturer's catalog numbers and conformance of submittal with requirements of Contract Documents.

B. Coordinate submittals with requirements of work and of Contract Documents.

C. Sign or initial in a rubber-stamped review block format, each sheet of shop drawings and product data and each sample label to certify compliance with requirements of Contract Documents. Notify Architect in writing at time of submittal, of any deviations from requirements of Contract Documents.

D. Do not fabricate products or begin work which requires submittals until return of submittal with Architect acceptance.

E. Contractor's responsibility for errors and omissions in submittals is not relieved by Architect's review of submittals.

F. Contractor's responsibility for deviations in submittals from requirements of contract documents is not relieved by Architect's review of submittals, unless Architect gives specific written acceptance of deviations. Architect will review submittals for general conformance to design intent only.

1.7 SUBMISSION REQUIREMENTS

A. Submit Shop Drawings and Product Data as soon as practicable after award of contract but not later than 30 calendar days before dates reviewed submittals will be needed.

B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 10 working days for review of each resubmittal.

C. Submit all office samples as soon as practicable but not later than 60 days after award of contract in order to facilitate color selections and coordination of the various materials. Final color selections and release of shop drawings contingent upon color selection will not be made until all office samples have been submitted, coordinated and approved.
   1. Color Board shall be delivered to the project site after 60 days. Contractor is responsible for updating color board with samples submitted by Contractor and approved by Architect after 60 days.

D. Digital Submittals: Submit to the Architect, or applicable consultant, shop drawings, product data, and samples required by specification sections. Do not submit illegible fax copies nor carbon copies of shop drawings and product data.
   1. The submittals shall be logged in by the General Contractor and tracked using the “Submittal” feature in the Architect’s Autodesk Construction Cloud (ACC) project management program. All submittals shall be submitted in .pdf format.
      a. Submittals 8-1/2" x 11" and/or 11" x 17" and greater than 50 pages: Provide digital copy for the Architect’s records.
      b. Large Format Drawings (larger than 11 x 17): Provide digital copy for the Architect’s records.
   2. Architect will indicate, via markup on each digital submittal, the appropriate action, then return submittal via the Architect’s Autodesk Construction Cloud (ACC) project management program.
   3. Submittals to be reviewed by consultants shall be submitted to the Architect via Architect’s Autodesk Construction Cloud (ACC) project management program with a copy simultaneously sent to the applicable consultant. Submittals will be reviewed by the consultant and then delivered/transmitted to the Architect via (ACC) for his review prior to transmitting them to the contractor. Submittals to be reviewed by the testing lab shall be handled in the same manner.
   4. Color Selections & Samples: Reference “Samples” Article within this specification section.
   5. Submit digital copies of shop drawings to both the Program Manager and the Architect for review. Direct transmittal by the Contractor to the consultant will not be permitted. Submittals will be reviewed by the consultant and then delivered to the Architect for his review prior to returning them to the contractor.

E. Contractor is responsible for the costs associated with the digital delivery of all submittals, and hard copy where required, to the Architect and the Architect's consultants and retrieval of all submittals from the Architect, when necessary.

F. Accompany submittals with transmittal letter containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. Identification of specification section and submittal numbers.
   5. The number of each shop drawing, product data and sample submitted.
   6. Notification of deviations from contract documents.
   7. Other pertinent data.

G. Submittals shall include:
   1. Date and revision dates.
   2. Project title and number.
   3. Names of Architect, Contractor, subcontractor, supplier and manufacturer.
   4. Identification of product or material and specification section number.
   5. Relation to adjacent structure, materials or other critical features.
   6. Field dimensions, clearly identified as such.
   7. Applicable reference standards.
   8. A blank space 3" x 4" for Architect's stamp.
   9. Identification of deviations from contract documents.
   10. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements, compliance with contract documents and coordination with requirements of the work. Note: Absence of the Contractor's stamp shall constitute grounds for rejection of the submittal until such time as the submittal has been processed in accordance with this requirement.
   11. Other pertinent data required by specifications.

1.8 RE-SUBMISSION REQUIREMENTS

A. Re-submission: For shop drawings and product data not approved by Architect, make corrections and changes in submittals required by Architect and re-submit until approved.

1. The digital re-submission shall be logged in using the “Create New Revision” feature in the Architect’s Autodesk Construction Cloud (ACC) project management program.

B. Shop Drawings:
   1. Revise initial drawings and re-submit as specified for initial submittal.
   2. Indicate on drawings any changes which have been made, other than those requested by Architect.

C. Product Data and Samples: Submit new data and samples as specified for initial submittal

1.9 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Distribute reviewed submittal of shop drawings and product data which carry Architect's stamp as follows: Contractor's file, project site file, record documents file, other prime contractors.

B. Keep and maintain a full set of submittals throughout the construction phase to be submitted to the Architect with other Close-out documents for delivery to the Owner for his permanent record. Set of submittals shall be delivered to the Architect in cardboard file boxes with string and button type closures. Organize submittals by CSI divisions, utilizing neatly labeled pressboard dividers to separate the sections. Neatly label short end of box with project name, contents and duration of construction.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED

END OF SECTION

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SECTION 01 35 00

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. General: The procedures and administrative requirements of this section apply to all of the sections of the specification which are involved in alterations to the existing building.
2. Extent Notes: Cut into or partially remove portions of the existing buildings as necessary to make way for new construction. Include such work as:
a. Cutting, moving, or removal of items shown to be cut, moved, or removed.
b. Cutting, moving, or removal of items not shown to be cut, moved, or removed, but which must be cut, moved, or removed to allow the new work to proceed. Work or items which are to remain in the finished work shall be patched or reinstalled after their cutting, moving, or removal, and their joints and finishes made to match adjacent or similar work.
c. Removal of existing surface finishes as needed to install new work or finishes.
d. Removal of abandoned items and removal of items serving no useful purpose, such as abandoned piping.
e. Repair or removal of dangerous or unsanitary conditions resulting from alterations work.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK; Sequence of construction and instructions concerning asbestos.
2. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.
3. Section 01 73 29 - CUTTING AND PATCHING.
4. Section 01 74 13 - CLEANING.
5. Section 02 41 19 - SELECTIVE STRUCTURE DEMOLITION.

1.2 SCHEDULING AND ACCESS

A. Maintenance of Access and Operations: During period of construction, do not obstruct in any manner existing exit ways of Owner-occupied areas. Prior to removal of existing exit ways (stairs, corridors, doors) as part of new work, provide and maintain new exit ways so as to maintain same number of exit ways. Maintain existing fire doors in an operable condition.

B. Maintenance of Existing Services:
1. Maintain environmental control in existing buildings, especially temperature, humidity and dust control.
2. Provide temporary lines and connections as required to maintain existing mechanical and electrical services in buildings.
3. Notify Owner a minimum of seven days prior to each required interruption of mechanical or electrical services in buildings. Such interruptions shall be only at such times and for lengths of time as approved by the Owner. In no event shall interruption occur without prior approval of the Owner.

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING EXTENDING WORK

A. New Materials: As specified in individual sections.

B. Match existing products and work for patching and extending work.

C. Determine type and quality of existing products by inspection and any necessary testing, and workmanship by use of existing as a standard. Presence of a product, finish, or type of work, requires that patching, extending, or matching shall be performed as necessary to make work complete and consistent with existing quality or specifications if more stringent.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that demolition is complete, and areas are ready for installation of new work.

B. Beginning of restoration work means acceptance of existing conditions.

3.2 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovations work; replace and restore at completion.

B. Remove unsuitable material not marked for salvage, such as rotted wood, rusted materials, and deteriorated masonry and concrete; replace materials as specified for finished work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Prepare surfaces and remove surface finishes to provide for proper installation of new work and new finishes.

E. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.3 INSTALLATION

A. Coordinate work of alterations and renovations to expedite completion.

B. Project shall be complete.

C. Remove, cut, and patch work in a manner to minimize damage and to provide means of restoring products and finishes to specified condition.

D. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent new finishes.

E. Install products as specified in individual sections.

3.4 ALTERATIONS, CUTTING, AND PROTECTION

A. Extent:
   1. Cutting and removal work shall be performed so as not to cut or remove more than is necessary and so as not to damage adjacent work.
   2. Conduct work in such a manner as to minimize noise and to minimize accumulation and spread of dirt and dust.
   3. Perform cutting for ductwork and other rectangular openings with carborundum saw with approved dust arrestor.
   4. Drill holes for conduit and piping using core drills.

B. Shoring, Bracing, and Capping: Provide shores, needling and bracing as needed to keep buildings structurally secure and free of deflection in all its parts, and as needed for installation of new structural members.

C. Responsibility and Assignment to Trades:
   1. Contractor shall assign the work of moving, removal, cutting, patching and repair to trades under his supervision so as to cause the least damage to each type of work encountered, and so as to return the buildings as much as possible to the appearance of new work.
   2. Patching of finish materials shall be assigned to mechanics skilled in the work of the finish trade involved.

D. Protection:

1. Protect remaining finishes, equipment, and adjacent work from damage caused by cutting, moving, removal and patching operations. Protect surfaces which will remain a part of the finished work.
2. Protect existing facilities and features, within designated construction limits and along corridor access route to construction area.
3. Cover existing wall and floor finishes in work areas, in adjacent areas, and along corridor access route to prevent damage from product delivery and construction operations. Use reinforced sheeting, listed by Underwriters' Laboratories, Inc., as having a flame spread rating of less than 25 and smoke developed rating of less than 50. Apply double thickness of sheeting, fastened to one side with no-tear fasteners. Tape joints continuously.
4. During demolition, cutting and construction, provide positive dust control by wetting dust debris and by completely sealing openings to Owner-occupied areas with temporary partitions, so as to prevent spread of dust and dirt to adjacent areas.
5. After materials, equipment and machinery are installed, properly protect work until final acceptance.
6. Damage resulting from construction operations shall be repaired by the Contractor without cost to the Owner.
7. During non-working hours, provide continuous security at openings cut into existing exterior walls and roofs.

E. Debris:
1. Remove debris promptly from the site each day. Removed material, except that listed or marked by the Architect for retention, becomes property of the Contractor. Load removed material directly on trucks for removal from site. Do not allow debris to enter sewers.
2. Do not let piled material endanger structure.
3. During cutting and coring operations, use metal lined wood box secured tight against surface, to catch falling debris and water.

3.5 PATCHING, EXTENDING, AND MATCHING

A. Skill: Patch and extend existing work using skilled mechanics who are capable of matching the existing quality of workmanship. The quality of patched or extended work shall not be less than that specified in the sections of the product and execution specifications which follow these general requirements.

B. Patching:
1. In areas where any portion of an existing finishing surface is damaged, lifted, stained, or otherwise made or found to be imperfect, patch or replace the imperfect portion of the surface with matching material.
2. Provide adequate support or substrate for patching of finishes.
3. If the imperfect surface was a painted or coated one, re-paint or re-coat the patched portion in such a way that uniform color and texture over the entire surface results.
4. If the surrounding surface cannot be matched, re-paint or re-coat the entire surface.

C. Quality:
1. In the sections of the product and execution of specifications which follow these general requirements, no concerted attempt has been made to describe each of the various existing products that must be used to patch, match, extend or replace existing work. Obtain such products in time to complete the work on schedule. Such products shall be provided in quality which is in no way inferior to the existing products.
2. The quality of the products that exist in the buildings, as apparent during pre-bid site visits, shall serve as the specification requirement for strength, appearance, and other characteristics.

D. Transitions:
1. Where new work abuts or finishes flush with existing work, make the transition as smooth and workmanlike as possible. Patched work shall match existing adjacent work in texture and appearance so as to make the patch or transition invisible to the eye.
2. Where masonry, or other finished surface is cut in such a way that a smooth transition with new work is not possible, terminate the existing surface in a neat fashion along a straight line at a natural line of division and provide trim appropriate to the finished surface.
3. Where two or more spaces are indicated to become one space, rework floors and ceilings so that horizontal planes, without breaks, steps or bulkheads result.
4. In cases of extreme change of level (3" or more), obtain instructions from Architect as to method of making transition. Either stepping, bulkheading, encasement, ramping, sloping or change of transition line shall be employed, or a combination of these, as directed in each case by the Architect.

E. Matching:
   1. Restore existing work that is damaged during construction to a condition equal to its condition at the time of the start of the work.
   2. At locations in existing areas where partitions are removed, patch the floors, walls, and ceilings with finish materials to match adjacent finishes.
   3. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.6 REPAIR

A. Replace work damaged in the course of alterations, except at areas approved by the Architect for repair.

B. Where full removal of extensive amounts of almost-suitable work would be needed to replace damaged portions, then filling, spackling, straightening, and similar repair techniques, followed by full painting or other finishing, will be permitted.

C. If the repaired work is not brought up to the standard for new work, the Architect will direct that it be cut out and replaced with new work.

3.7 FIRESTOPPING

A. Where existing partitions or walls are penetrated by new work, seal around penetrating conduit or sleeve with approved and listed safing.

3.8 CLEANING

A. In addition to cleaning specified in SECTION 01 74 13 - CLEANING, clean Owner-occupied areas of work daily.

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 CODES

A. Where references are made on drawings or specifications to codes, they shall be considered an integral part of the contract documents as minimum standards. Nothing contained in the contract documents shall be so construed as to be in conflict with any law, bylaw or regulation of the municipal, state, federal or other authorities having jurisdiction.

B. Perform work in compliance with all City of Tomball ordinances and requirements.

1.2 GOVERNING LAWS

A. Additional information with legal implications regarding applicable governing laws and jurisdictions can be found in the conditions of the contract.

1.3 PERMITTING

A. Architect shall notify Contractor that the Contractor may make and submit the applications for the building permit. The Owner shall pay the municipality directly for the building permit and all other development “impact” fees, if any. The Contractor shall continue to be responsible for payment of other permits, governmental fees, licenses, and inspections necessary for proper execution of the Contract and which are legally required when bids or proposals are received. Such fees and expenses shall only be reimbursable to Contractor if expressly agreed to in the General Conditions. The Contractor shall be responsible for complying with any federal, state, county and municipal laws, codes and regulations applicable to the performance of the work, including, but not limited to, any laws or regulations requiring the use of licensed contractors to perform parts of the work.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the contract documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the contract documents to the extent referenced. Such standards are made a part of the contract documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the contract documents.

C. Copies of Standards: Each entity engaged in construction on project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the contract documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in specifications or other contract documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the contract documents.

ADAAG	Americans with Disabilities Act (ADA) Accessibility Guidlines for Buildings and Facilities Available from Access Board www.access-board.gov	800.872.2253 202.272.0080
CRD	Handbook for Concrete and Cement Available from Army Corps of Engineers Waterway Experiment Station http://www.erdc.usace.army.mil/	601.634.2355
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point www.dodssp.daps.dla.mil	215.697.6257
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point www.dodssp.daps.dla.mil	215.697.6257
	Available from General Services Administration www.gsa.gov	202.501.1021
	Available from National Institute of Building Sciences www.nibs.org	202.289.7800
ICC-ES	ICC Evaluation Services, Inc. www.icc-es.org	800.423.6587 562.699.0543
MIL	See MILSPEC	

MIL-STD	See MILSPEC	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point www.dodssp.daps.dla.mil	215.697.6257
TAS	Texas Accessibility Standards P.O. Box 12157 Austin, TX 78711 www.license.state.tx.us/ab/abtas.htm	512.463.3211

1.2 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in specifications or other contract documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the contract documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	703.358.2960
AAMA	American Architectural Manufacturers Association www.aamanet.org	847.303.5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	202.624.5800
ACI	ACI International (American Concrete Institute) www.aci-int.org (www.concrete.org)	248.848.3700
AGA	American Gas Association www.aga.org	202.824.7000
AISC	American Institute of Steel Construction www.aisc.org	800.644.2400 312.670.2400
AISI	American Iron and Steel Institute www.steel.org	202.452.7100
ANSI	American National Standards Institute www.ansi.org	202.293.8020
APA	APA-The Engineered Wood Association www.apawood.org	253.565.6600
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers www.ashrae.org	404.636.8400
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	610.832.9585
AWI	Architectural Woodwork Institute www.awinet.org	571.323.3636

AWPA	American Wood Protection Association www.awpa.com	205.733.4077
AWS	American Welding Society www.aws.org	800.443.9353 305.443.9353
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	212.297.2122
BIA	Brick Industry Association (The) www.gobrick.com	703.620.0010
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	630.584.1919
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	301.596.2583
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	847.517.1200
DHI	Door and Hardware Institute www.dhi.org	703.222.2010
FM	Factory Mutual System (See FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	401.275.3000
GA	Gypsum Association www.gypsum.org	301.277.8686
GANA	Glass Association of North America www.glasswebsite.com	785.271.0208
HMMA	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	703.435.2900
IGCC	Insulating Glass Certification Council www.igcc.org	315.646.2234
IGMA	Insulating Glass Manufacturers Alliance (The) www.igmaonline.org	613.233.1510
MBMA	Metal Building Manufacturers Association www.mbma.com	216.241.7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	888.480.9138

MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	312.644.6610
MIA	Marble Institute of America www.marble-institute.com	440.250.9222
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	630.942.6591
NCMA	National Concrete Masonry Association www.ncma.org	703.713.1900
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	207.829.6901
NEMA	National Electrical Manufacturers Association www.nema.org	703.841.3200
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	800.344-3555 617.770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	301.589.1776
NHLA	National Hardwood Lumber Association www.nhla.com	800.933.0318 901.377.1818
NLGA	National Lumber Grades Authority www.nlga.org	604.524.2393
NOFMA	National Oak Flooring Manufacturers Association (The Wood Flooring Manufacturers Association) www.nofma.org	901.526.5016
NRCA	National Roofing Contractors Association www.nrca.net	800.323.9545 847.299.9070
NTMA	National Terrazzo & Mosaic Association, Inc. www.ntma.com	800.323.9736 540.751.0930
NWWDA	National Wood Window and Door Association (See WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	312.786.0300
PDCA	Painting and Decorating Contractors of America www.pdca.org	800.332.7322 314.514.7322
SDI	Steel Deck Institute www.sdi.org	847.458.4647
SDI	Steel Door Institute www.steeldoor.org	440.899.0010

SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	516.294.5424
SGCC	Safety Glazing Certification Council www.sgcc.org	315.646.2234
SIGMA	Sealed Insulating Glass Manufacturers Association (See IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	843.626.1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	703.803.2980
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	850.434.2611
TCNA	Tile Council of America, Inc. www.tileusa.com	864.646.8453
TPI	Truss Plate Institute, Inc. www.tpinst.org	703.683.1010
UL	Underwriters Laboratories Inc. www.ul.com	800.285.4476 847.272.8800
USGBC	U.S. Green Building Council www.usgbc.org	800.795.1747 202.828.7422
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	800.283.1486 503.639.0651
WDMA	Window & Door Manufacturers Association (Formerly: NWWA - National Wood Window and Door Association) www.wdma.com	800.223.2301 312.321.6802
WI	Woodwork Institute www.woodworkinstitute.com	916.372.9943
WWPA	Western Wood Products Association www.wwpa.org	503.224.3930

B. Code Agencies: Where abbreviations and acronyms are used in specifications or other contract documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the contract documents.

BOCA	BOCA International, Inc. (See ICC)
CABO	Council of American Building Officials (See ICC)

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	909.472.4100
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	888.422.7233 703.931.4533
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

C. Federal Government Agencies: Where abbreviations and acronyms are used in specifications or other contract documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the contract documents.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	800.638.2772 301.504.6816
EPA	Environmental Protection Agency www.epa.gov	202.272.0167
OSHA	Occupational Safety & Health Administration www.osha.gov	800.321.6742 202.693.1999

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 42 16

DEFINITIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. “Furnish": Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.

B. "Install": Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

C. "Product": Materials, systems and equipment.

D. “Project Manual”: Volume assembled for the Work which may include the bidding requirements, sample forms, conditions of the contract, and specifications.

E. "Provide": Furnish and install, complete and ready for the intended use.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Quality control of products and workmanship.
2. Contractor's construction-related professional design services.
3. Contractor's design-related professional design services.
4. Manufacturer's instructions.
5. Manufacturer's certificates and field services.
6. Mockups.

B. Related Requirements:
1. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Field samples. Submittal of manufacturer's instructions.
2. Section 01 42 00 - REFERENCES.
3. Section 01 45 23 - TESTING AND INSPECTION SERVICES.
4. Section 01 62 00 - PRODUCT OPTIONS.
5. Individual Specifications Sections: Mockups required.
6. Individual Specification Sections: Contractor's professional design services required.

1.2 GENERAL

A. The Architect and Contractor are responsible for managing and maintaining quality for the duration of the project at all phases. During Design the Architect shall manage their own quality over their work and provide design and specification a level of quality meeting or exceeding industry standard or as required by the district. The Architect shall be responsible for notifing all parties of any variances or deficiencies.

B. In all cases manufacturer's installation and handling of their product shall be adhered to.

C. The contractor shall provide qualifications of all subcontractors within 45 days of Notice to Proceed. The contractor shall only utilize subcontractors/installers who are qualified by the manufacturer of the equipment. Where a subcontractor cannot provide such clarification, the district may elect to deny those subcontractors from performing the work. Any change in price shall be upon the contractor.

D. The contractor shall provide notification to the district at least 48 hours in advance of any walk-through events, utility shutdowns or interruptions or in a renovation on an active campus, prior to entry for purposes of performing work.

E. At a minimum, the following walk-through events, the district is to be notified 48 hours in advance for inclusion into the event, i.e.. Electrical, Plumbing, Mechanical Systems, Technology, etc. (Notifications shall be in writing).
1. Below grade rough-in:
a. Electrical mains, all under slab distribution.
b. Plumbing mains and in ground valves.
2. Above grade rough-in:
a. Main distribution of all utilities.
b. In wall piping and wiring of all utilities.
c. Built rack supports.
d. Prior to wall close up.
e. Prior to ceiling close up.
f. Prior to any remaining concealed space cover up.

F. Minimum pre-installation conference with subcontractors. The A/E shall establish and identify which subcontractors require this conference and coordinate with the General Contractor.

1. All major disciplines:
   a. Mechanical.
   b. Electrical.
   c. Plumbing.
   d. Technology.
   e. Instructional Technology.

G. If the project is in an Authority/Agency Having Jurisdiction (AHJ), a third party code/plan review will be made and field inspections completed as part of the process. It is the A/E's responsibilty to follow through on all submissions. Standards for inspections by third party inspectors shall be established during the Pre-Construction meeting. The third party review service shall be provided by the district.

H. Mock-Up:
   1. The district will be involved in approvals of all aesthetic mockups. All mockups shall be completed prior to ordering materials.
   2. Allow 48 hours notice for the district approval of all A/E/Consultant specified mockups including one classroom and one wet lab mockup full rough-in of all wall devices and blocking for review prior to proceeding with the remainder of the work.

1.3 DESCRIPTION

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, workmanship, and site conditions, to produce work in accordance with contract documents.

1.4 DEFINITIONS

A. Contractor’s Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Submit signed and sealed drawings, calculations, specifications, certifications, shop drawings, and other submittals required by individual specification sections. Prepare such deliverables directly by, or under direct supervision of, appropriate licensed design professional in the state the project is located.

B. Design Service Types Required:
   1. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
   2. Design-Related: Design services explicitly required to be performed by another design professional due to highly technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design intent of the project.

1.5 WORKMANSHIP

A. Comply with industry standards of the region except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Provide suitably qualified personnel to produce work of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

D. Provide finishes to match approved samples.

1.6 CONTRACTOR’S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Contractor’s professional design services are subject to requirements of project’s Conditions for Construction Contract.

B. Provide such engineering services as may be necessary to plan and safely conduct construction operations and execute portions of the work. Such engineering services may pertain to, but may not be limited to, temporary construction of sheeting, shoring, supports, scaffolding, bracing, falsework, temporary or permanent foundation underpinning, stairs, steps, rigging, and hoisting.

1.7 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections. Submit a Request for Information (RFI) to Architect if the criteria indicated are not sufficient to perform required design services.

C. Refer to individual specification sections regarding the required scope of Contractor's design-related professional design services.

1.8 MANUFACTURER'S INSTRUCTIONS

A. Require compliance with instructions in full detail, including each step in sequence.

B. Should instruction conflict with contract documents, request clarification from Architect/Engineer before proceeding.

1.9 MANUFACTURER'S CERTIFICATES

A. When required in individual Specifications section, submit manufacturer's certificate, in duplicate, certifying that products meet or exceed specified requirements, executed by responsible officer.

1.10 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specifications section, have manufacturer or his authorized representative provide qualified representative to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment test, adjust, and balance of equipment as applicable, and to make written report of observations and recommendations to Architect.

B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within 30 days of observation to Architect/Engineer for review.

1.11 MOCKUPS

A. Tests will be performed under provisions of SECTION 01 45 23 - TESTING AND INSPECTION SERVICES

B. Assemble and erect complete, with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Acceptable mockups in place may be retained in completed work.

1.12 FIELD SAMPLES

A. Install field samples at the site as required by individual specification sections for review.

B. Acceptable samples represent a quality level for the work.

C. Where field sample is specified in individual sections to be removed, clear area after field sample has been accepted by Architect/Engineer.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 45 23

TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included: Contractor shall employ and pay for the services of an independent testing laboratory acceptable to the Owner, and who has the facilities and capabilities to perform the tests listed in the various sections of the specifications.

B. Related Requirements:
1. Document 00 31 32 - GEOTECHNICAL DATA.
2. Terms and Conditions: Inspections, testing, and approvals required by public authorities.
3. Section 01 45 00 - QUALITY CONTROL : Manufacturer's certificates.
4. Section 01 78 39 - PROJECT RECORD DOCUMENTS.
5. Individual Specifications Sections: Inspections and tests required, and standards for testing.

1.2 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

B. ACI SP-66 - ACI Detailing Manual; 2004.

C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2026a.

D. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2026.

E. ASTM C127 - Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate; 2025.

F. ASTM C128 - Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate; 2025.

G. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2025.

H. ASTM C143/C143M - Standard Test Method for Slump of Concrete; 2026a.

I. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

J. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.

K. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

L. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

M. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

N. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025b.

O. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

P. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems; 2022.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Amendment (2026).

1.3 SELECTION AND PAYMENT

A. Owner will employ services of an independent materials testing laboratory to perform specified inspection and testing and will pay for these services directly to the testing laboratory.

B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of contract documents. Contractor will pay all testing required by local authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Laboratory shall comply with requirements of ASTM E329 and ASTM D3740 and provide certifications to this effect.

B. Laboratory shall maintain a full-time registered Engineer on staff to review specific tests required by this specification.

C. Laboratory shall be authorized to operate in State in which project is located.

D. Testing equipment shall be calibrated to ensure accurate results and values in order to ensure that test results are true and valid, and at intervals with devices of an accuracy traceable to either NBS Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

A. Provide qualified personnel at site after due notice from Contractor; cooperate with Architect, Contractor, and appropriate public authorities having jurisdiction in performance of services.

B. Perform specified inspection, sampling, and testing of products in accordance with latest, up-to-date standards.

C. Ascertain compliance of materials and mixes with requirements of contract documents.

D. Promptly notify Architect, appropriate consultants, Contractor, Owner, and authority having jurisdiction of observed irregularities or non-conformance of work or products.

E. Perform additional inspections and tests required by Architect, Owner, Contractor, or authority having jurisdiction.

1.6 LABORATORY REPORTS

A. Promptly submit written report of each test and inspection; two copies to Architect and one copy each to Owner, Contractor, applicable consultant, and authority having jurisdiction. Each report shall include:
   1. Date issued.
   2. Project title and number.
   3. Testing laboratory name, address and telephone number.
   4. Name and signature of laboratory inspector.
   5. Date and time of sampling or inspection.
   6. Record of temperature and weather conditions.
   7. Date of test.
   8. Identification of product and specification section.
   9. Location of sample or test in the project.
   10. Type of inspection or test.

11. Results of tests and compliance with contract documents.
12. Interpretation of test results, when requested by Architect.

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of contract documents.

B. Laboratory may not approve or accept any portion of the work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop work.

1.8 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.

B. Cooperate with laboratory personnel, and ensure ready access to work and to manufacturer's facilities, if requested by testing lab.

C. Provide incidental labor and facilities for access to work to be tested, to obtain and handle samples at the site, or at source of products to be tested, in order to facilitate tests and inspections, and for storage and curing of test samples.

D. Notify laboratory of material sources and furnish lab-determined necessary quantities of representative samples of materials proposed for use which are required to be tested.

E. Notify Architect and laboratory 24 hours prior to expected time for operations requiring inspection and testing services. Cancel notifications in a timely manner if items or systems are not ready for inspection as intended. Reimburse Owner for trip charges when cancellation notifications are not made in a timely fashion.

F. Advise laboratory in a timely fashion to complete required inspection and testing prior to subsequent work being performed.

G. Reimburse Owner for all subsequent re-testing of products or systems found to be defective or otherwise not in accordance with specification requirements, and for any overtime pay required as a result of any inspection requirements that may fall outside of normal job-site weekday work schedule. Remove rejected products or work and replace with products or work of specified quality.

H. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and testing laboratory when the source of any material is changed after the original tests or inspections have been made.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 EARTHWORK (SITE GENERAL)

A. Make necessary soil tests (Atterberg Limit Series ASTM D4318 and ASTM D698 Standard Proctor) to determine moisture content and density of existing subgrade. Perform necessary soil tests (Atterberg Limit Series and ASTM D698 Standard Proctor for each type of imported fill) to determine the moisture content and to inspect and test the placement of additional fill lifts to verify that all fill materials used are in accordance with the specifications for that use. Perform one field density test (ASTM D6938) per 5,000 sq. ft. of site area in the area affected on each lift prior to placement of additional fill material.

B. Imported Topsoil Tests: Testing for topsoil quality compliance shall be performed by the Testing Laboratory.

3.2 PAVING OR SPECIAL SURFACE SUBGRADE PREPARATION

A. Perform one subgrade in-place density test per 7,500 sq. ft. of subgrade, after subgrade preparation, in accordance with ASTM D6938. Perform tests within 48 hours of pavement construction.

B. Pulverization tests on lime subgrade, TEX101E, Part III, at same frequency as density tests.

3.3 BUILDING SUBGRADE PREPARATION

A. Make necessary soil tests (Atterberg Limit Series and ASTM D698 Standard Proctor for each type of fill) to determine the moisture content and density of existing subgrade and inspect and test the placement of additional fill lifts to verify that all fill materials used are in accordance with the specifications for that use. Perform one field density test (ASTM D6938) for each 5,000 sq.ft. of area within the building footprint on each lift prior to placement of additional fill material.

3.4 FORMWORK, REINFORCING STEEL AND INSERTS

A. Make general inspection of formwork.

B. Prior to each concrete pour, inspect fabrication and bending of bars, bar sizes, spacing, placement and tying in accordance with ACI SP-66.

C. Prior to each concrete pour, inspect positioning of steel inserts and assemblies, sizes, and spacing, and inspect fusion-welded anchors and sheer connectors.

3.5 CAST-IN-PLACE CONCRETE

A. Design Mixes:
1. At the beginning of the work, Contractor shall submit proposed concrete mixes for review by the Architect, structural engineering consultant, and testing laboratory, including the sieve analysis of fine and course aggregate ASTM C136/C136M, dry rodded weight of coarse aggregate - ASTM C 29, and the specific gravity (bulk saturated surface dry), of fine and coarse aggregates ASTM C127 and ASTM C128.
2. The testing laboratory will submit their findings to the structural consultant, who will subsequently forward this information, with their review of the submittals, to the Architect.
3. Contractor shall not mix concrete for placing in the work until confirmation laboratory reports are supplied to reflect that each proposed mix will develop the strength required. Successful past history in accordance with ACI 318 will be satisfactory.

B. Test Cylinders: Make at least one test of each day's pouring of concrete or each 100 cubic yards, whichever is the least, on each different portion or section of the work. Mold and cure specimens in accordance with ASTM C31/C31M, and test in accordance with ASTM C39/C39M. Test cylinders shall be made and tested by the laboratory. Footings, walls, and floor systems constitute different sections. Each test shall consist of four specimens, one of which shall be broken at seven days, two at 28 days and one held in reserve. Determine temperature and air content for each set of test cylinders in accordance with ASTM C 231.

C. Field Quality Control:
1. Determine slump for each concrete strength test and whenever consistency of concrete varies, in accordance with ASTM C143/C143M.
2. Monitor and record addition of water to concrete and length of time concrete is allowed to remain in truck.
3. Verify delivery tickets indicating class of concrete, amount of water added during initial batching, and time initial batching occurred.
4. Monitor work being performed in accordance with ACI (American Concrete Institute) recommendations as a standard of quality.
5. Reference SECTION 03 30 00 - CAST-IN-PLACE CONCRETE for additional requirements.

D. Source Quality Control: An independent testing laboratory representative shall periodically inspect and control concrete mixing and loading of transit mix trucks at batch plant at intervals appropriate to monitor quality of material issued on job.

3.6 STRUCTURAL STEEL

A. Fabrication of, erection of, and connections between, structural steel members, including welding and tension in high strength bolts, will be accomplished under and subject to the inspection of an independent testing agency. The general contractor, structural steel fabricator, and erector shall afford full cooperation to the laboratory.

B. Perform the following testing and inspection: (Prior to placement of steel deck)
1. Check location of condition of anchor bolts.
2. Check plumbness and tolerance of steel frame.
3. Qualification of welders and welding techniques (at Contractor's expense).
4. Visually inspect common bolts.
5. Inspection of high-strength bolting:
   a. Visually inspect connections.
   b. Check tightness of at least 33% of connections.
   c. Check at least two bolts of each girder to column connection.
6. Visually inspect field and shop welds.
7. Ultrasonic or X-ray testing of full penetration welds.
8. Re-inspect corrective measures required at expense of Contractor.
9. Verify that no members are damaged.
10. Verify that materials and installation are according to contract documents and industry standards.

C. Gas Cutting: Do not use gas cutting torches for correcting fabrication errors in the structural framing. Cutting will not be permitted on any member, unless specifically approved by the structural engineer. Finish gas-cut sections equal to a sheared appearance when gas finish cutting is permitted. Do not flame cut holes or enlarge holes by burning.

D. Correction: The fabricator or erector shall correct deficiencies in structural steel work which inspection and test reports have indicated to be not in compliance with the specified requirements. Perform all additional tests required to reconfirm non-compliance of the original work and to show compliance of corrected work. Retesting of non-conforming work shall be paid by the Contractor.

E. All welders employed during erection of structural steel must be certified by The American Welding Society for type of base materials and positions encountered. Certification testing to be performed at Contractor's expense and copies of Certifications shall be submitted for review upon request and maintained at the project site by the Contractor.

3.7 STEEL JOISTS

A. All steel joists and connections to structural steel members shall be inspected.

B. Quality Assurance: All welding performed during the manufacture and erection of steel joists shall comply with the requirements of AWS D1.1/D1.1M.

C. Inspect condition of joists after erection; check method of attachment to structures and details of bridging and accessories to verify compliance with required standards.

3.8 METAL DECK AND FIELD WELDED SHEAR STUDS:

A. The erection of metal deck and field welded shear studs shall be subject to inspection by the testing agency.

B. Shear Studs:
1. Test minimum of two shear studs welded at start of each production period in order to determine generator, control unit and stud welder setting. Studs shall be capable of being bent 45° from vertical without weld failure. If, after welding, visual inspection reveals that sound weld or a full 360° fillet has not been attained for a particular stud, such stud shall be struck with hammer and bent 15° off perpendicular to nearest end of beam. Studs failing under this test shall be replaced.
2. When the temperature is below 32°F., two studs from each group of 100 studs (or one stud if less than 100 studs are present) should be tested after cooling. Studs shall not be welded below 0°F. or when surfaces are wet with rain or snow. If stud fails in weld, two new studs shall pass test before resumption of welding.

3.9 AIR BARRIER

A. **Mock-up Testing: Perform preconstruction testing on field mock-ups. Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.**
   1. **Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.**
   2. **Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.**
   3. **Water Penetration Testing: Mockups will be tested for water penetration according to ASTM E 1105.**
   4. **Adhesion Testing: Mockups will be tested for required air-barrier adhesion to substrate according to ASTM D 4541 (modified).**
      a. **Use a type II pull tester, except that the membrane shall be cut through to separate the material attached to the disc from the surrounding material.**
      b. **Perform test after curing period recommended by the material manufacturer.**
      c. **Record mode of failure and area where the material failed in accordance with ASTM D4541.**
      d. **The inspection report shall indicate whether the specified adhesion requirement has been met.**
   5. **Compatibility Determinations: Mockups will be inspected for visual signs of decay, chemical attack, or degradation of any kind. Suspect instances shall be reported to the corresponding manufacturer who shall provide a letter that approves moving forward with the project or rejects the use of the product or rejects the method or circumstances of installation with an appropriate explanation of the position taken.**
   6. **Notify Architect seven days in advance of the dates and times when mockups will be tested.**
   7. **Perform the air leakage test and water penetration test of mockups prior to installation of cladding and trim but after installation of all fasteners for cladding and trim, and after installation of other penetrating elements**.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Air-barrier dry film thickness.
   3. Continuous structural support of air-barrier system has been provided.
   4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   5. Site conditions for application temperature and dryness of substrates have been maintained.
   6. Maximum exposure time of materials to UV deterioration has not been exceeded.
   7. Surfaces have been primed, if applicable.
   8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   9. Termination mastic has been applied on cut edges.
   10. Strips and transition strips have been firmly adhered to substrate.
   11. Compatible materials have been used.
   12. Transitions at changes in direction and structural support at gaps have been provided.
   13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   14. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:
   1. Qualitative Air-Leakage Testing: Test air barrier assemblies for air leakage according to ASTM E1186, smoke pencil with pressurization or depressurization or ASTM E1186, chamber pressurization or depressurization with smoke tracers.
   2. Quantitative Air-Leakage Testing: Test air barrier assemblies for air leakage according to ASTM E783. 5% of each type of door, strefront and curtainwall, minimum of 1 per type, shall be tested.
   3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

3.10 FIRESTOPPING

A. Penetration Firestopping: Perform testing and inspections according to ASTM E2174.

B. Joint Firestopping: Perform test and inspections according to ASTM E2393.

3.11 SMOKE TEST OF DRAINAGE AND VENT PIPING

A. Test to check for joint leakage in the sanitary sewer system and vent system.

3.12 OTHER WORK REQUIRING TESTS

A. Refer to individual sections covered under Divisions 22, 23, and 26 for other work requiring tests by independent testing laboratory.

END OF SECTION

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 GENERAL

A. Provide temporary facilities and controls needed for the work including, but not limited to those described in the Articles below.

B. Maintain temporary facilities and controls as long as needed for safe and proper completion of the work.

C. When establishing locations of Temporary Facilities, the owner shall have the opportunity to review and assist in final placement of trailers and traffic entry. The Contractor shall provide a layout of what is intended and gain approval before setting and fixed elements or traffic entries.

D. All utilities, power, watewr, gas, data/internet shall be part of the General Conditions and included in the cost of the project. The cost for use and maintaining these services shall be paid in full by the General Contractor and are not reimbursable as a separate line item beyond General Conditions.

1.2 REFERENCE STANDARDS

1.3 ACCESS

A. Provide adequate access to, and temporary roads to, the site of the building if required for the prosecution of the work.

B. Provide and maintain access to fire hydrants, free of obstructions.

1.4 FIELD OFFICE

A. Provide and maintain a weathertight temporary field office equipped with adequate illumination; with glazed operable windows; with smooth tables for perusal of drawings and specifications; and with metal legal size four-drawer filing cabinet. During cold weather the field offices shall be equipped with a heating device to maintain 65°F. temperature during the work day. During hot weather the offices shall be equipped with an air conditioning device to maintain temperature below 80°F. Provide and pay for fuel and electric energy. In addition to the above listed equipment, provide a space to accommodate the site meetings and have a layout/conference table at 28" height and chairs for 12 people. Upon completion of the project, remove offices from the premises.

1.5 TELEPHONES AND ELECTRONIC COMMUNICATION SERVICE

A. Provide telephones/mobile phones in the field office. Telephone shall be in operation from the commencement of work until the acceptance of the building. Contractor shall pay for installation, maintenance, and removal of telephones, lines and for all use charges.

B. Electronic Communication Service: Provide a computer, printer, high-speed data connection, and internet service as required for the Contractor to maintain internet access and e-mail correspondence.
   1. Contractor shall pay for installation, maintenance, and removal of high-speed data connection and for all use charges.
   2. The Architect's project management system is Autodesk Construction Cloud (ACC), which can be accessed by logging in at the following website: https://acc.autodesk.com/ Contractor shall utilize this system for all formal and informal correspondence with the Architect and Architect's Consultants, including E-Mails, Requests for Information, Proposals, Submittals, Submittal Transmittals, Meeting Minutes (for regularly scheduled meetings), and Warranty Responses (if warranty items are submitted in the system). In addition, Subcontractor Lists, Project Schedules, Schedule of Values, Pay Applications and other documents requiring submission shall be uploaded in pdf, Word, or Excel format by the Contractor to the appropriate location in ACC.

3. While the project management system is very user friendly and easy to learn, Architect will provide informal training for the Contractor as necessary to expedite the Contractor's familiarity with the program.

1.6 TEMPORARY ELECTRICAL SERVICE

A. Existing Building Areas:
   1. At all locations, the Contractor may utilize building electrical power to the extent existing power may be suitable for construction operations. The Contractor shall make all tie-ins and shall maintain utility service in all occupied areas. Damage, if any, caused by the Contractor use or tie-ins shall be immediately corrected by the Contractor to as-new conditions. Owner shall pay only the energy charges.
   2. Provide GFCI adapters since existing circuits may not be protected.
   3. The Contractor shall provide and maintain electrical power to points in the building convenient for and available to all trades, including mechanical and other subcontractors, so that power may be secured anywhere in the building with no more than a 100 ft. extension cord. Energy charges for power taken from existing building electrical system shall be paid by the Owner.

1.7 TEMPORARY LIGHTING

A. Provide and maintain temporary lighting inside the building for safe and adequate working conditions throughout all areas where work of any kind is being performed. Provide at least 1/2 watt of incandescent lighting for each square foot of space. Where practical, place temporary lights in the locations where the permanent lighting fixtures are to be installed.

1.8 TEMPORARY HEAT

A. Provide necessary heat during the course of construction, including equipment, fuel and attendance where required. Equipment for temporary heating shall be of a non-smudging type. The permanent heating system may be used for temporary heat, when installed. Upon completion and before acceptance of the building, Contractor shall repair all damage caused by such temporary use and shall clean all filters.

B. When the outside temperature is below freezing, inside of the building shall be kept at or above 40°F. at all times. While painting and finishing are in progress, the temperature shall be kept at or above 60°F. Contractor shall make good all damage caused by insufficient heat.

1.9 TEMPORARY VENTILATION

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.10 TEMPORARY SANITARY FACILITIES

A. Provide and maintain adequate sanitary toilet facilities on the project site. The toilet facilities shall meet the requirements of the public authorities having jurisdiction and their use strictly enforced. Sanitary sewer "tap" fee and monthly use fees, if any, shall be paid by Contractor if temporary facilities are connected to city sanitary sewer.

1.11 REFUSE

A. The Contractor shall provide refuse removal service at all times.

1.12 PROTECTIVE FACILITIES

A. Provide and maintain temporary guardrails, handrails and covers for floor, roof and wall openings, vertical shafts and stairways. If movement of the protective facilities is required by a subcontractor to perform his work, it will be the responsibility of that subcontractor to give prior notification to the Contractor and to replace the protective facilities in a satisfactory manner.

B. Provide and maintain, as per City of Tomball requirements, fire lane(s) and other required fire protection at the appropriate time and sequence of construction.

1.13 BARRICADES

A. Provide and maintain lighted barricades and fences for the public protection in accordance with requirements of the local city ordinances.

1.14 TEMPORARY FENCING

A. Provide and maintain for the duration of construction a temporary fence of design and type needed to prevent entry onto the work by the public.

1.15 TEMPORARY FIRE PROTECTION

A. Contractor shall provide adequate fire extinguishers on the premises during the course of construction, of the type and size recommended to control fires, which may result from the particular work being performed in accordance with the local fire marshal and fire codes.

B. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of ignition for possible fires.
   1. Keep work area free of combustible material.
   2. A fire watch consisting of at least one man furnished by Contractor with a fire extinguisher in hand and with no other assigned duties, shall be posted to stand by and observe for potential hazards while welding or cutting is being done. Equip fire watch with suitable personal eye protection and fire extinguishers.
   3. At completion of work operations, immediately inspect work and adjacent area for hazards. Re-inspect work for hazards at 1/2 hour and at one hour after completion of welding and cutting operations.

C. No smoking shall be allowed within the building or on the site. Post NO SMOKING signs in areas where work is in progress.

1.16 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide and operate pumping equipment.

B. Protect site from puddling or running water.

1.17 CLEANING DURING CONSTRUCTION

A. Control accumulation of waste materials and rubbish; periodically dispose of off site.

B. Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

C. Refer to SECTION 01 74 13 - CLEANING for additional cleaning requirements.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary materials, equipment, services, and construction prior to substantial completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations to a depth of 2'; grade site as indicated. Restore existing facilities used during construction to specified, or to original, condition.

1.19 PROJECT IDENTIFICATION SIGNS

A. Furnish and erect a project sign, approximately 4' high by 8' long of 3/4" thick exterior grade plywood, in conformance with sign detail supplied by the Architect. Support on posts of framing of treated wood or steel.

B. Erect sign within 30 days of start of construction and maintain in good condition until completion of project. Sign shall be located as directed by the Architect.

C. Furnish and erect Architect logo signs in identical type, size and quantity as General Contractor logo signs. Architect logo signs shall be placed in locations adjacent to all General Contractor signs.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 62 00

PRODUCT OPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for product options and substitutions.

B. Related Requirements:
1. Section 01 31 00 - PROJECT MANAGEMENT AND COORDINATION: Coordination of construction.
2. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Product data submittals.
3. Section 01 42 00 - REFERENCES: Applicability of specified reference standards.
4. Section 01 78 23 - OPERATION AND MAINTENANCE DATA.
5. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

1.2 PRODUCT LIST

A. Within 30 days after date of contract, submit to the Architect a list of products and materials which are proposed for substitution per SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 CONTRACTOR'S OPTIONS

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer.

B. For products specified by naming several products or manufacturers, followed by the words "NO SUBSTITUTIONS", select one of the products/manufacturers named.

C. For products specified by naming only one product and manufacturer, there is no option unless a substitution is approved as specified below.

D. For products specified by naming only one product and manufacturer, followed by the words "NO SUBSTITUTIONS", there is no option.

1.4 SUBSTITUTIONS

A. Requests for substitution to material, products, or equipment instead of those specified will be considered if received at least 10 days prior to the bid date. Substitution request received within 10 days of the bid date will be returned without review. Refer to Substitution Request (During the Bidding Phase) form attached to this section.

B. Within 30 days after Notice to Proceed, Architect will consider additional formal requests from the Contractor for substitutions of products in place of those specified. Refer to Substitution Request (After the Bidding Phase) form attached to this section.

C. Submit a separate request for each substitution on a copy of the "SUBSTITUTION REQUEST" form, attached to this section. Include in request:
1. Complete data substantiating compliance of proposed substitution with contract documents.
2. For products:
   a. Product identification, including manufacturer's name and address.
   b. Manufacturer's literature, including product description, performance and test data and reference standards.
   c. Samples, if applicable.
   d. Name and address of similar projects on which product was used and date of installation.
3. For construction methods:
   a. Detailed written descriptions of proposed method.
   b. Complete drawings illustrating methods or revisions.

4. Itemized Comparison of qualities of proposed substitution with product or method specified.
5. Changes required in other elements of work because of substitution.
6. Effect on construction schedule.

D. Request for substitution constitutes a representation that General Contractor or Construction Manager:
1. Has personally investigated proposed product or method and determined that it is equal to or superior in all respects to that specified.
2. Will provide same warranties for substitution as for product or method specified.
3. Will coordinate installation of accepted substitution into the work, making such changes as may be required for the work to be complete in all respects.
4. Waives all claims for additional cost, under his responsibility and related to substitution, which subsequently become apparent.

E. Substitutions will not be considered if:
1. They are indicated or implied on shop drawings or product data submittals without formal request submitted in accordance with this section.
2. Acceptance will require substantial revision of contract documents.

F. If substitution is not approved or accepted, Contractor shall furnish specified product or method at no additional cost to the Owner.

G. Acceptance of a proposed substitution prior to the bid date will be in the form of an addendum.

H. Where a substitution is proposed, both the General Contractor and the prime Design Consultant shall consultant the provided standards before accepting. Where there is a variance from the standard, the Entity proposing the change shall request approval in writing.

I. A substitution may include materials, products, software or other listed item.

J. The request shall contain at a minimum:
1. A description of the item.
2. Where in the standards the deviation is coming.
3. What the benefit to Tomball ISD will be if approved including cost saving, improved performance, schedule improvement, improved warrant/service/availability of parts, etc.
4. other descriptions as needed.

K. Until the approval is made in writing from TISD, the use of this product, material, equipment, software or vendor shall not be incorporated or represented or represented in any cost estimating or schedules.

L. If any substitution is provided without authorization, the entity which employed it without approval shall be liable for the complete replacement cost and for any schedule damages which may result from that change. The entity shall hold the destrict harmless for any resulting damages resulting from the unauthorized change.

M. Remedies for correcting an unauthorized material or vendor may be:
1. Change at no cost to the district including in ancillary costs associated with delays.
2. The district may choose to keep the material or vendor but the entity making the change will be required to pay for any difference in cost of what should have been provided. By choosing to retain the unauthorized alternate, the entity making the change is liable for any performance failures, replacement costs, warranty costs or failed equipment up to and including after a replacement of the material with what was originally specified. Warranty for an approved change shall automatically be extended for a (2) year time period from Substitution Completion.

N.

1.5 SUBMITTAL PROCEDURES

A. Submit request for substitution.

B. Architect will review Contractor's requests for substitutions with reasonable promptness.

C. For accepted products, submit shop drawings, product data, and samples under provisions of SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SUBSTITUTION REQUEST
(During the Bidding Phase)
(Submittal must be received 10 days prior to bid/proposal date)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, custom color/pre-selected color availability, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E/ design, detailing, and construction costs caused by the substitution.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

A/E REVIEW AND ACTION

☐ Substitution approved - Submit bid/proposal based on accepted substitution.

☐ Substitution approved as noted - Submit bid/proposal based on accepted substitution - as noted.

☐ Substitution rejected - Submit bid/proposal for specified materials.

☐ Substitution Request received too late - Submit bid/proposal for specified materials.

Signed by: _____ Date: _____

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐_____

SUBSTITUTION REQUEST
(After the Bidding Phase)
(Submittal must be received not later than 30 days after Notice to Proceed)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section No.: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

For finish materials and pre-finished equipment, list the colors available for the specified item and the colors available for the proposed substitution.

☐ Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Section 01 33 23.

☐ Substitution approved as noted - Make submittals in accordance with Section 01 33 23.

☐ Substitution rejected - Use specified materials.

☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐_____

_____

_____

_____

_____

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SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included:
1. Packaging, Transportation.
2. Delivery and Receiving.
3. Product Handling.

B. Related Requirements:
1. SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULES.
2. SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Manufacturers' Instructions.
3. SECTION 01 66 00 - PRODUCT STORAGE AND HANDLING REQUIREMENTS.
4. Individual Sections: Specific requirements for packaging, shipping and handling.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 PACKAGING, TRANSPORTATION

A. Require supplier to package products in boxes or crates for protection during shipment, handling and storage. Protect sensitive products against exposure to elements and moisture.

B. Protect sensitive equipment and finishes against impact, abrasion and other damage.

3.2 DELIVERY AND RECEIVING

A. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.

B. Coordinate deliveries to avoid conflict with work and conditions at site; limitations on storage space; availability of personnel and handling equipment; and Owner's use of premises.

C. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.

D. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.

E. Immediately on delivery, inspect shipment to assure
1. Product complies with requirements of contract documents and reviewed submittals.
2. Quantities are correct.
3. Accessories, and installation hardware are correct.
4. Containers and packages are intact and labels legible.
5. Products are protected and undamaged.

3.3 PRODUCT HANDLING

A. Provide equipment and personnel to handle products by methods to prevent soiling and damage.

B. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging and surrounding surfaces.

C. Handle product by methods to avoid bending or over-stressing. Lift large and heavy components only at designated lift points.

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Included:
1. Storage, General.
2. Enclosed Storage.
3. Exterior Storage.
4. Maintenance of Storage.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK.
2. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Storage facilities. Protection of installed work.
3. Section 01 65 00 - PRODUCT DELIVERY REQUIREMENTS.
4. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 STORAGE, GENERAL

A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.

B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

3.2 ENCLOSED STORAGE

A. Store products, subject to damage by the elements, in substantial weathertight enclosures.

B. Maintain temperature and humidity within ranges stated in manufacturer's instructions.

C. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.

D. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

3.3 EXTERIOR STORAGE

A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.

B. For products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.

C. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.

D. Provide surface drainage to prevent erosion and ponding of water.

E. Prevent mixing of refuse or chemically injurious materials or liquids.

3.4 MAINTENANCE OF STORAGE

A. Periodically inspect stored products on a scheduled basis.

B. Verify that storage facilities comply with manufacturer's product storage requirements.

C. Verify that manufacturer required environmental conditions are maintained continually.

D. Verify that surfaces of products exposed to the elements are not adversely affected; that any weathering of finishes is acceptable under requirements of contract documents.

3.5 MAINTENANCE OF EQUIPMENT STORAGE

A. For mechanical and electrical equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions shown on exterior of package.

B. Service equipment on a regularly scheduled basis, maintaining a log of services; submit as a record document.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Requirements and limitations for cutting and patching of work.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK: Work by Owner or by separate contractors.
2. Section 01 62 00 - PRODUCT OPTIONS.
3. Individual Specifications Sections:
a. Cutting and patching incidental to work of the section.
b. Advance notification to other Sections of openings required in work of those sections.
c. Limitations on cutting structural members.

1.2 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submit written request in advance of cutting or alteration which affects
1. Structural integrity of any element of the project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight-exposed elements.
5. Work of Owner or separate contractor.

C. Include in request
1. Identification of project.
2. Location and description of affected work.
3. Necessity for cutting or alteration.
4. Description of proposed work and products to be used.
5. Alternatives to cutting and patching.
6. Effect on work of Owner or separate contractor.
7. Written permission of affected separate contractor.
8. Date and time work will be executed.

1.3 PAYMENT FOR COSTS

A. Costs resulting from ill-timed or defective work, or work not conforming to contract documents, including costs for additional services of Architect or other consultants, shall be borne by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products: Those required for original installation.

B. For any change in materials, submit request for substitution under provisions of SECTION 01 62 00 - PRODUCT OPTIONS.

PART 3 - EXECUTION

3.1 GENERAL

A. Execute cutting, fitting and patching including excavation and fill, to complete work, and to

1. Fit the several parts together, to integrate with other work.
2. Uncover work to install ill-timed work.
3. Remove and replace defective and non-conforming work.
4. Remove samples of installed work for testing.
5. Provide openings in elements of work for penetrations of mechanical and electrical work.

3.2 INSPECTION

A. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

B. After uncovering, inspect conditions affecting performance of work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.3 PREPARATION

A. Provide temporary supports to assure structural integrity of surroundings; devices and methods to protect other portions of project from damage.

B. Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

C. Maintain excavations free of water.

3.4 PERFORMANCE

A. Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.

B. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

D. Restore work with new products in accordance with requirements of contract documents.

E. Fit work tight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

F. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated packing material, full thickness of the construction element.

G. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 13

CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Throughout the construction period, maintain the structures and sites in a standard of cleanliness as described in this section.

B. Related Requirements: In addition to standards described in this section, comply with requirements for cleaning as described in other pertinent sections of these specifications.

1.2 QUALITY ASSURANCE

A. Conduct a daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

A. Provide required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.2 COMPATIBILITY

A. Use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General:
   1. Retain stored items in an orderly arrangement allowing maximum access, not impeding traffic or drainage, and providing required protection of materials.
   2. Do not allow accumulation of scrap, debris waste material, and other items not required for construction of the work.
   3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the project sites.
   4. Provide adequate storage for all items awaiting removal from the project sites, observing requirements for fire protection and protection of the ecology.

B. Sites:
   1. Daily, and more often if necessary, inspect the sites and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.
   2. Weekly, and more often if necessary, inspect all arrangements of materials stored on the sites. Restack, tidy, or otherwise service arrangements to meet the requirements of this section.
   3. Maintain the sites in a neat and orderly condition at all times.

C. Structures:
   1. Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.
   2. Weekly, and more often if necessary, sweep interior spaces clean.
      a. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and a hand-held broom.

3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the necessary cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily (and more often if necessary) at all times while work is being performed in the space in which finish materials are installed.
    a. "Clean", for the purpose of this subparagraph shall be interpreted as meaning free from foreign material which, in the opinion of the Architect, may be injurious to the finish floor material.

3.2 FINAL CLEANING

A. "Clean", for the purpose of this Article, and except as may be specifically provided otherwise, shall be interpreted as meaning the level of cleanliness generally provide by skilled cleaners using commercial quality building maintenance equipment and materials.

B. Prior to completion of the work, remove from the project site[s] all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final progress cleaning as described in this section.

C. Sites:
1. Unless otherwise specifically directed by Architect, broom clean paved areas on the sites and public paved areas adjacent to the site.
2. Completely remove resultant debris.

D. Structures:
1. Exterior:
    a. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.
    b. Remove all traces of splashed materials from adjacent surfaces.
    c. If necessary to achieve a uniform degree of cleanliness, hose down the exterior of the structures.
    d. In event of stubborn stains not removable with water, Architect may require light sandblasting or other cleaning at no additional cost to the Owner.
2. Interior:
    a. Visually inspect interior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.
    b. Remove all traces of splashed material from adjacent surfaces.
    c. Remove paint droppings, spots, stains, and dirt from finished surfaces.
3. Glass: Clean inside and outside.
4. Polished Surfaces: To surfaces requiring routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished. This does not apply to resilient flooring surfaces. Reference SECTION 09 65 00 - RESILIENT FLOORING for cleaning of resilient flooring.

E. Special floor/base final cleaning requirements:
1. Contractor shall coordinate with the Owner’s housekeeping department for preparing the surfaces for final cleaning by the Contractor and protective coatings installed by the Owner.
2. Protection after final treatment until date of Substantial Completion shall be the responsibility of the Contractor.
3. All repairs or re-application required as a result of damage caused by the Work shall be the responsibility of the Contractor as directed by the Owner.

F. Schedule final cleaning, as approved by the Architect, to enable the Owner to accept a completely clean work.

3.3 CLEANING DURING OWNER'S OCCUPANCY

A. Should the Owner occupy the work, or any portion thereof, prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning shall be as determined by the Architect in accordance with the General Conditions of the Contract for Construction.

END OF SECTION

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SECTION 01 77 00.00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for digital project closeout, including but not limited to:
   1. Inspection procedures.
   2. Project record document submittal.
   3. Operating and maintenance data submittal, including training sessions for equipment and systems.
   4. Submittal of warranties.
   5. Submittal of spare parts and maintenance materials.

B. Related Requirements:
   1. Section 01 11 00 - SUMMARY OF WORK: record drawings.
   2. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   3. Section 01 74 13 - CLEANING: final cleaning.
   4. Section 08 71 00 - DOOR HARDWARE: keys and keying schedule.

1.2 GENERAL

A. Punch List:
   1. Ensure all final test results have been provided with all final reports.
   2. The Owner shall be notified 48 hours prior to the Architect/Contractor starting the Punch List walk. The Owner will participate, and their comments shall be incorporated. Where there is a conflict of opion, the item shall still be recorded, and the Program Manager will work to a resolution with all parties.
   3. The Punch list walk shall be scheduled to occur at least 3 weeks prior the scheduled Substantial Completion date and be done using Project Mates.
   4. To receive Substantial Completion, the facility must at a minimum provide the following items and any significant scope of work necessary for the facility to be used for its intended purpose with all AHJ approvals:
      a. An AIA G704 document fully executed indicating the established value of any outstanding work and work listed on the punch list.
      b. All major systems necessary to use all parts of the facility as designed, shall be fully operational and complete.
      c. All the A/E's punch list of items requiring corrective action and incorporating and Owner comments.
      d. The certificate of Occupancy.
      e. The Certificate of Compliance when applicable.
      f. Health Department approvals.
      g. All required test results and certificates on all systems.
   5. The Architect's Punch List shall be returned to the Contractor and Owner within 5 business days of the final day of walking.
   6. The punch list shall be created in such a way to provide the location in a method that is easily discernible. it shall indicate a graphic layout of the room with directional reference. Notes shall be keyed to the graphic layout and be clearly narrated to limit confusion. The format shall be provided for review prior to the walk. Any reasonable adjustmenbts to the format shall be incorporated.
   7. Final cleaning - Ensure mechanical, electrical, technology, storage and janitorial rooms are clean and free of all trash debris prior as part of the punch list. No stored materials are allowed in these rooms.
   8. Closeout Documents (items listed below are a minimum and shall include in addition all other documents required by the A/E specification.)
      a. TISD requires at least:
         1) All documents cited in the A/E/Consultant Specification.
         2) (1) hard copy of all construction document as-built/record drawings, including drawings, specifications, permits and AHJ certifications.
         3) As-built/record drawings in (CAD) and (PDF) format as individual sheets. File names shall reflect the sheet number, and

4) (1) full set of updated specifications incorporating all changes to materials and equipment during construction.
5) (1) full set of all remaining documents in (PDF).

b. All warranty/guarantee documents or similar which have an original signature on them and shall include a quality copy to be included in a PDF. All remaining documents, unless noted otherwise, shall be provided in Personal Document Format (PDF) and are to be uploaded into Project Mates. Drawings are to be uploaded as single files by discipline folders as provided in Project mates. In addition, the contractor shall provide (2) separate duplicate thumb drives containing ALL documents including those provided in hard copy. Where requested all CAD files shall be provided in DWG format with the naming format (Ex. A101, E101 and so on.)

c. The pdf files shall be cataloged in a logical format following CSI outlines standard with an index included and uploaded into Project Mates. DO NOT simply copy all the files over. File naming shall be logical and consistant between groupings and disciplines.

d. Drawings and Specifications only shall be provided at each contractual phase completion in the same way. 1 set of hard copy full size, 1 set of hard copy half size and 1 pdf of all documents. All phase drawings shall be nuploaded into Project Mates as part of completion of that phase and the electronic thumb drives provided concurrently. During pohase completion only one thumb drive is required. Drawings uploaded into project mates shall be by sheet grouped in folders discipline.

e. The contractor shall provide the following drawings full size laminated showing valves, disconnects, pull boxes, cleanouts, damper locations, duct detectors, smoke detectors, FCP and all related maintenance for acceptance by the Owner:
1) The Mechanical plan of the whole building (2) copies.
2) The Electrical plan of the whole building (2) copies.
3) The Plumbing drawing of the whole building (2) copies.
4) Fire Detection plan of the whole building (2) copies.
5) Network/Data/Security/Camera plan of the whole building (2) copies.
6) An enlarged plan at 3/4"=1'-0" for the Fire Riser Room, Each Mechanical Room, Each Electrical Room, and the Chiller yard or similar outdoor equipment areas if separate.

9. Attic Stock and Extra materials.
a. All stored materials or attic stock shall be delivered to 11211 FM 2920, Tomball, Texas. The specific building will be provided when deliveries are made. Prior to any delivery the contractor must contact the pre-determined person and arrange a time to drop off materials.
b. Provide 48 hours notice prior to delivery.
c. Dropped materials shall contain a detailed list of what is being delivered. A transmittal stating attic stock is not acceptable. A copy of this list is considered part of the delivery and acceptance without this list will not be made. A photograph(s) as necessary to sho proof of delivery shall be provided with copies of transmittals and list of delivery. The provided transmittal for all dropped materials shall show the signature and printed name of the individual who received them.
d. One set of all filters per location for all echanical Units minimum and Plumbing Systems. Within (5) days after substantial completion the contractor shall replace all filters and request the A/E's verification. The filters shall not be dated more than (5) days prior to substantial completion.
e. When a water softener is specified - provide 400# of salt in addition to the full system at turn over.
f. Rebuild kit for ALL backflow preventers. (1) kit per type.
g. Backflow preventers shall be installed at ALL Kitchen and Food Service equipment. Certification of all backflow preventers is required for all locations.
h. Building Main Water Filters - A/E shall verify these have been changed during the punch list walk post Substantial Completion.
i. All other filters - A/E shall verify these have been changed during the punch list post Substantial Completion.
j. All filters shall be changed no sooner than 1 week prior to Substantial Completion or they will have to be changed again.
k. Keys - Building keys-Refer to Keying but no keys are to be provided to any staff. All key transfers shall be Facilities Director in person. Any key that is provided to staff other than the Facilities Director will be considered free and not a part of the official count.

1.3 SUBSTANTIAL COMPLETION

A. General: Substantial Completion is defined in Paragraph 9.8.1 (A201 and A201/CMA) of the General Conditions.

B. Preliminary Procedures: Before requesting inspection for certification of substantial completion, complete the following. List exceptions in the request.
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
      a. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete construction and reasons the work is not complete.
   2. Advise Owner of pending insurance change-over requirements.
   3. Submit specific digital warranties, maintenance agreements, final certifications and similar documents.
   4. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   5. Submit digital record drawings, maintenance manuals and similar final record information.
   6. Deliver tools, spare parts, extra stock and similar items.
   7. Make final change-over of permanent locks and transmit keys and keying schedule to Owner. Advise the Owner's personnel of change-over in security provisions.
   8. Complete start-up testing of systems, and training sessions for Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups and similar elements.
   9. Complete final clean-up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

C. Inspection Procedures: On receipt of a request for inspection, Architect will either proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion following inspection, or advise Contractor of construction that must be completed or corrected before the certificate will be issued.
   1. Architect will repeat the inspection when requested and assured that the work has been substantially completed.

D. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, submit the following documents, indexed and submitted digitally. List exceptions in the request.
   1. Final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   2. Updated final statement, accounting for final additional changes to the contract sum.
   3. Certified copy of Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by Architect.
   4. Consent of surety to final payment.
   5. Final Liquidated Damages settlement statement.
   6. Evidence of final, continuing insurance coverage complying with insurance requirements.
   7. Evidence of Compliance with Requirements of Governing Authorities
      a. Certificate of Occupancy.
      b. Certificates of Inspection required for mechanical and electrical systems.
   8. Operation and Maintenance Data: Under provisions of SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA.
   9. Warranties and Bonds: Under provisions of SECTION 01 78 30 - WARRANTIES AND BONDS.
   10. Project Record Documents: Under provisions of SECTION 01 78 39 - PROJECT RECORD DOCUMENTS.
   11. Spare Parts and Maintenance Materials: Under provisions of SECTION 01 78 40 - SPARE PARTS, OVERAGES AND MAINTENANCE MATERIALS.
   12. Keys and Keying Schedule: Under provisions of SECTION 08 71 00 - DOOR HARDWARE.
   13. Evidence of Payment and Release of Liens: In accordance with General Conditions of the Contract for Construction.

14. Evidence of Payment of Debts and Claims: In accordance with General Conditions of the Contract for Construction.
15. Certificate of Project Compliance: Required under provisions of Texas Administrative Code (TAC), Chapter 61, 1036(c)(3)(F). Form developed by the Texas Education Agency (TEA). See form attached to the end of this Section.
16. Certification of Asbestos and Lead Free Project: Contractor shall submit to Architect a letter addressed to Owner certifying that no materials used in the construction of this project contain lead nor asbestos materials in excess of amounts allowed by local/state standards, laws, codes, rules and regulations, Federal Environmental Protection Agency (EPA) standards and the Federal Occupational Safety and Health Administration (OSHA) standards, whichever are most restrictive. Certification shall further state that should lead or asbestos fibers be found in this project in concentrations greater than the allowed amounts, that Contractor shall be responsible for determining which materials contain the lead or asbestos fibers and shall take corrective action to remove those materials from the project at no additional cost to the Owner. Final payment shall not be made until this letter of certification has been received.
17. Affidavits from all Subcontractors and Suppliers stating that no asbestos products have been installed in this project. The attached “Affidavit of Non-Asbestos, Lead, and PCB Use in Project” form must be notarized.

B. Re-inspection Procedures: Architect will re-inspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been complete, except items whose completion has been delayed because of circumstances acceptable to Architect.
   1. Upon completion of re-inspection, Architect will advise Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
   2. If necessary, re-inspection will be repeated.

C. Re-inspection Fees: Should status of completion of work require re-inspection by Architect due to failure of work to comply with Contractor's claims on initial inspection, Owner will deduct the amount of Architect and appropriate consultants compensation for re-inspection services from final payment to Contractor. The reimbursement transaction shall be executed by change order to the contract.

1.5 CLOSEOUT PROCEDURES

A. Digital Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Manuals shall be submitted digitally and properly indexed. Also submit one heavy-duty 3-1/2", three-ring vinyl-covered binder, with identification on front and spine of binder. Include the following types of information:
   1. Emergency instructions.
   2. Spare parts list.
   3. Copies of warranties.
   4. Wiring diagrams.
   5. Recommended "turn around" cycles.
   6. Inspection procedures.
   7. Shop drawings.
   8. Fixture lamping schedule.

B. Digital Shop Drawings: Keep and maintain a full set of digital submittals throughout the construction phase to be submitted to Architect with other close-out documents for delivery to Owner for his permanent record. Set of submittals shall be delivered to Architect. Organize submittals by CSI divisions.

C. Operating and Maintenance Training Sessions: Prepare a written agenda of items to be covered at each training session. Attendance by Owner's operating and maintenance personnel is mandatory. Notify Owner not less than 48 hours prior to scheduled training sessions.
   1. Arrange for each installer of equipment and systems that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
      a. Maintenance manuals.
      b. Record documents.
      c. Spare parts and materials.
      d. Tools.
      e. Lubricants.

f. Fuels.
g. Identification systems.
h. Control sequences.
i. Hazards.
j. Cleaning.
k. Warranties and bonds.
l. Maintenance agreements and similar continuing commitments.

2. Training sessions shall consist of not less than five days of not less than four hours each day. A copy of maintenance manuals for equipment or system being demonstrated shall be on hand during training session. As part of instruction for operating equipment, demonstrate the following procedures:
   a. Start-up.
   b. Shutdown.
   c. Emergency operations.
   d. Noise and vibration adjustments.
   e. Safety procedures.
   f. Economy and efficiency adjustments.
   g. Effective energy utilization.
3. Training sessions shall be conducted for:
   a. Doors and Hardware.
   b. Technology Systems.
4. Demonstration and Training DVDs
   a. General: Engage a qualified commercial photographer to record demonstration and training DVDs. Record each training session separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids. TISD requires videos to be included in the closeout record drawings on a separate USB memory stick.
   b. Digital Format: Provide high-quality DVD color recording.
   c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
   d. Narration: Describe scenes by audio narration by microphone while being recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   e. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from recording opposite the corresponding narration segment.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

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CERTIFICATION OF PROJECT COMPLIANCE

Distribution to:

District	___	**Architect/Engineer**	___
Contractor	___	**Texas Education Agency**	___
Other	___	**Building Department**	___

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1. PRO JECT INFORMATION:
(name, address)

ARCHITECT/ENGINEER:

CONTRACTOR/CM:

PROJECT NUMBER:

CONTRACT DATE:

DISTRICT:

DATE DISTRICT AUTHORIZES PROJECT:

BRIEF DESCRIPTION OF PROJECT:

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2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

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3. The District certifies that the enrollment projections, educational specifications and objectives of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: BY: **DATE:**

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4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the State Board of Education, July 1992, and as provided by the district.

ARCHITECT/ENGINEER: BY: **DATE:**

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5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: BY: **DATE:**

---

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: BY: **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:

– name and address of the school facility
– the Architect/Engineer and Contractor
– the school district's project number (if applicable)
– the date of execution of the construction contract
– name, address, and telephone number of the school district
– the date that the school district authorized the superintendent to hire an architect/engineer
– scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.104, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

Complete this form and return to the Architect upon close-out of the project.

PROJECT NAME: _____

_____

Architect's Project Number: _____

OWNER NAME: _____Phone No. _____

Address: _____

The undersigned affirms and certifies that to the best of their knowledge and belief asbestos-, lead-, and PCB-containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems, including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project. Lead sheet flashing used in through roof plumbing penetration applications is the only permissible lead-containing material on the Project.

SIGNED: _____ DATE: _____

PRINTED NAME: _____

TITLE: _____

COMPANY: _____

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS)
)
COUNTY OF)

Subscribed and sworn before me on this _____ day of _____, _____

_____
Notary Public

My Commission expires _____

END OF FORM

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Digital Manual Only.
   1. Format and content of manuals.
   2. Instruction of Owner's personnel.
   3. Schedule of submittals.

B. Related Requirements:
   1. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   2. Section 01 45 00 - QUALITY CONTROL: Manufacturer's instructions.
   3. Section 01 77 00.00 - CLOSEOUT PROCEDURES.
   4. Section 01 78 30 - WARRANTIES AND BONDS.
   5. Section 01 78 39 - PROJECT RECORD DOCUMENTS.
   6. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.2 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.3 FORMAT

A. Submit operation and maintenance manuals on digital media acceptable to Owner and Architect. Enable reviewer comments on draft submittals.

B. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated Correlate data into related consistent groupings.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; list title of project identify subject matter of contents.

D. Arrange content by systems, under section numbers and sequence of table of contents of this project manual.

1.4 SUBMITTALS

A. Submit copy of preliminary draft or proposed formats and outlines of contents before start of work. Architect/Engineer will review draft and return with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.

C. Submit completed files in final form 15 days prior to final inspection. Files will be returned after final inspection, with Architect/Engineer comments. Revise content of documents as required prior to final submittal.

D. Submit revised volumes of data in final format within 10 days after final inspection.

1.5 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Architect/Engineer and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project record documents as maintenance drawings.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in SECTION 01 45 00 - QUALITY CONTROL.

F. Warranties and Bonds: Bind in copy of each.

1.6 ELECTRONIC MANUAL FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture-protection and Weather-exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: As specified in individual specifications sections.

E. Provide a listing in table of contents for design data, with tabbed fly sheet and space for insertion of data.

1.7 ELECTRONIC MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Give function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.

C. Include as-installed color coded wiring diagrams.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide as-installed control diagrams by controls manufacturer.

K. Provide Contractor's coordination drawings, with as-installed color coded piping diagrams.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Additional Requirements: As specified in individual specifications sections.

O. Provide a listing in table of contents for design data, with tabbed fly sheet and space for insertion of data.

1.8 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

B. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 78 30

WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preparation and digital submittal of warranties and bonds.
2. Schedule of submittals.

B. Related Requirements:
1. Document 00 21 16 - INSTRUCTIONS TO PROPOSERS: Proposer bonds.
2. General Conditions of the Contract for Construction: Performance Bond and Labor and Material Payment Bonds, Warranty, and Correction of Work.
3. Section 01 77 00.00 - CLOSEOUT PROCEDURES.
4. Section 01 78 23 - OPERATION AND MAINTENANCE DATA.
5. Section 01 78 39 - PROJECT RECORD DOCUMENTS.
6. Individual Specifications Sections: Warranties and bonds required for specific products or work.

1.2 FORM OF SUBMITTALS

A. Warranties and Bonds shall be submitted digitally within one file.

B. Label digital cover of each binder with typed or printed title WARRANTIES AND BONDS, with title of project; name, address and telephone number of Contractor; and name of responsible principal.

C. Table of Contents: Neatly typed, in the sequence of the table of contents of the project manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

D. Separate each warranty or bond with index tab sheets keyed to the table of contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.3 PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed and submitted digitally by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the date of substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

1.4 TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.

B. Make other submittals within 10 days after date of substantial completion, prior to final application for payment.

C. For items of work when acceptance is delayed beyond date of substantial completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Maintenance and submittal of record documents and samples.

B. Related Requirements:
1. General Conditions of the Contract for Construction: Documents at the site.
2. Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
3. Section 01 77 00.00 - CLOSEOUT PROCEDURES.
4. Section 01 78 23 - OPERATION AND MAINTENANCE DATA.
5. Individual Specifications Sections: Manufacturer's certificates and certificates of inspection.

1.2 GENERAL

A. Record drawings shall include but not limited to correct As-Built or As-Constructed documents showing and deviation from the design, actual locations for valves, dampers, detectors, alarms, wall devices, registers, cameras, WAPS, underground piping, underground wiring for site and building interior, overjead duct runs, piping, wiring, junction boxes, pull boxes, cut-off valves, switches, resets of any type, and and building element which is different from the design including doors, windows, openings, column wraps, columns, millwork, equipment, etc. and all site undergound of all disciplines.

B. Record documents include specifications for any material, equipment or conveyance system.

C. Record documents include SDS sheets for everything which is in the facility whether built, installed or applied. ALL items brought onsite and incorporated within the project must include SDS sheets.

D. SDS and asbestos exclusion letter shall be submitted to TISD together. Asbestos exclusion letter shall be signed the Architect.

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. In addition to requirements in General Conditions, maintain at the site for Owner one record copy of:
1. Contract drawings.
2. Specifications.
3. Addenda.
4. Change orders and other modifications to the contract.
5. Reviewed shop drawings, product data, and samples.
6. Field test records.
7. Inspection certificates.
8. Manufacturer's certificates.

B. Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage for record documents and samples.

C. Label and file record documents and samples in accordance with section number listings in table of contents of this project manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain record documents in a clean, dry and legible condition. Do not use record documents for construction purposes.

E. Keep record documents and samples available for inspection by Architect.

1.4 RECORDING

A. Record information on a set of opaque drawings, and in a copy of a project manual. All changes made in these drawings in connection with the final construction and installation shall be neatly made in red ink on the prints.

B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.

C. Contractor shall include with the record documents, all changes and modifications made by addenda, change orders, supplementary instructions, or other forms of documentation, written or verbal, which alter the documents.

D. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.

E. Contract drawings and shop drawings: Legibly mark each item on the drawings to record actual construction, including:
   1. Measured depths of elements of foundation in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
   4. Field changes of dimension and detail.
   5. Changes made by addenda and modifications.
   6. Details not on original contract drawings.
   7. References to related shop drawings and modifications.

F. Specifications: Legibly mark each item in the specifications to record actual construction, including:
   1. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.
   2. Changes made by addenda and modifications.

G. Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, and other documents required by individual specifications sections.

H. Maintain these documents to reflect the current conditions of the work. Changes shall be reviewed on a monthly basis with the Architect's representative. The Contractor's updating of the "installed condition drawings" shall be a prerequisite to the monthly review of the Contractor's payment request by the Architect's representative.

1.5 SUBMITTALS

A. At contract closeout, deliver record documents and samples under provisions of SECTION 01 77 00.00 - CLOSEOUT PROCEDURES.

B. Transmit with cover letter in duplicate, listing:
   1. Date.
   2. Project title and number.
   3. Contractor's name, address, and telephone number.
   4. Number and title of each record document.
   5. Signature of Contractor or authorized representative.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 78 40

SPARE PARTS, OVERAGES AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements Includes:
1. Products required.
2. Storage and delivery of products.

B. Related Requirements:
1. Section 01 66 00 - PRODUCT STORAGE AND HANDLING REQUIREMENTS.
2. Section 01 77 00.00 - CLOSEOUT PROCEDURES.
3. Section 01 78 23 - OPERATION AND MAINTENANCE DATA.
4. Individual Specifications Sections: Specific spare parts and materials required.

1.2 PRODUCTS REQUIRED

A. Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual sections to be provided to Owner, in addition to that required for completion of work.

B. Products: Identical to those installed in the work. Include quantities in original purchase from manufacturer to avoid variations in manufacture.

1.3 STORAGE, MAINTENANCE

A. Store products with products to be installed in the work, under provisions of SECTION 01 66 00 - PRODUCT STORAGE AND HANDLING REQUIREMENTS.

B. When adequate, secure storage facilities are available at site, capable of maintaining conditions required for storage and not required for contract work or storage, or for Owner's needs, spare products may be stored in available space.

C. Maintain spare products in original containers with labels intact and legible, until delivery to Owner.

1.4 DELIVERY

A. Coordinate with Owner: Deliver and unload spare products to Owner at Owner's Maintenance Facility and obtain receipt prior to final payment.

B. For portions of project accepted and occupied by Owner prior to substantial completion, deliver a proportional part of spare products to Owner; obtain receipt.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 02 41 19

SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Taking down, cutting away, breaking out and removing portions of existing site features to accommodate new and/or remodeled construction.
2. Disconnecting, capping and removing identified utilities.
3. Offsite disposal and/or salvaging for reinstallation, indicated components.

B. Related Requirements:
1. Section 01 11 00 - SUMMARY OF WORK: Instructions concerning hazardous materials.
2. Section 01 35 00 - ALTERATION PROJECT PROCEDURES: Re-installation of removed materials.
3. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Barricades; Dust control.
4. Section 01 78 39 - PROJECT RECORD DOCUMENTS.

1.2 REFERENCE STANDARDS

1.3 SUBMITTALS

A. Submit demolition and removal procedures and schedule under provisions of SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submit record documents under provisions of SECTION 01 78 39 - PROJECT RECORD DOCUMENTS. Accurately record actual locations of capped utilities and subsurface obstructions.

1.4 PROJECT CONDITIONS

A. Occupancy: Owner will be continuously occupying portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's operations.

B. Existing Conditions: Owner assumes no responsibility for actual condition of items or structures to be demolished. Contractor shall visit the building[s] and verify the nature and extent of demolition required. Conditions existing at time of commencement of contract will be maintained by Owner insofar as practicable. However, variations within structures may occur by Owner's removal and salvage operations prior to start of selective demolition.

C. Property Protection: Contractor shall be responsible for the protection of adjoining property, including all parts of the building outside the limits of demolition and site improvements outside the limits of the new construction.

1.5 EXISTING CONDITIONS

A. Conduct demolition to minimize interference with adjacent portion of structures to remain.

B. Conduct operations with minimum interference with Owner's usage of building[s]. Maintain protected egress and access at all times and maintain protected egress at fire exits as required by the Fire Marshall.

1.6 PROTECTION

A. It is essential that there be minimal interruptions of existing mechanical and electrical systems in addition to the normal operation of Owner's facilities.

B. Take care to ensure that there will be no damage to elements or portions thereof which are not required to be removed. Erect and maintain temporary shoring, bracing, and other means to safeguard the structural integrity of the existing portions of building and its parts to remain.

C. Erect and maintain temporary bracing, shoring, lights, barricades, signs and other means to protect workers and other persons, and finishes and improvements to remain from damage; all in accordance with applicable regulatory requirements.

D. Erect and maintain temporary barriers to confine dust and debris.

E. Protect existing trees to remain. Keep area within the drip line clear of construction traffic, parking, soil contamination, soil stockpiling, storage of materials, debris and ponding water.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials designated for demolition shall become the Contractor's property; remove and dispose of such materials unless otherwise indicated or specified. Sales of salvage materials are not allowed on site.

B. Furnishings and equipment items to remain the Owner's property will be removed by him prior to the start of demolition (or will be designated on the drawings herein or to be removed and stored by Contractor). Items not so designated shall be considered debris and shall be removed and disposed of accordingly.

C. Carefully disconnect, remove and protect items directed by the Owner to be salvaged.

D. Transport salvaged items to on-site storage areas designated by the Owner.

PART 3 - EXECUTION

3.1 INSPECTIONS

A. Prior to starting demolition, make inspection and report observable defects and structural weaknesses of construction designated for demolition, of adjacent structures, and of improvements to remain. If unsatisfactory conditions exist, do not commence demolition until appropriate determinations have been made.

B. Following demolition, make inspection and report defects and structural weaknesses of items partially demolished, cut, or removed, of adjacent structures; and of improvements remaining.

3.2 PREPARATION

A. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition work is performed in rooms or areas from which such items have not been removed.

B. Prevent movement or settlement of adjacent structures. Provide bracing, shoring and underpinning as required.

C. Protect existing appurtenances, structures and landscaping which are not to be demolished.

D. Locate, disconnect, remove and cap designated utility lines within demolition areas.

E. Mark location of disconnected utilities. Identify utilities and indicate capping locations on project record documents.

F. Provide weatherproof closures for exterior openings resulting from demolition work.

3.3 PERFORMANCE

A. Demolition: Carry out the work carefully and in an orderly manner to minimize interference with the daily operations in the building and to avoid damage to permanent parts of the building and the equipment therein. Hold noise, dust and vibration to a minimum. Remove all items and parts so shown and noted on the drawings and as otherwise may be required to be removed to carry out the work.

B. Shoring: Provide temporary shoring for walls and framing wherever present supports are removed or weakened. Any settling or cracking of the existing construction due to the removal of supports and faulty or insufficient shoring shall be the responsibility of the Contractor and shall be repaired at no additional expense to the Owner.

C. Material and Equipment Disposal:
   1. The materials and items of equipment which are noted and shown to be salvaged and re-used in new locations or re-used for patching shall be carefully removed and safely stored until ready for reinstallation.
   2. Other items and all debris shall become the property of the Contractor and shall be removed from the premises entirely. Under no circumstances shall debris be allowed to accumulate.

D. Damage: Any existing construction to be left in place which is damaged by the demolition operations shall be refinished or replaced at no additional expense to the Owner. The repair of such damage shall leave the parts in a condition at least equal to that found at the start of the work.

E. Perform demolition in accordance with ANSI A10 - Construction and Demolition Standards, ANSI/ASSE A10.6 - Safety and Health Program Requirements for Demolition Operations, and applicable regulatory requirements.

F. Remove items designated for demolition within the limits of work indicated and as required to perform the work. Do not remove anything beyond the limits of demolition indicated without the prior written approval of Architect. If in doubt whether to remove an item, obtain written approval prior to proceeding.

G. If in the event hazardous materials (asbestos, PCB's etc.) are encountered during the course of the demolition work, or if it is even suspected that such materials will or have been encountered cease work immediately in the affected area and promptly notify the Owner and Architect.

3.4 CUTTING

A. Make new openings neat, as close as possible to profiles indicated and only to extent necessary for new work.

B. Do not cut or alter structural members unless specifically indicated or approved, and do not damage reinforcing or structural steel to remain.

C. At concrete, masonry, paving and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and -coring equipment. Do not over-cut at corners of cut openings.

D. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.

3.5 PIPES, DUCTS AND CONDUITS

A. Remove deactivated mechanical, plumbing and sprinkler piping, ducts and electrical conduit, including fastenings, connections and other related appurtenances and accessories which would otherwise be exposed in the completed work or interfere with construction operations.

B. These facilities above ceilings may remain in place if their presence does not result in interference with new work, in which case they shall be removed to extent necessary.

C. Cap deactivated piping systems at points of cutoff.

3.6 RECONDITIONING EXISTING SUBSTRATES

A. Clean surfaces on which new materials will be applied, removing adhesives, bitumen and other adhering materials, as necessary to furnish acceptable substrates for new materials.

B. Perform sandblasting, chipping, grinding, acid washing, etching and other work as required by conditions encountered and new materials involved.

C. Use of acids or other cleaning agents shall include neutralizing, washing, rinsing and drying, as applicable.

D. Determine substrate requirements for reconditioned surfaces in cooperation with the manufacturer's representative and installer of each new material involved.

3.7 CLEAN UP

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1SUMMARY

A. Section Includes: Formwork with accessories for the cast-in-place concrete and permanent shoring.

B. Related Sections:
   1. Section 03 30 00 - CAST-IN-PLACE CONCRETE.
   2. Section 07 26 00 - VAPOR RETARDERS.

1.2 REFERENCE STANDARDS

A. ACI 301 - Specifications for Concrete Construction; 2020.

B. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

C. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).

1.3 SUBMITTALS

A. SUBMITTALS
   1. Exposed surface form-facing material.
   2. Concealed surface form-facing material.
   3. Form ties.
   4. Waterstops.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Lumber: S2S&CM or S2S&SL No. 3 Boards or better Southern Pine not less than a nominal 1" thick.

B. Plywood: EXT-APA grade-trademarked B-B Plyform, Class I, or High Density Overlaid Plyform, Class I. B-B Plyform shall be sanded but not mill oiled. Plywood shall be new.

C. Expansion Joint Filler:
   1. Concealed: ASTM D1751, asphalt saturated cane fiberboard.
   2. Exposed: ASTM D1752, Type I, premolded, non-bituminous, closed cell sponge rubber. Color to be stone gray.
      Type 5; Grace Construction Products
      705; Greenstreak Plastic Products
      RB6-38; Vinylex Corp.

2.2 ACCESSORIES

A. Form Ties: Form ties for exposed concrete surfaces shall be manufactured to allow a positive breakback of at least 1" inside the concrete surface. Ties shall be equipped with a plastic cone or washer not less than 1" in diameter and 1" long which will cover the hole and prevent leakage of mortar. Form ties for unexposed surfaces shall be bolt rods or patented devices having a minimum tensile strength of 3000 pounds when fully assembled. Ties shall be adjustable in length and free of lugs, cones, washers or other features which would leave a hole larger than ⅞" in diameter, or depressions back of the exposed surface of the concrete. Ties shall be of such construction that, when the forms are removed, there will be no metal remaining within 1" of the finished surface of the concrete.

B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or affect bond of subsequent surface finish manufactured by Nox-Crete, Symons, or approved equivalent.

C. Dovetail Anchor Slots: 24 gage galvanized steel anchor slots with ⅝" throat, 1" deep, furnished with foam or felt fillers to exclude grout seepage.

D. Plastic Waterstops: Multiple rib extruded strips of PVC resin ⅜" thick and 6" wide. Product/manufacturer; one of the following:
Type 5; Grace Construction Products
No. 705; Greenstreak Plastic Products
RB6-38; Vinylx Corp

E. Plastic Waterstops: Volcay Waterstop-RX by American Colloid Co., 1" x ¾" size, comprised of butyl rubber and bentonite clay, or approved equivalent.

F. Chamfer Strips: Extruded plastic triangular chamfer with ¾" face; Burke "CSF-¾", Greenstreak Cat. No. 612.

PART 3 - EXECUTION

3.1 FORMWORK

A. General: Construct forms in compliance with referenced standard. All forms, shores, falsework, bracing and other temporary supports shall be engineered by the Contractor to support all loads imposed during construction, including weight of construction equipment, allowance for live loads and lateral forces due to wind and temporary imbalance of discontinuity of building components.

B. Construction: Construct forms to the dimensions and shapes of the concrete members as detailed and scheduled; and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Set, assemble and brace forms to withstand wet concrete construction loads without deflection, movement, or leakage. Provide access for placing and adjusting reinforcement and cleaning forms.
1. Exposed Surfaces: Form with plywood the non-wearing concrete surfaces exposed to view. On these surfaces locate the form ties in uniform patterns. The joints shall be tight and flush. Plywood may be re-used only with the specific approval of the Architect. Chamfer exposed outside corners.
2. Concealed Surfaces: Form with wood or metal forms the concealed vertical surfaces of grade beams and walls below grade.
3. Soffits: Form the soffits of grade beams and walls bearing on piers using rectangular fiberboard set forms.
4. Recesses and Chases: Form for and provide in their proper locations all slots, chases and recesses indicated or implied by the drawings and not formed by sleeves, frames, and other equipment furnished under other sections. The trades requiring such recesses and openings in concrete shall furnish the necessary information for their correct location and placement.
5. Joint Waterstops: Provide continuous waterstops for joints in the concrete walls below grade and in other concrete joints where detailed. Install waterstops with one-half the width encased in the concrete on the first pour and the other half in the second pour. Make end points watertight by fusing with a hot iron. Prefabrication of corners and whole frames is recommended where this is practical.

C. Inserts and Fasteners: Provide for the installation of inserts, conduits, sleeves, drains, hangers, nosings, metal reglets, nailing strips, and like items required for the attachment of other work and furnished by other trades. Properly locate in cooperation with other trades and secure in position before concrete is placed.

D. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.

E. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

F. Installing Shoring: Before backfilling, install permanent shoring along the bottom of concrete grade beams around areas of suspended floor construction to prevent caving of backfill material into the under floor areas. Provide shoring where the under floor grade at a beam is below the beam soffit.

1. Dig the shoring at least 5" into the soil at the bottom and lap it approximately 3" up over the outside face of the beam or wall.
2. Cut the panels to fit snugly at piers, footings, corners, and other irregularities.

3.2 EARTH FORMS

A. Earth forms are not permitted.

3.3 REMOVAL OF FORMS

A. Remove forms with sufficient care to avoid scarring exposed surfaces. Prying against face of concrete will not be permitted. Remove forms completely so that no wood form material is left in contact with concrete.
   1. General: Formwork for walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations, but in no event before concrete is 24 hours old. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured.

3.4 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

B. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view. Do not patch formwork.

3.5 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

SUMMARY

A. Section Includes:
Reinforcement with accessories for the cast-in-place concrete.
1. Reinforcing steel bars and welded steel wire fabric for cast-in-place concrete.
2. Support chairs, bolsters, and spacers, for supporting reinforcement.

B. Related Sections:
1. Section 03 11 00 - CONCRETE FORMING AND ACCESSORIES.
2. Section 03 30 00 - CAST-IN-PLACE CONCRETE.
3. Section 04 20 00 - MASONRY UNITS.
4. Section 07 95 00 - EXPANSION CONTROL.
5. Section 31 63 29 - DRILLED CONCRETE PIERS.

1.1REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

B. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007 Edition, September 1, 2007.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2025.

1.2 SUBMITTALS

A. Shop Drawings: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Drawings shall show the size, length, form and position of bar reinforcing and accessories.

B. Certification: Submit a letter certifying that reinforcing bars comply with specified standard for grade.

1.3 QUALITY ASSURANCE

A. Standard: Reinforcement shall meet the requirements of ACI 318 Building Code Requirements for Structural Concrete.

1.4 DELIVERY AND STORAGE

A. Stack reinforcing steel in tiers and mark so that each length, size, shape and location can be readily determined. Exercise care to maintain reinforcement free of dirt, mud, paint or rust.

B. Store materials and accessories on dunnage and under protective sheeting.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed billet steel.

B. Reinforcing Fabric: ASTM A185/A185M, welded steel wire fabric in flat sheets.

C. Tie Wire: 16 gage annealed steel wire.

D. Accessories: Anchors, dowels, spacers, chairs, bolsters and other devices for supporting and fastening reinforcement and normally considered as accessories to the concrete work.

2.2 FABRICATION

A. Fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with the CRSI Manual.

B. In case of fabricating errors, do not straighten or re-bend reinforcement in a manner that will weaken or injure the material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Placing Steel:
1. Place reinforcement in accordance with CRSI "Placing Reinforcing Bars" and ACI 318, with provisions of ACI 318 governing.
2. Assemble reinforcing steel in the forms, wired and fastened securely. Bending shall be done cold. Bars with kinks or bends not detailed shall be rejected.
3. Clean reinforcing steel of loose rust, mill scale, grease, dirt and other coatings which will reduce or destroy bond with the concrete. A thin film of tight rust will not be objectionable.
4. Position, support, and secure reinforcement to resist displacement by formwork, construction, and concrete placing operations.
5. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers.
6. Place reinforcement to obtain minimum coverages for concrete protection.
7. Arrange, space, and securely tie bars and bar supports together with the specified tie wire.
8. Set wire ties so twisted ends are directed away from exposed concrete surfaces.
9. Support reinforcement and fasten together to prevent displacement by construction loads of placing concrete. Use No. 16 gauge black annealed wire at all joints and crosses to accurately position reinforcement in place.
10. Over formwork, use metal or plastic bar chairs and spacers to support reinforcement.
11. Where concrete surface will be exposed to weather in finished structure, use non-corrosive or corrosion protected accessories within ½" of concrete surface.
12. Where successive mats of reinforcing fabric are continuous, overlap welded wire fabric so that overlap measured between outermost cross wires of each fabric sheet is not less than spacing of cross wires plus 2".
13. Bars having splices not shown on shop drawings will be subject to rejections.
14. Do not bend reinforcement after being embedded in hardened concrete.
15. Do not allow bars to be in contact with dissimilar materials.

3.2 FIELD QUALITY CONTROL

A. Inspection and Evaluation: The testing and inspection laboratory shall inspect placement of all reinforcing steel to confirm compliance with the contract documents.

B. Concrete shall not be poured without inspection approval as noted above.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1SUMMARY

A. Section Includes: Cast-in-place concrete, including mixing, placing, and finishing.

B. Related Sections:
1. Section 01 45 23 - TESTING AND INSPECTION SERVICES.
2. Section 03 11 00 - CONCRETE FORMING AND ACCESSORIES.
3. Section 03 20 00 - CONCRETE REINFORCING.
4. Section 07 26 00 - VAPOR RETARDERS.

1.2 REFERENCE STANDARDS

A. ACI 301 - Specifications for Concrete Construction; 2020.

B. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).

C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2026a.

D. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

E. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2026.

F. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; 2020 Edition.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

H. ASTM C127 - Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate; 2025.

I. ASTM C128 - Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate; 2025.

J. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2025.

K. ASTM C143/C143M - Standard Test Method for Slump of Concrete; 2026a.

L. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

M. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2025.

N. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

O. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

P. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

Q. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

1.3 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data:
1. Submit product data for admixture, bonding compound, curing compound, grout, and sealer.
2. Submit copies of manufacturer's printed product data, clearly marked, to indicate proposed fibrous concrete reinforcement materials. Printed data should state 1.5 lbs. of fiber to be added to each cubic yard of concrete.

C. Design Mixes:
1. At the beginning of the work, Contractor shall submit proposed concrete mix designs for review by the Architect, structural engineering consultant, and testing laboratory per SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   a. Include the sieve analysis of fine and course aggregate ASTM C136/C136M, dry rodded weight of coarse aggregate - ASTM C29, and the specific gravity (bulk saturated surface dry), of fine and coarse aggregates ASTM C127 and ASTM C128.
   b. State admixture used and project conditions required for specific admixtures.
   c. Proposed concrete mix design shall also include the results of compressive tests.
2. Contractor shall not mix concrete for placing in the work until confirmation laboratory reports are supplied to reflect that each proposed mix will develop the strength and slump required. Successful past history in accordance with ACI 318 will be satisfactory.

1.4 QUALITY ASSURANCE

A. Standard: Concrete shall meet the requirements of ASTM C94/C94M.

B. Perform work in accordance with ACI 301, 304, 305, 306, and 309.

C. Obtain materials from same source throughout the work.

D. Batch plant shall be able to show a minimum of five-years experience in batching concrete. If required, they shall furnish a list of similar sized jobs or special condition jobs performed during the last two-years.

E. Surface Tolerances: For all finished concrete wearing surfaces, the variation from level or from elevations indicated shall not exceed ¼" in 16'. If variations exceed those as set forth then the wearing surface shall be filled or ground down as required to meet the stated tolerances.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:
1. Cold Weather Placing: Do not place concrete when the temperature is below 40°F. or is expected to fall below 40°F. within 24 hours after placing concrete; unless either favorable weather is forecast or adequate arrangements for protection and heating have been made in accordance with ACI 306.
2. Hot Weather Placing: Do not place concrete when hot weather conditions exist that would impair the quality and strength of concrete, i.e. any combination of high air temperature, low relative humidity, and wind velocity, unless adequate arrangements for protection have been made in accordance with ACI 305.

B. Coordination: Notify other trades and Contractors well in advance of placing concrete to allow them sufficient time in which to install work which is to be built-in or cast into the concrete.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cements: ASTM C150/C150M, Type I, domestic manufacture.

B. Fine Aggregate: ASTM C33/C33M, washed sand with a fineness modulus of between 2.50 and 3.00.

C. Coarse Aggregate: ASTM C33/C33M, clean crushed stone or washed gravel. The nominal maximum particle size shall not exceed 1/5 of the narrowest dimension between forms or ¾ of the minimum clear spacing between reinforcing bars.

D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
   2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

E. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures, equal to Master Builders "MasterAir AE 200", Master Builders Solutions, a brand of MBCC Group.

F. Water: Clean and potable.

2.2 CONCRETE TREATMENT PRODUCTS

A. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements. Product/ manufacturer; one of the following:

   Sikadur 32, Hi-Mod; Sika Chemical

   Sealtight Rezi-Weld 1000; W.R. Meadows, Inc.

   MasterInject 1000; Master Builders Solutions, a brand of MBCC Group.

B. Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, clear, acrylic copolymer based liquid for curing and sealing concrete. Product/manufacturer; one of the following:

   Safe-Cure Clear; ChemMasters ClearDR

   Diamond Clear VOX; Euclid Chemical Co.

   Cure & Seal 1315 LVOC; Symons Corp., a Dayton Superior Co.

   Vocomp-20; W.R. Meadows, Inc.

C. Concrete Sealer at Interior Exposed Concrete: Provide Sealtight Vocomp-25 Acrylic Concrete Sealer as manufactured by W.R. Meadows, Inc., Fort Worth, Texas (phone 817.834.1969).

D. Concrete Sealer at Exterior Exposed Concrete: Provide SealtightTiah Acrylic Concrete Sealer as manufactured by W.R. Meadows, Inc., Fort Worth, Texas (phone 817.834.1969).

E. Non-metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, non-metallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and 30-minute working time. Product/manufacturer; one of the following:
   NS Grout; Euclid Chemical Co.
   Sealtight 588 Precision Grout; W.R. Meadows, Inc.
   Sonogrout® 10K; Master Builders, a BASF Chemical Company

F. Re-surfacing and/or Self-Leveling Underlayment Material: Provide Ardex K-15 as distributed by Ardex, Inc. (phone 888.512.7339, www.ardex.com) or Super Flo-Top as manufactured by The Euclid Chemical Co.

2.3 SELECTING PROPORTIONS FOR CONCRETE

A. Strength: Select proportions for a mix designed to produce concrete with a minimum 28-day compressive strength of 3000 psi, unless noted otherwise.

B. Admixture:
   1. Use admixture in all concrete. Select the type (normal, retarder, or high early) best suited for the temperature conditions at the time the concrete is placed and finished.
   2. Use water reducing admixture only with the permission of the Engineer. Do not use water reducing admixture and air entrainment together with any slabs to receive a hard troweled finish. Use air entrainment in all concrete to be pumped (5%).

C. Use air-entraining admixture in all exterior concrete, including pavement and flatwork. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content by volume with a tolerance of plus or minus 1½ percent within the following limits:
   1. 3 to 6 percent, 1½" max. aggregate.
   2. to 6.5 percent, 1" max. aggregate.
   3. 4 to 8 percent, ¾" max. aggregate.
   4. 5 to 9 percent, ½" max. aggregate.

D. Calcium chloride shall not be used.

E. Slump: Select proportions to produce concrete with the following maximum allowable slumps. The slump limits given shall apply after inclusion of the admixture.

Reinforced piers, footings	5"+/- 1"
Reinfoced walls, beams, slabs	5" +/- 1"
Pavement, flatwork	5" +/- 1"

2.4 MIXING AND DELIVERY

A. Measurement of concrete materials, mixing, and delivery of fresh concrete to the project shall meet the requirements of ASTM C94/C94M. Transit-mixed concrete supplier shall have a plant with sufficient capacity and transportation facilities to assure continuous delivery at the rate required.

B. Mix concrete in accordance with ASTM C94/C94M, Alternative No. 2, or ACI 304.

C. Deliver concrete in accordance with ASTM C94/C94M.

D. Select proportions for normal weight concrete in accordance with ACI 301 Method 1. Mix not less than one minute after materials are in mixer.

E. Do not transport or use concrete after 90 minutes has expired from time of initial mixing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before any concrete is placed, the forms and reinforcement shall be inspected by the Contractor and the Owner’s testing laboratory. Notify the Owner’s testing laboratory not less than one working day before concrete is scheduled to be placed. Bucks, sleeves, anchors and other fixtures to be embedded in concrete shall be properly positioned and anchored. Wash down form surfaces to remove foreign substances. Provide elevated runways clearing steel and other embedded work.

B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

C. At locations where new concrete is doweled to existing work, drill over-sized holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.

3.2 CONVEYING CONCRETE

A. Convey concrete to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Equipment for chuting, pumping, and pneumatically conveying concrete shall be such as to assure a continuous flow of concrete at the delivery end without separation. The use of aluminum chutes or pipes for transporting concrete will not be permitted.

3.3 PLACING CONCRETE

A. Notify Architect and testing laboratory a minimum of 24 hours prior to commencement of concreting operations.

B. General: Place concrete in continuous horizontal lifts no deeper than 24". Avoid inclined lifts and inclined construction joints and do not cause or allow concrete to flow horizontally in the forms. Keep conveying equipment clean and free of hardened concrete. Use tremies or suitable chutes for placing concrete in high narrow walls so that concrete will not have a free vertical fall in excess of 3'.

C. Place concrete in accordance with ACI 301 and as specified below:
   1. Unless protection is provided, do not place concrete in rain, sleet, or snow.
   2. Regulate rate of placement so concrete remains plastic and flows into position.
   3. Deposit concrete continuously until panel or section is completed. Place as near as possible to its final location; do not rehandle.
   4. Do not place concrete, under any circumstances, except in presence of testing laboratory.
   5. When placing concrete in masonry, exercise extreme care to prevent concrete from staining face of masonry.
   6. Consolidation
      a. Comply with requirements of ACI 309.
      b. Use mechanical vibrating equipment for consolidation.
      c. Do not use vibrators to transport concrete in forms.
      d. Use vibrators with sufficient speed and amplitude to consolidate effectively.
      e. Keep a spare vibrator on site during all concrete pours.
      f. Thoroughly consolidate concrete and work around reinforcement, embedded items and into corners of forms. Thoroughly consolidate layers of concrete with previous layers.
   7. Expansion Joint Fillers: Place pre-molded expansion joint fillers at locations as detailed and whenever required to separate site paving from building slabs. Refer to Drawings for required joint dimensions. Reference SECTION 03 11 00 - CONCRETE FORMING AND ACCESSORIES for joint filler products.
   8. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, thoroughly roughen and clean the surfaces of the latter of all foreign matter, scum, and laitance. Re-tighten forms and re-coat the surface of the previously deposited concrete with specified bonding agent per manufacturer's directions.

D. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

E. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.

F. Saw cut control joints at an optimum time after finishing. Use 1/4" thick blade, cutting 1/4 into depth of slab thickness.

G. Separate exterior slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within ¼" of finished slab surface.

H. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.

I. Maintain record of concrete placement. Record date, location, quantity, air temperature and test samples taken.

J. Beams and Walls: Place beams and walls continuously where possible. Start placing at ends of section and progress toward the center. Do not place concrete in beams and walls supported on piers until the concrete in the piers is no longer plastic.

K. Slabs: Place each slab in one continuous operation without joints within the area established for a continuous pour. Start placing at the far end of the area and place each load of concrete against previously placed concrete, not away from it.

L. Drains: Check the setting of floor drains so that they will finish flush with floor surfaces without varying the intended elevations and slopes. Slope surfaces down to drains at least ⅛" per foot or as shown.

M. Compaction: Compact concrete with ramming and spading tools during placing to work the coarse aggregate away from the forms and to produce a dense mass without air pockets. Work concrete through and around reinforcing steel. Do not disturb any embedded work.

N. Consolidation: Use high frequency mechanical vibrators to consolidate concrete and eliminate lift lines in walls exposed to view. Vibrators shall be operated by skilled mechanics under close supervision. Insert and withdraw the vibrator heads at points from 18" to 30" apart for short periods. Do not allow heads to touch the forms.

O. Leveling: Level and grade the top surface of slabs with straight edges over gauge strips. Level the top of foundations for the reception of subsequent work. Level and line steps in like manner over strips or forms. Remove wood spreaders, block, and screeds as the concrete is placed and before it sets.

P. Construction Joints: Generally, locate construction joints in beams and suspended slabs in the middle third of the span. Form each construction joint with a vertical bulkhead. Remove the bulkhead as soon as the concrete has attained its initial set and leave the surface rough. Before placing fresh concrete against the surface, coat the surface with bonding compound applied in conformance with the manufacturer's instructions.

Q. Loading: Do not shake or move the forms and reinforcement nor place any strain on projecting metal after the concrete has taken its initial set. Do not permit loading or traffic of any kind on the construction until the concrete has fully hardened.

R. Hot Weather Placement: Take special care to prevent high temperatures in the fresh concrete during hot weather. Use a set-retarding type admixture to assure that concrete remains workable and lift lines will not be visible. For flatwork use a spray-on evaporation retardant as needed during finishing operations.

S. Mechanical equipment pads required in mechanical yard shall be 6" thick with #4 @12" o.c. each way in mid-slab. Pour pad 6" larger than equipment all around. Additionally provide a continuous poured-down edge beam around the pad 18" deep by 10" wide reinforced with 2-#5 continuous in bottom of beam with #3 ties @ 24" o.c. Add intermediate beams, same size and reinforcing, if pad exceeds 12'-0" in either direction and every 12'-0" thereafter. Provide 4" thick sand bed under slab. Top of slab elevation shall be 3" above finish grade around pad.

T. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

U. Construction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade with inserts ¼" wide by ¼ of slab depth. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured, remove inserts and clean groove of loose debris. If joint pattern is not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible.

3.4 CORRECTING DEFECTIVE CONCRETE

A. Examine concrete for defects as the forms are removed. Concrete out of alignment or with defective surfaces shall be considered as not conforming to the intent of these specifications. Such concrete shall be removed from the project site unless the Architect grants permission to patch the defective area.

B. Concrete that does not attain the specified 28-day strength shall be removed from the project site at the Contractor's expense.

C. Formed surfaces exposed to view shall not have fins, offsets, voids, and bulges. Minor grain marks will not be objectionable, but the texture shall be uniform. Leave corners and other details sharply defined and surfaces straight and true.

D. Repair honeycomb, pour joints, stone pockets, and like imperfections by wetting and pointing with mortar to match adjacent concrete. Where unacceptable surface blemishes occur on concrete exposed to view, rub the entire surface to produce a uniform appearance throughout.

3.5 FILLING TIE ROD AND BOLT HOLES

A. Fill solidly with stiff cement grout the holes in concrete resulting from the removal of bolts and rods. Strike off flush any excess mortar at the faces of the holes. In concrete exposed to view, holes shall be patched with mortar to match adjacent concrete.

3.6 CONCRETE TOPPING

A. Concrete Toppings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 3000 psi at 28 days.
   2. Minimum Cementitious Materials Content: 540 lb/cu. yd.
   3. Slump Limits: 5 inches, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. _____ Provide concrete topping as detailed, at minimum thickness of 2 inches. Before the topping is placed, remove loose dirt and sand particles with a stiff broom. Brush in a bonding coat of neat cement just ahead of the topping. Screed, tamp, and float the topping to the lines and slopes indicated. Finish as specified below.

C. Delay installation of concrete toppings at entrances to insure that finished surfaces will not be stained nor damaged by subsequent construction activities. Remove and re-installed stained or damaged concrete toppings at entrances as directed by Architect.

3.7 CONCRETE STAIR FILL

A. Provide concrete fill in the tread and landing pans of the steel stairs. Mix the fill with 1 part Portland cement, 1½ parts sand, and 2 parts pea gravel, by volume. Place fill and trowel to a dense, smooth finish free of blemishes.

3.8 CONCRETE FINISHING

A. Rubbed Concrete Finish
   1. Exposed non-wearing concrete surfaces noted to be "Rubbed Concrete" shall be given a rubbed finish.
      a. Remove the forms as soon as possible and while the concrete is still "green". Level offsets and fins, and repair surfaces.
      b. Wet surfaces and rub with a carborundum brick or other suitable abrasive to obtain a uniformly textured and colored finish. Flush the surfaces with clean water to remove slurry and loose particles.
      c. After the rough work on the building has been completed, again rub the surfaces with a carborundum brick. For this rubbing use a slurry made from a patching and repairing compound equal to "Pave-Crete." Apply the slurry and rub it thoroughly into the concrete to provide the desired finish. Remove surplus slurry with burlap before it hardens.
      d. The finished work shall be free of holes and other unsightly defects and shall be uniform in texture and color. Leave corners sharply defined and surfaces straight and true.

3.9 CONCRETE FLOOR, SLAB, AND TOPPING FINISHES

A. Steel Trowel: For concrete floor surfaces to be left exposed, to receive resilient tile, or carpet, provide a standard integral trowel finish. This finish is required on all concrete wearing surfaces for which other specific finishes are not indicated or scheduled.
   1. Strike the surface at the finish floor elevation, and roll and tamp the concrete to force aggregate away from the surface. Screed to a true, level surface except where slopes are specifically indicated, and float when hard enough to support knee boards.

2. Bring the surface to a true grade by cutting down high spots and filling low spots with fresh concrete. Test with a 16 ft. straight edge, or shorter in restricted areas, and limit surface variations to not more than ¼" in 16'.
3. Finish the floor with a steel trowel to a smooth dense surface. When hard enough to ring under the trowel, burnish the surface to the final polished finish.

B. Smooth: Concrete slab surfaces to be covered with thinset ceramic tile shall receive steel trowel finish, except that the second burnish troweling shall be omitted. Leave surfaces with some "tooth" for a bond.

C. Rough: Concrete slab surfaces to be covered with quarry and ceramic tile shall be roughened for bond by scrubbing with stiff brooms to exposed the aggregate before laitance has hardened. Sweep the surfaces to remove loose material.

D. Brush: Provide a texture finish for exterior concrete except where scheduled otherwise. After floating and an initial troweling, go over the surfaces with a soft bristle brush or broom to produce a fine textured non-slip finish. Exposed vertical surfaces and corners shall be tooled and troweled smooth.

E. Float: Concrete slab surfaces to be covered with membrane waterproofing and with insulation board, or slabs with sloped surfaces, shall be screeded and floated to a true, relatively smooth finish without sharp projections, offsets and other irregularities.

3.10 CURING

A. Cure all concrete at least 7 days. All curing procedures shall prevent evaporation of moisture from the concrete for the full curing period. Protect surfaces from traffic damage until the curing is complete.

B. Keep exposed vertical surfaces and the tops of beams and walls moist by spraying with water or covering with saturated burlap, starting as soon as the surfaces will resist erosion.

C. Concrete surfaces to be covered with thinset flooring materials (ceramic tile, vinyl composition tile, etc.), shall be cured by covering with reinforced 2-ply paper or 4 mil thick polyethylene sheeting laid with joints lapped 3" and sealed with tape. Do not use curing compound on these surfaces.

D. Coat other concrete wearing surfaces with the curing and sealing compound, using at least 1 gallon per 300 sq. ft. Areas damaged by traffic or subsequent construction operations shall be re-coated.

3.11 FIELD QUALITY CONTROL

A. Acceptance Tests:
1. Samples for strength tests of concrete shall be taken from each 75 cu. yds., or fraction thereof, of each mix design of concrete placed in any one day.
2. Sampling procedures shall meet the requirements of ASTM C172/C172M. If concrete is being pumped, take concrete samples for testing at the point of placement and not at the mixer discharge.
3. Make and record a slump test on each sample. The method of test shall meet the requirements of ASTM C143/C143M.
4. Make 4 cylinders from each sample for strength tests, 1 for 7-day, 2 for 28-day test, and 1 in reserve. The cylinders shall be made on the project site by an Independent Testing Laboratory and shall be cured and tested in conformance with the requirements of ASTM C31/C31M and ASTM C39/C39M.
5. Samples for 3-day strength tests may be taken at the Contractor's discretion and at the Contractor's expense.
6. Samples for temperature and slump tests of concrete shall be taken from each truck, of each mix design of concrete placed in any one day.
7. Testing lab representative shall be on site at all times during concrete pours.
8. No water shall be added to concrete mix on project site without approval from Owner's Testing Laboratory.
9. Concrete delivery tickets for all trucks shall be given to General Contractor for later submission to Owner. Delivery tickets shall record time truck left plant, time truck arrived at site and mix design number being delivered. A maximum of 90 minutes will be allowed from mixing of concrete to delivery.

B. Evaluation of Test Results:
1. Each strength test result shall be the average of 2 cylinders from the same sample tested at 28 days.

2. Strength of each concrete mixture will be satisfactory if the average of any 3 consecutive compressive-strength tests equals or exceeds the specified compressive strength and no individual strength test value falls below specified compressive strength by more than 500 psi.
3. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that compressive strengths or other requirements have not been met. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work.

C. The cost of testing service shall be per SECTION 01 45 23 - TESTING AND INSPECTION SERVICES.

3.12 GROUTING

A. Grout base plates and other structural members. Pea gravel may be added to the grout if the space to be grouted is 1" thick or more. Do not add sand to the grout.

3.13 BASE PLATE ANCHOR BOLTS

A. Set the anchor bolts for steel base plates. Use templates.

3.14 PATCHING

A. Patch and repair existing concrete to restore smooth, uniform surfaces.

B. Prepare the surfaces by removing loose and faulty material down to firm concrete. Edges of concrete exposed to view shall be saw-cut straight and square. Brush the surfaces free of dirt and debris and flush down with clean water. After the surfaces are dry, coat them with bonding compound used in conformance with the manufacturer's instructions.

C. Major patching and deep fills shall be done with a mixture of 1 part Portland cement, 1½ parts sand, and 1½ parts pea gravel. Work and tamp the fill into place, screed the surface and float and trowel to a smooth finish. Cure as specified above.

D. Minor patching and re-surfacing of concrete to be covered with tile and carpet shall be done using a suitable re-surfacing material such as Ardex K-15 or Super Flo-Top, which can be carried to a feather edge. Mix and apply in conformance with the manufacturer's instructions and finish to a smooth surface.

3.15 SEALING EXPOSED CONCRETE FLOORS

A. Immediately prior to completion of the building, clean exposed concrete floors to remove dirt, stains, paint, oil and grease. Coat the clean, dry surfaces with sealing compound. Application shall conform to the manufacturer's instructions. Do not allow to puddle.

3.16 PROTECTION AND CLEAN UP

A. Floor Protection: All concrete floors which will be exposed to view in the completed building shall be covered with reinforced paper with joints lapped and sealed. Maintain the protective covering until all wet work in the building (masonry, plaster, and tile) is completed.

B. Clean Up: Excess concrete and wash water from concrete truck drums shall not be dumped anywhere on the site or on adjoining streets, but shall be disposed of away from the premises.

END OF SECTION

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1SUMMARY

A. Section Includes: Structural metal framing.

B. Related Sections:
1. Section 01 45 23 - TESTING AND INSPECTION SERVICES.
2. Section 03 30 00 - CAST-IN-PLACE CONCRETE: grouting under base plates.
3. Section 05 40 00 - COLD-FORMED METAL FRAMING: lightgage framing.

1.2 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

C. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014 Edition.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.

F. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

G. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2024.

H. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

I. ASTM F1852 - Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014 Edition.

1.3 SUBMITTALS

A. General:
1. Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
2. Contractor shall be responsible for omissions and errors and for conformance with the drawings and specifications relative to the various details.
3. Architect's review will cover member sizes, strength of connections and general arrangements but not dimensions or quantities.

B. Shop Drawings: Indicate shop and erection details, including cuts, copes, connections, holes, threaded fasteners and welds.

C. Product Data:
1. Provide Manufacturer's data and certification for pre-assembled bolt, washer, and nut.
2. Provide copy of Welders' Certification. Welders must show proof of certification within the last year prior to starting any welding on the project.

1.4 QUALITY ASSURANCE

A. Codes and Standards:
1. Fabrication and erection shall comply with the requirements of AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", "Specifications for Structural Joints using ASTM A325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation and "Code of Standard Practices for Steel Buildings and Bridges", latest editions.
2. Welders and welding procedures shall comply with requirements of ANSI/AWS D1.3/D1.3M Structural Welding Code.
3. Steel Structure Painting Council
a. Painting Manual, Volume 1, Good Painting Practice.
b. Painting Manual, Volume 2, Systems Specifications.
4. Research Council on Riveted and Bolted Structural Joints: "Specifications for Structural Joints using ASTM A325 Bolts.

B. Design
1. Substitutions: Submit substitutions of sections or modifications of details, or both, and the reasons with the shop drawings for approval. Submitted substitutions must be clearly identified and noted as such. Coordinate approved substitutions, modifications, and necessary changes in related portions of the work by the fabricator and accomplish same at no additional cost to the Owner.
2. Responsibility for errors: The Fabricator shall be responsible for all errors of detailing, fabrications, and for the correct fitting of structural steel members.

1.5 QUALIFICATIONS

A. Structural Steel Fabricator: Not less than 5 years' experience in the fabrication of structural steel for buildings.

B. Structural Steel Erection: Not less than 5 years' experience in the erection of structural steel. Welders must be qualified to perform all procedures and positions encountered per AWS certification standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Bolts and other anchorage devices to be embedded in concrete and masonry shall be delivered to the site before the start of concrete or masonry work. Furnish setting drawings and templates for the installation of anchor bolts.

B. Fasteners shall be protected from dirt and moisture at the project site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that is present in as- delivered condition.

1.7 PROJECT CONDITIONS

A. Coordinate erection of structural steel with work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel:
1. ASTM A36/A36M, typical Channels, Angles, Bars, and Plates.
2. ASTM A992/A992M, W Shapes.

B. Hollow Structural Sections: ASTM A500/A500M, Grade B and C.

C. Pipe Columns: ASTM A53/A53M, Grade B.

D. Anchor Rods, Bolts, Nuts, and Washers:
1. Anchor Rods: ASTM F1554, Grade 55.

2. Nuts: ASTM A563, heavy hex Grade C, C3, D, DH, or DH3.
3. Washers: ASTM F436/F436M.

E. High-Strength Bolts, Nuts, and Washers:
1. Heavy hex steel structural bolts: ASTM A325, Type 1, uncoated.
2. Heavy hex carbon-steel nuts: ASTM A563, Grade C, C3, D, DH, or DH3.
3. Hardened carbon-steel washers: ASTM F436/F436M.

F. Tension Control Bolt Assemblies: ASTM F1852; Lohr "High Strength Rapid Tension Bolts".

G. Shop Paint: SSPC-Paint 25, Type I, iron oxide, zinc oxide, raw linseed oil, and alkyd. Do not prime areas which are to receive sprayed-on fireproofing.

H. Bituminous Paint: Cold applied asphalt mastic, SSPC Paint 12, compounded for 30-mil thickness per coat.

2.2 FABRICATION

A. General: Fabricate structural steel in accordance with referenced specifications.
1. Drawings indicate the design, sections and weights of members. Make no substitutions except with the written permission of the Architect. Do not use dimensions scaled from the drawings for fabrication. Contractor shall, when necessary, determine actual dimensions at the building.
2. Workmanship shall conform to the best practice in structural steel shops. Materials shall be clean and straight. Shop kinks will not be permitted.
3. Exposed steel, where in view, shall meet the requirements of the AISC Manual for "Architecturally Exposed Structural Steel."

B. Connections shall conform to the standard specifications of the American Institute of Steel Construction.

C. Punching:
1. Shop-punch steel members for bolts and hanger rods needed to support wood nailers and other items.
2. At hollow structural sections located in the exterior building envelope, provide shop-punched holes in steel sections as indicated on drawings, for installation of sprayed foam insulation to completely fill hollow structural section cavity

D. Marking: Components of high strength steel required to have a yield stress greater than 36 kips/sq. in. shall be clearly marked with the ASTM designation over any shop coat prior to shipment from the fabricator's plant.

E. Shop Painting:
1. Do not paint steel surfaces to be welded, including top flange of steel beams that are to receive shear studs. Do not paint steel surfaces which are scheduled to receive sprayed-on fireproofing. Clean this steelwork of oil and grease with solvent cleaner and remove dirt and other foreign matter by sweeping with brushes or with compressed air.
2. Apply one coat of shop paint to steel. Prior to application of shop paint clean steel to remove loose mill scale, rust, weld slag, dirt, and other foreign matter. Clean welds of spatter, smoke, and iron oxide film. Remove oil and grease with solvent cleaner
3. Apply shop paint to dry surfaces thoroughly and evenly by brush, spray, roller coating, or dipping at the election of the fabricator.

PART 3 - EXECUTION

3.1 ERECTION

A. General: Comply with AISC Specifications and Code of Standard Practice, and as herein specified.

B. Erection of structural metal shall comply with the requirements of referenced codes and standards.
1. The use of a cutting torch for field correction of fabricating errors will be permitted only with the approval of the Architect. For each fabrication error the Contractor shall submit a drawing of existing conditions and the proposed correction for the Architect's review.
2. Set column base plates to correct elevations; support temporarily on shims until the columns have been plumbed and grouted.

3. Make field connections by electric arc welding or with high-strength pre-assembled threaded fasteners.

C. Metal Protection: Apply two coats of bituminous paint to all steel members embedded or in contact with soil.

D. Make high-strength bolted connections in conformance with "Specifications for Structural Joints Using ASTM A325 Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints, November 13, 1985.
1. Prior to installation, clean bolts, nuts, and washers, if required. Dirt and noticeable rust on bolts, nuts, and washers will not be allowed.
2. Install Lohr "High Strength Rapid Tension Bolts" in accordance with the manufacturer's instructions.

E. Erect steel framing true and plumb; brace temporarily where necessary to handle all loads to which the structure may be subjected. The Contractor shall remove such bracing as part of his equipment. Securely connect all work to take care of dead load, wind, and erection stresses.

F. Steel framing members supporting and connected to metal panels shall be erected to ⅛" tolerance for entire member length in any direction.

G. Provide neoprene rubber bearing pads where steel beams bear on concrete.

3.2 FIELD QUALITY CONTROL

A. Inspection and Testing: Verification inspection and testing of all field connections shall be done by an Independent Testing Laboratory, and copies of the inspection and test reports shall be submitted to the Architect and Contractor. The cost of these inspections and tests shall be paid as specified in SECTION 01 45 23 - TESTING AND INSPECTION SERVICES.

B. High-Strength Bolted Connections: All bolted connections shall be visually inspected in accordance with manufacturer's specifications.

C. Welded Connections:
1. All field fillet welds shall be visually inspected in accordance with the applicable parts of AWS D1.1/D1.1M Section 6, Inspection.
2. In addition to visual inspection, full penetration butt welds shall be subjected to ultrasonic testing in accordance with AWS D1.1/D1.1M, Section 6, Part C, Ultrasonic Testing of Groove Welds.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior non-load-bearing wall framing.
   2. Cold-formed steel angles at wall openings and copings.

B. Related Sections:
   1. Section 05 12 00 - STRUCTURAL STEEL FRAMING.
   2. Section 05 50 00 - METAL FABRICATIONS: steel angles.
   3. Section 07 42 13 - METAL WALL PANELS.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2025.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025, with Amendment (2026).

E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2025, with Errata (2026).

F. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

G. ICC-ES AC58 - Acceptance Criteria for Adhesive Anchors in Cracked and Uncracked Masonry Elements; 2022.

H. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

I. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.3 SYSTEM DESCRIPTION

1.4 SUBMITTALS

A. Product Data: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include manufacturer's specifications, load tables, dimension diagrams, anchor details, installation instructions for products to be used in lightgage framing work, and type and location of fasteners. Describe materials and finish, product criteria, and limitations.

B. Shop Drawings: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Drawings shall incorporate fabrication and erection details.

C. Evaluation Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. All structural members shall be designed in accordance with AISI "Specifications for the Design of Cold-Formed Steel Structural Members", latest edition.

B. Qualifications: Welders and welding procedures shall comply with the requirements of ANSI/AWS D1.3/D1.3M Structural Welding Code.

1.6 DELIVERY AND STORAGE

A. Protect metal members from rusting and damage. Deliver to project site in manufacturer's containers or bundles, fully identified with name, brand, type and grade. Store off the ground in a dry, ventilated space.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lightgage Steel Framing: Basis of Design ClarkDietrich Building Systems (phone 800.543.7140 web site: www.clarkdietrich.com). ASTM A1003/A1003M, Provide Metal Framing, 18 gage minimum with 1-5/8” flange minimum, structural stud framing members. Refer to structural drawings for specific size, type, and locations of framing which may be used on the project.

B. Substitutions: Under provisions of SECTION 01 62 00 - PRODUCT OPTIONS. Other acceptable manufacturer's with products of equal substance and function include:
CEMCO Steel
Marino/Ware
Mill Steel Company
The Steel Network

C. Furnish bridging and bracing members shown or required for a complete and structurally sound installation.

D. Track: Formed steel; channel shaped; same width and finish as studs, tight fit; 18 gage thick, solid web.

2.2 ACCESSORIES

A. Slide Clips: ASTM A653/A653M, Grade A, galvanized metal clip.
1. ASTM A653/A653M, Grade C, galvanized metal clip.
2. Designed and manufactured for attachment of metal stud framing to edge of structural steel framing.
3. Permits differential vertical movement between stud and floor or roof structure.
4. Clip and its connection to structure shall be adequate to safely brace metal studs to resist design lateral load of at least 330 pounds (allowable stress increase permitted by Building Code already taken into account).

B. Bracing and Furring: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

C. Bridging: 1-1/2" C.R. channels, 16 ga; same finish as framing members.

D. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer’s standard widths to match width of bottom track or rim track members as required.

F. Glazing System, Door and Louver Perimeter Angle, and Coping Nailer Support Angle:
1. This shall include cold-formed stainless steel angles around exterior glazing system openings, exterior door openings and exterior louver openings as detailed at stud, CMU and concrete walls.
2. This shall include continuous cold-formed steel support angles supporting wood nailers at copings and other similar conditions as detailed at stud, CMU and concrete walls.
3. Fabricate perimeter angle and coping nailer support angle from SEI/ASCE 8-02, Type 304 stainless steel sheet.

2.3 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A 90, hot dip galvanized.

B. Anchorage Devices: Power driven as recommended by manufacturer for size and spacing.

C. Welding Electrodes: Comply with AWS D1.1/D1.1M and AWS D1.3/D1.3M.

D. Post-Installed Anchors (for securing window perimeter angle to masonry or concrete structure): Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

2.4 FABRICATION

A. General: Framing components may be prefabricated into panels prior to erection. Cut framing components accurately to fit squarely against abutting members. Hold members firmly in position until properly fastened. Prefabricated panels shall be square and braced against racking. Attach similar components by welding.

B. Protective Finishing: Paint abraded surfaces and welds after fabrication, using galvanizing repair paint for galvanized surfaces.

2.5 FINISHES

A. All framing members shall be formed from hot-dip galvanized steel, G60 (Z180) coating, conforming to the requirements of ASTM A1003/A1003M, Structural Grade, Type H.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel framing members and accessories in accordance with the manufacturer's instructions and the erection drawings. Spacing of studs shall not exceed 16" o.c.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

C. Securely anchor track to floor and overhead structure or member. Seat studs squarely in the track with the stud flange securely attached to the flanges of both upper and lower track.
1. Attach structural components by welding, bolting or with self-drilling screws.
2. Wire tying of framing components in structural applications will not be permitted.

D. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thinness of 2.0 mils. For galvanized surfaces, apply galvanizing repair paint.

E. Construct corners using minimum three studs. Double stud at wall opening, door, and window jambs.

F. Provide vertical stud within 12 inches of jamb for brick anchor attachment at openings. Reference BIA Technical Note 28B.

G. Provide rows of horizontal bridging welded in place at spacing recommended by stud manufacturer to resist lateral forces and stud rotation.

3.2 TOLERANCES

A. Maximum Variation from True Position: ±1/8" from plan location.

B. Maximum Variation of any Member from Plane: 1/8" in 10 feet.

END OF SECTION

SECTION 08 11 00

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hollow metal doors and frames, sidelight frames, and borrowed light frames.

B. Related Sections:
1. Section 08 71 00 - DOOR HARDWARE: hardware locations.
2. Section 09 91 00 - PAINTING: finishing of hollow metal doors and frames.

1.2 REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2026.

B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2026.

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025, with Amendment (2024).

1.3 SUBMITTALS

A. Shop Drawings: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
1. Include door sizes, construction, frame types, wall anchors, and accessories required for installation.

1.4 QUALITY ASSURANCE

A. Standard: Provide steel doors and frames complying with the Steel Door Institute ANSI/SDI A250.8 and as herein specified. Hollow metal provider that is not a member of the Steel Door Institute is not approved and must submit product data and samples for review.

B. Conform to requirements of ANSI/SDI A250.8.

C. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal doors and frames to the project site with no dents or open seams and store upright in a protected dry area. Provide packaging and wrapping to protect hollow metal items.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide steel doors and frames as manufactured by one of the following:
Ceco Door Products; an ASSA ABLOY Group Co.
Curries Company; an ASSA ABLOY Group Co.
Deansteel Mfg., Inc.
Mesker Door, Inc.
Republic Builders Products Co.

Steelcraft; an Ingersoll-Rand Co.

2.2 MATERIALS

A. Sheet and Strip: ASTM A1008/A1008M, commercial quality, leveled, cold-rolled steel free of scale and other surface defects.

2.3 FABRICATION

A. Flush Steel Doors: Full flush type of welded seamless construction with no visible seams or joints on faces or vertical edges.
   1. Exterior Doors:
      a. Extra Heavy Duty; 0.053” thick metallic-coated steel sheet faces (16 ga.); ANSI/SDI A250.8 Level 3; ANSI/SDI A250.4 Performance Level A; Edge Construction Model 2 Seamless.
      b. Provide foamed-in-place polyurethane insulation with maximum U-factor of 0.37 for assembly with frame.
      c. Steel reinforced, stiffened and sound-deadened by laminating insulation completely filling the door and formed steel vertical stiffeners spaced 6" o.c. and attached to face sheets by spot welds and with the spaces between stiffeners filled with insulation material.
      d. Face: Metallic-coated steel sheet, with minimum A60 coating.
   2. Steel thickness is thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.
   3. Continuous vertical interlocking joints on lock and hinge edges with seams continuously welded, filled and dressed smooth. Bevel vertical edges.
   4. Top and bottom edges closed with continuous recessed steel channels spot welded to both faces. Top edge of exterior doors sealed flush with closing channel to exclude water.
   5. Overlapping steel astragals for pairs of labeled doors as required by manufacturer to meet codes.
   6. Louvers: Provide factory installed, inverted "V" or "Y" sightproof type fixed louvers. Louver blades shall be 18 gage and frame shall be 18 gage welded construction.

B. Steel Frames: Combination buck, frame and trim type. Provide frames with face width, throat opening, backbend, and jamb depth as per dimensions shown.
   1. Exterior Frames:
      a. Extra Heavy Duty; 0.067” thick metallic-coated steel sheet (14 ga.); ANSI/SDI A250.8 Level 3; ANSI/SDI A250.4 Performance Level A.
      b. Continuously welded (full profile welded).
      c. Metallic-coated steel sheet with minimum A60 coating.
   2. Brake-form to profile free of warp, buckles, and fractures with corners square and sharp. Form stop integral with frame except where detailed otherwise. Dress sheared edges straight and smooth.
   3. Close corner joints tight with trim faces mitered and continuously welded. Dress exposed welds flush and smooth.
   4. Fabricate frames for large openings in knocked-down sections for field assembly with butt joints and internal reinforcing sleeves. Knocked-down frame assemblies shall be trial assembled in the shop.
   5. Loose glazing stops shall be 16 gage steel, mitered corners, fastened with countersunk flathead screws. Fabricate stops to receive vinyl gaskets.
   6. Weld 14 gage steel floor anchors inside each jamb with two holes each anchor for floor anchor bolts.
   7. Furnish frames with steel spreader temporarily fastened to the feet of both jambs for rigidity during shipping and handling.

C. Shop Finish: After fabrication, doors and frames shall be degreased, phosphatized, and factory painted inside and out with a rust inhibitive synthetic primer. Apply mineral filler to eliminate weld scars and other blemishes.

D. Fabricate frames and doors with hardware reinforcement plates welded in place. Provide mortar guard boxes.

E. Reinforce frames wider than 48" with roll formed steel channels fitted tightly into frame head, flush with top.

F. Prepare frame for silencers. Provide three single rubber silencers for single doors and mullions of double doors on strike side, and two single silencers on frame head at double doors without mullions.

G. Close top edge of exterior door flush with inverted steel channel closure. Seal joints watertight.

2.4 HARDWARE PREPARATION

A. Prepare doors and door frames for hardware. Mortising, reinforcing, drilling, and tapping shall be done at the factory for mortised hardware. Reinforcement shall be provided for surface-applied hardware, and the drilling and tapping for this hardware shall be done in the field. Provide plaster guards for hinge and strike reinforcements and cutouts on frames.

B. Reinforcement plates in doors and frames for hardware shall be 7 gage for hinges and 12 gage for all other hardware.

C. Punch for and install rubber silencers on all interior hollow metal door frames. Furnish 3 silencers for each single door and 2 silencers for each pair of doors. Set out and adjust strikes to provide clearance for the silencers. Omit silencers on exterior door frames.

2.5 CLEARANCES

A. Doors shall have pre-fit clearances of:
   1. At Head and Lock Stile: 1/8".
   2. At Hinge Stile: 1/16".
   3. At Door Sill:
      a. Without Threshold: 1/8" from bottom of door to top of decorative floor finish or covering.
      b. With Threshold: 1/8" from bottom of door to top of threshold.
   4. Between meeting edges of pair of doors: 1/8".

2.6 ACCESSORIES

A. Rubber Silencers: Resilient rubber.

B. Anchors: Three per jamb, typically, of type to suit supportive construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate conditions under provisions of SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify surfaces and conditions are ready to receive work of this section. Notify Architect of any existing conditions which will adversely affect execution. Beginning of execution will constitute acceptance of existing conditions.

3.2 INSTALLATION

A. Install frames in accordance with SDI-105.

B. Install doors in accordance with DHI.

C. Install fire-rated frames and place fire-rated doors in accordance with NFPA 80.

D. Coordinate with masonry and wallboard construction for anchor placement.

E. Coordinate installation of glass and glazing.

F. Install doors accurately in frames, maintaining specified clearances.

G. Setting Frames:
   1. Check frames for rack, twist and out-of-square, and correct.
   2. Set frames accurately to maintain scheduled dimensions, hold head level and maintain jambs plumb and square.
   3. Anchor frames securely to adjacent construction. Anchor to floor at each jamb with two bolts to prevent twist.
   4. Leave spreader bars in place until frames have been permanently built into the walls.

H. Hanging Doors:
   1. Fit and hang the doors to maintain specified door clearances. Metal hinge shims are acceptable to maintain clearances.
   2. Doors shall be out of wind and shall operate smoothly and quietly after adjustment.

3.3 TOLERANCES

A. Maximum Diagonal Distortion: 1/8" measured with straight edge, corner to corner.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Coiling doors.

B. Related Sections:
   1. Section 05 50 00 - METAL FABRICATIONS: steel frames for coiling door openings.
   2. Section 08 71 00 - DOOR HARDWARE: cylinders.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

B. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test; 2022.

C. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2026.

D. ICC (IECC)-2021 - International Energy Conservation Code; 2021.

E. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; 2020.

1.3 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Include installation details and operating procedures.

C. Product Data and Testing:
   1. Insulated Coiling Doors
      a. Provide documentation that doors meet ICC (IECC)-2021 requirements.
      b. Provide Air Leakage Test Report per ASTM E283/E283M.
   2. Tornado and Hurricane Resistant Coiling Doors: Provide documentation that doors meet requirements of ICC 500.

D. Certifications:
   1. Provide certification of compliance with ICC 500-2014 ICC/NSSA Standard for the Design and Construction of Storm Shelters
   2. Provide certification of compliance with FEMA 361 Safe Rooms for Tornados and Hurricanes.
   3. Provide certification of compliance to sustain 300 psf wind pressure in accordance with ASTM E330.
   4. Provide certification of compliance in accordance with the requirements of ASTM E1886 Large Missile Impact for FEMA 361 assemblies.

1.4 QUALITY ASSURANCE

A. Wind Load:
   1. Standard Doors: Exterior coiling doors shall be constructed to safely resist uniform pressure (velocity pressure) of 22.
   2. Standard Doors in Coastal Areas: Exterior coiling doors shall be constructed to safely resist uniform pressure (velocity pressure) of 43.8 psf .

PART 2 - PRODUCTS

2.1 COILING DOORS

A. Provide face-of-wall mounted coiling door. Product/manufacturer; one of the following:
ESD10; Cornell/Cookson, LLC.
610 Series; Overhead Door Corp.
1. Operation: Chain hoist using hand chain and Chain hoist using removable hand cranK.
2. Curtains:
a. Interlocking slats cold roll formed of galvanized steel.
b. End of alternate slats to be fitted with malleable iron endlocks.
c. Slat design shall satisfy a windload of 20 psf.
d. Curtain to be reinforced with bottom bar consisting of two angles of galvanized steel. Install weatherseal on bottom of bars.
3. Spring Counterbalance:
a. House in steel pipe of diameter and wall thickness to restrict maximum deflection to 0.03" per foot of door width.
b. Springs to be helical torsion type.
c. Spring tension to be adjustable by means of external adjustment wheel.
4. Bracket Plates: 1/4" thick min. steel formed to fit contour of end bracket.
5. Guides:
a. Structural galvanized steel angles of 3/16" min. thickness.
b. Fit guides with two flexible weathering strips (both sides). Door shall not rattle in wind.
6. Hoods:
a. Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head when not concealed in ceiling. Contour to fit end brackets to which hood is attached. Roll and reinforice top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face.
b. Fabricated of galvanized steel sheet metal no lighter than 24 gage, laterally reinforced.
c. Provide intermediate hood supports for hoods exceeding 16'-0".
d. Fit with internal neoprene header weather baffle.
e. Fit entire length of hood with internal 4" brush seal with aluminum retainer to act as wind baffle. Door shall not rattle in wind.
7. Locks: Provide slide bolts suitable for padlocks for manually operated doors.
8. Finish:
a. Galvanized Surfaces:
1) Base Coat: ASTM A653/A653M galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat.
2) Finish Coat: Zirconium treatment followed by baked-on polyester powder coat, with color as selected by Architect; minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness; H or better.
b. Ungalvanized Surfaces: Shop coat of rust inhibiting metallic primer.
9. Weatherstripping: Door to be fully weatherstripped at sill, hood, and at guides.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coiling doors shall be installed by skilled mechanics supervised by the manufacturer's authorized representative.

B. Erect the doors, guides, and accessories in a rigid substantial manner, straight and plumb, and with horizontal lines level.

C. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL Listed.

3.2 TESTING AND ADJUSTING

A. Upon completion of installation, put all items through at least ten operating cycles. Make required adjustments and assure that components are in optimum operating condition.

END OF SECTION

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SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Commercial door hardware, weatherstripping, sound seals, smoke seals, and thresholds to fully equip doors throughout the project, including aluminum doors.

B. Related Sections:
   1. Section 06 40 00 - ARCHITECTURAL WOODWORK: millwork hardware.
   2. Section 08 11 00 - HOLLOW METAL DOORS AND FRAMES.
   3. Section 08 33 23 - OVERHEAD COILING DOORS

1.2 REFERENCE STANDARDS

A. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025, with Amendment (2024).

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

E. UL 305 - Standard for Panic Hardware; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Hardware Schedule: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Hardware schedule shall be in the vertical format as outlined by the Door and Hardware Institute. Schedule items required for the entire project. Include a picture or catalog cut of each item and list the finish. Provide manufacturer's installation instructions for closers.
   1. An explanation of abbreviations, symbols, and codes contained in schedule must accompany all documentation submitted.
   2. Door hardware schedule shall be prepared by or under the supervision of supplier’s or installer's Architectural Hardware Consultant, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams.
   3. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

B. Templates: Upon receipt of reviewed hardware schedule, provide one copy of reviewed schedule with templates to each fabricator of doors and frames and other work effected by the hardware.

C. Accessibility Standards: Submit a letter verifying that the hardware submitted is in conformance with Texas Accessibility Standards (TAS), Architectural Barriers Act--Article 9102, Vernon's Texas Civil Statutes and Texas Government Code, Chapter 469 and ICC A117.1 Accessible and Usable Buildings and Facilities (International Building Code).

D. Certifications:
   1. Architectural Hardware Consultant shall inspect complete installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer’s instructions.
   2. Provide two copies of certifications to Architect.

E. Keying Schedule: Prepared by or under the supervision of supplier's or installer's Architectural Hardware Consultant detailing Owner's final keying instructions after a keying meeting with the Owner has taken place. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

F. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
2. Qualification Data: For Installer and Architectural Hardware Consultant.

G. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.4 QUALITY ASSURANCE

A. Departures from Scheduled Designations: Only those products listed will be accepted. NO SUBSTITUTIONS WILL BE ACCEPTED. Manufacturers listed as being acceptable must still meet the conditions of this specification.

B. Accessibility Standards: Hardware shall be in conformance with Texas Accessibility Standards (TAS), Architectural Barriers Act--Article 9102, Vernon's Texas Civil Statutes and Texas Government Code, Chapter 469 and ICC A117.1 Accessible and Usable Buildings and Facilities (International Building Code).
1. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
2. Door Closers: The sweep period of closers shall be adjusted so that from an open position of 70°, the door will take at least three seconds to move to an open position of approximately 3" from strike side of door.
3. The maximum force for pushing or pulling open a door shall be as follows:
a. Exterior hinged doors: Reserved.
b. Interior Hinged Doors: Not to exceed 5 lbf. applied perpendicular to door.
c. Sliding or Folding Doors: Not to exceed 5 lbf. applied parallel to door at latch.
d. Fire doors: Adjusted to meet minimum closing force permitted by governing fire safety standards.

C. Life Safety Standard; NFPA 101: Comply with the following for means of egress doors:
1. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
2. Door Closers: Not more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

D. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this project.

E. Hardware Installer Qualifications: Employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying. A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

F. Prior to the installation of the finish hardware, it shall be a contract requirement that the hardware supplier and his representatives be present at the initial installation and to render recommendations as required for the following hardware installation procedures:
1. Installation of all hardware, except hinges, associated with one pair of exterior aluminum entrances.
2. Installation of all hardware, except hinges, associated with one exterior hollow metal door.
3. Installation of all hardware, except hinges, associated with one pair of fire-rated plastic laminate wood doors which utilize vertical rod exit devices.
4. Installation of all hardware, except hinges, associated with one fire-rated plastic laminate wood corridor door.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Material shall be delivered to project site in a timely manner so as not to impede job progress. Factory drop shipments will not be accepted. Material must be marked with manufacturer's name, number, finish, door number, and hardware set number.

1.6 WARRANTY

A. Door closers shall carry a published ten-year limited factory warranty against defects in workmanship and operation.

B. Locksets shall carry a published three-year (minimum) limited factory warranty against defects in workmanship and operation. **[IF ONLY ONE MFR. OR PRODUCT IS ALLOWED, REVISE TO BE WARRANTY FOR THAT MFR.]**

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hinges:
1. Furnish butt hinges with flat button tips.
2. Provide hinges from one manufacturer.
a. Manufacturer: Ives (IVE)
b. Acceptable: Hager, McKinney
3. Manufacturers and respective catalog numbers:

Hager	**Ives**	**McKinney**
BB1279	5BB1	TB2714
BB1168	5BB1HW	T4B3786
BB1191	5BB1	TB2314
BB1199	5BB1HW	T4B3386
1250	- - -	1502

4. Furnish hinges in size, weight, and finishes listed in hardware set. Where scheduled as BB, provide ball bearing hinges. Oil-impregnated porous metal bearing hinges are not acceptable.

B. Locks and Trim:
1. Mortise Locks:
a. Provide mortise locks with three piece anti-friction latch.
b. Provide ASA 4-7/8" standardized strikes with curved lips of sufficient length to protect door jambs and trim from damage by latch bolt.
c. Furnish strikes with steel wrought boxes.
d. Acceptable manufacturers and respective catalog numbers:

Schlage
L9010
L9466
L9486
L9440
L9050
L9070
L9456

L9080

L9457

e. Provide mortise locks in functions as listed in hardware sets.
f. Locks and trim shall be from the same manufacturer.
g. **Provide mortise locks, cylindrical locks, and deadlocks from the same manufacturer.**
   1) Manufacturer: Schlage (SCH)
   2) Acceptable: No Substitution

2. Provide in functions as listed in hardware sets.
   a. Provide cylindrical locks, mortise locks, and deadlocks from the same manufacturer
3. Deadlocks:
   a. Provide mortise, non-handed, locks.
   b. Provide standard strike.
   c. Furnish strikes with steel wrought boxes.
   d. Acceptable manufacturers and respective catalog numbers:

      Schlage

      L463

   e. Provide deadlocks, cylindrical locks, and mortise locks from the same manufacturer.

C. Exit Devices:
1. Provide exit devices in functions as listed in hardware sets (and with cylinder dogging), including cylinder cores.
2. Provide exit devices from one manufacturer.
   a. Manufacturer: Von Duprin (VON)
   b. Acceptable: No Substitution
3. Provide exit devices with stainless steel touch pads.
4. Provide recessed metal strikes where floor and head strikes are scheduled.
5. For mortise exit devices, furnish strikes with wrought boxes.
6. Provide and install exit devices with sex nuts and bolts.
7. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency for fire and panic protection, based on testing according to UL 305 and NFPA 252.
8. Provide full-height rod and latch guard protectors as scheduled.
9. Acceptable manufacturers and respective catalog numbers:

   Von Duprin

   99NL-OP

   99EO

   99L x 07

   99L-F x 07

   9927L x 07

   9927L-F x 07

   9927EO

   9927EO-F

   9947L x 07

   9947L-F x 07

   9947EO

   9947EO-F

   22L

   22L-F

D. Door Closers:
1. Provide door closers with a 50% power adjustment and adjustable backcheck.
2. Provide and install door closers with sex nut and bolts.
3. Do not install on the outside of exterior doors nor on the corridor side of room doors. Install door closers so that the arm is not visible on the public side of the door.
4. Whenever it is necessary to install a closer on the side of the door away from the hinges, use parallel arm, regardless of model number specified.
5. All closers shall have full covers. Door closer covers shall be attached with a minimum of two screws. Snap-on covers will not be acceptable.
6. All exterior closers are required to have extra-duty arms. Door closer arm joints shall be permanently affixed or affixed with tamper proof screws. Snap-apart arms will not be acceptable.
7. Provide all necessary brackets and adaptor plates for a complete installation.
8. Door closers shall be installed to allow for 180° swing.
9. Provide door closers from one manufacturer.
   a. Manufacturer: LCN (LCN)
   b. Acceptable: No Substitution
10. Acceptable manufacturers and respective catalog numbers:

	Exterior/Storefront Doors
LCN	
P4040-EDA	

E. Push, Pull, and Kick Plates:
1. Provide plates in 0.050" thick stainless steel with countersunk flat-head screws and four edges beveled.
2. Attach pulls with through bolts.
3. Provide kick plates 2" less door width.
4. Acceptable manufacturers and respective catalog numbers:

	Hager	**Ives**	**Rockwood**
Push Plates	30S	8200	70C
Pulls	3G x 30S	8302-8	107 x 70C
Kick Plates	194S	8400 B4E	K1050 B4E
Cylinder Pulls	121L	- - -	90

5. Provide Push, Pull and kick Plates from one manufacturer.
   a. Manufacturer: Ives (IVE)
   b. Acceptable: Hager, Rockwood

F. Door Stops:
1. Floor Stops:
   a. Floor stops shall be solid cast brass or bronze.
   b. Furnish and install floor stops with machine screws and expansion shield.
   c. As conditions require, provide necessary carpet risers.
2. Acceptable manufacturers and respective catalog numbers:

Hager	Ives	Rockwood
259F	- - -	481
269F	FS18S	462
258F	FS451	485
249F	FS434	486

3. Provide Push, Pull and kick Plates from one manufacturer.
   a. Manufacturer: Ives (IVE)
   b. Acceptable: Hager, Rockwood

G. Door Bolts and Coordinators:

1. Surface Bolts: Minimum of 1/2-inch diameter rods of brass, bronze, or stainless steel with minimum 12-inch long rod for doors up to 84 inches in height. Provide longer rods for doors exceeding 84 inches.
2. Flush Bolts: Manual design, minimum 5/8" throw. Equip with extension bolts of lengths to locate operating mechanism at 12 inches above floor for bottom unit and not over 72 inches above floor for top unit. Provide dust-proof strikes without thresholds.
3. Acceptable manufacturers and respective catalog numbers:

Ives	Rockwood
FB458	555
FB31P	1842
FB41P	1942
COR Series	1600

4. Provide Coordinators from one manufacturer.
   a. Manufacturer: Ives (IVE)
   b. Acceptable: Hager, Rockwood

H. Fasteners:
1. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.
2. Where necessary, furnish fasteners with toggle bolts, expansion shields, sex bolts, and other anchors, appropriate for the material to which the hardware is to be applied and according to the recommendations of the hardware manufacturer.
3. Fasteners shall be packaged with hardware.
4. Provide fasteners of the same material and finish as the hardware.

2.2 KEYS AND KEYING REQUIREMENTS

A. Key System: Schlage Primus XP Utility-Patented Keyway, interchangeable conventional core cylinders for all exterior devices, including exterior doors, perimeter fence gates and exterior and interior coiling gates. Utility patent protection to extend at least until 2039. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate, use factory GMK charge. For interior exit devices, use Schlage (non-Primus) interchangeable conventional core cylinders. Cylinders to be conventional 6-Pin brass construction by same manufacturer. New construction shall be IC removeable core format for all interior locksets.
1. Existing factory registered master key system.
2. Stamp all keys with keyset symbol per keying structure determined in keying meeting(s).
3. Provide concealed internal stamp on all cylinders with keyset symbol per keying structure determined in keying meeting(s).
4. Supply (2) cut keys per cylinder.
5. Provide (2) of each cut - Grand mastewr Keys, Bldg. master and each Area Master at each facility other than High Schools.
6. Provide (4) of each cut - Grand master keys,, Bldg. Master and each Area Master at each high school.
7. Supply 100 key blanks at all facilities except high schools or as determined by Owner.
8. Supply 300 key blanks at all high schools or as determined by Owner.
9. Supply 500 pre-programmed electronic key fobs at all high schools unless directed otherwise by Owner.
10. Supply 1,000 pre-programmed electronic key fobs at all high schools unless directed otherwise by Owner.
11. Non-I.C. construction keying: furnish Split-Key. Furnish 10 construction keys.
12. Furnish 4 construction insert exterior tool 35-057.
13. Furnish 2 construction control keys.
14. At all facilities except high schools, furnish (2) key cabinets and (2) tag filing systems; size of cabinets and location(s) to be determined by Owner during keying meeting.
15. At all high schools, furnish (4) key cabinets, and (4) tag filing systems; size of cabinets and location(s) to be determined by Owner during keying meeting.
16. Furnish 2 Grand Master Primus XP control keys.
17. Furnish 20 P&S locking keys for light switches.

B. Initiate and conduct keying meeting(s) with owner and I-R Security & Safety Consultants representatives to determine system keyway(s) and structure. Furnish owner's written approval of the system.

C. All locks and cylinders to be secure shipment directly from the factory where permanent records are maintained to Owner's Director of Maintenance. Construction cores will be given to the General Contractor by the District locksmith with a transmittal sheet. All permanent keys to be secure shipment directly from point of origination to Owner's Director of maintenance.

D. Removeable mullions on exterior doors to have Schlage Primus XP interchangeable core cylinder, keyed to exterior building master. Removeable mullions on interior doors to have Schlage interchangeable core cylinder, keyed to interior building master.

E. Bitting List: furnish secured shipment direct from point of origin to owner's Director of maintenance upon completion. locksmith will set up key box; Contractor to hang key box in location(s) determined by Owner.

F. At Substantial Completion, Contractor to remove inserts in owner's presence and demonstrate consequent non-operability of construction key. Contractor to give all removed inserts and all construction keys to Owner. Owner's District locksmith will install permanent cylinders.

G. Provide XXXX for secure lockdown of rooms.

2.3 HINGE METHODS

A. Note: drawings typically depict doors at 90 degrees, but doors will actually swing to maximum allowable. Use wide-thro conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise Architect if 8-inch width is insufficient.

B. Conventional hinges: Steel or stainless steel pins and concealed bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
1. Three hinges per leaf to 7-foot, 6-inch height. Add one for each additional 340 inches in height, or a fraction thereof.
2. Extra heavy weight hinges on doors over 3 feet, 5-inches in width.
3. Extra heavy weight hinges on doors with panic hardware for fire exit devices.
4. Out-swinging exterior doors: non-ferrous with non-removeable (NRP) pins.
5. Non-ferrous material at exterior doors and at doors subject to corrosive atmospheric conditions.
6. Provide shims and shimming instructions for proper door adjustment.
7. All hinges to be ball bearing type. Plain Bearing hinges are not acceptable for any project.
8. All hinges at exterior doors or at high-security rooms to be tamper-proof.

C. Continuous Hinges:
1. Geared-type aluminum at exterior doors.
2. Heavy-duty, extra-bearing units for doors over 3-foot, 5-inches in width.
3. Heavy-duty, extra-bearing units for doors with panic hardware or fire exit devices.
4. Use wide-thro units where needed for maximum degree of swing, advise Architect if commonly available hinges are insufficient.

2.4 LOCKSETS, LATCH SETS, DEADBOLTS

A. Extra-heavy-Duty Cylindrical locks and latches: Schlage ND Sparta 626
1. Chassis: cylindrical design, corrosion-resistant plated cold-rolled steel, through-bolted.
2. Locking Spindle: stainless steel, interlocking design.
3. Latch Retractors: forged steel. Balance of inner parts: corrosion-resistant plated steel, or stainless steel.
4. Backset 2-3/4" typically, more or less as needed to accomodate frame, door or other hardware.
5. Lever Trim: accesible design, independent operation, spring-cage supported, minimum 2" clearance from lever mid-point to door face.
6. Electric Operation: Manufacturer-installed continuous duty solenoid.
7. Strikes: 16 gage curved steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
8. Certifications:
   a. ANSI A 156.2, 1994, Series 4000, Grade 1.
   b. Ul listed for A label and lesser class single doors up to 4' x 8'.
9. Specific room functions:
   a. Teacher, staff and adult restrooms - ND-40.

b. Classroom doors - ND-70.
c. Multiple-person Teacher, staff, adult and Student restrooms - ND-70.
d. Single-user student restrooms off classrooms (e.g. Kindergarten and Pre-K), Adult unisex restrooms ahead of security inside kitchen area, staff restroom inside custodial restroom - ND-40.
e. Electroic locks on owner specified doors.

10. Accepted substitutions: None.

2.5 SURFACE CLOSERS

A. Surface Closers: LCN 4041
1. Full rack-and pinion type cylinder with molded plastic cover and cast-iron body.
2. Non-sized, non-handed, and adjustable. Place closer inside building, stairs and rooms.
3. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
4. Opening pressure: Per ADA/TAS requirements.
5. Seperate adjusting valves for closing speed, latching speed and backcheck.
6. Heavy Duty arems (EDA) at exterior doors scheduled with parallel arm units.
7. Exterior doors do not require seasonal adjustments intemperatures from 120-degrees F to -30-degrees F, furnish data on request.
8. All closers to be through-bolted.
9. All closers to be supplied with Cush Arms.
10. non-flaming fluid; will not fuel door or floor covering fires.
11. Ensure size and drop of closer is coordinated with door stile and rails so that closer device is not visible from opposite side of door.
12. Pressure Relief Valves (PRV): unsafe, not acceptable.
13. Accepted substitution: None.

2.6 OTHER HARDWARE

A. Automatic Flush Bolts: Low operating force design, "LBR" type where scheduled.

B. Surface Bolts: Shall be used at pairs of doors from non-fire rated mechanical rooms for the inactive leaf. Coordinate frame prep with frame supplier.

C. Overhead Stops: Stainless Steel (100 series). Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

D. Kick-Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

E. Door Stops: Provide stops to protect walls, casework or other hardware.
1. Unless otherwise noted in hardware sets, provide wall type Ives WS401 with appropriate fasteners. Where wall type can not be used, provide floor type; do not use floor stops at exterior doors unless Owner approved (Ives FS18S exterior and FS448 interior). If neither can be used, provide overhead type.
2. Locate overhead stops for maximum possible opening. Consult with Owner to coordinate these with furniture locations. minimum: 130 deg stop if not in an alcove/90 deg stop if in alcove with additional 5 deg for dead stop. Note degree of opening in submittal.

F. Seals: Finished to match adjacent frame color. Resilient seal material: polypropylene, nylon brush, or solid high-grade neoprene. UL label applied to seals on rated doors. Substitute products: certify that the products are equal to or exceed specified material's thickness and durability. Proposed substitutions: submit for Owner approval.
1. Solid neoprene: MIL Spec. R6855-CL III, Grade 40.
2. Non-corroding fasteners at in-swinging exterior doors.
3. Exterior pairs of mechanical room doors: Doors shall be equipped with appropriate seals, astragal, threshold, drip cap and sweeps to prevent the intrusion of rain water. Provide astragals at all interior pairs of doors to mechanical rooms.
4. Sound Control openings: Use components tested as a system using nationally accepted standards by independent laboratories. Ensure that the door has the necessary sealed-in-place STC ratings. Adhesive mounted components not acceptable. Fasten applied seals over bead of sealant.

5. Fire-Rated Doors, Resilient Seals: UL10C / UBC Standard 7-2 compliant. Coordinate with selected door manufacturers and selected frame manufacturers requirements. Where rigid housed resilient seals are scheduled in this section and the selected door manufacturer only requires an adhesive-mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal plus the adhesive applied seal. Adhesive applied seals alone are deemed insufficient for this project where rigid housed seals are scheduled.
6. Fire-Rated Doors, Intumescent Seals: Furnished by selected door manufacture. Furnish fire-labeled opening assembly complete and in full comnpliance with UL 10C / UBC Standard 7-2. Where required, intumescent seals vary in requirement by door type and door manufacturer - careful coordination required. Adhesive-applied intumescent strips are not acceptable, use concealed-in-door-edge type or kerfed-in-frame type.

G. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected. Ensure compliance with ADA/TAS requirements.

H. Thresholds: As scheduled and per details. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for Owner's approval.
1. Exterior's: Seal perimeter to exclude water and vermin. Use butyl-rubber or polyisobutylene sealant complying with requirements in Division 7 "Thermal and moisture Protection". Non-ferrous 1/4 inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equal) Flat head Sleeve Anchors (SS/FHSL).
2. Acoustic openings: Set units in full bed of Division 7 compliant butyl-rubber or polyisobutylene sealant; leave no air space between thresahold and substrate.
3. plastic plugs with wood or sheet metal screws are not acceptable substitute for specified fastening methods.

I. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

J. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pair doors. Omit where adhesive mounted seals occure. Do not leave and unfilled/uncovered pre-punched silencer holes.

K. Wall & Floor-mounted electromagnetic door holders: LCN's SEM series or approved equivalent. Incorporate into U.L. listed fire & life safety system, doors release to allow closure and latching when door's zone is in alarm state. Use minimum projection required to allow door to open as widely as allowed by wall conditions and projection of door hardware.

2.7 FINISHES

A. Comply with base material and finish requirements indicated by the following:
1. Hinges, exterior US32D
2. Continuous geared hinges US28
3. Locksets US26D
4. Exit Devices US26D x US32D touch bar
5. Closers SBL
6. Pulls, nylon, color as selected by Architect.
7. Kick Plates US32D
8. Flush Bolts US26D
9. Dustproof Strike US26D
10. Stops US26D

2.8 WEATHERSTRIPPING, AND THRESHOLDS

A. Provide weatherstripping and thresholds as manufactured by one of the following:
National Guard Products, Inc. (NGP)
Pemko Mfg. Co.
Reese Weatherstripping & Thresholds

B. Materials:
1. Extruded Aluminum: Alloy 6063-T5, and compatible with specified finish.

2. Rolled Aluminum: Alloy 5052-H14, mill finish.
3. Gasketing: UL or Warnock Hersey approved material.
4. Fasteners: Stainless steel, cadmium plated steel, or hard aluminum.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fit and install hardware on doors in conformance with the following hardware schedule. Hardware shall be installed by tradesmen skilled in the application of commercial grade hardware.
   1. Provide properly sized and accurately located mortises and drilled holes for hardware on wood doors, using appropriate jigs, templates and power equipment.
   2. Metal frames shall be drilled and tapped accurately.
   3. Fit hardware accurately, remove until painter's finish is applied, and then replace and adjust.
   4. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.
   5. Position and install the various hardware items on doors to agree with the locations specified, or as may be specifically detailed.
   6. Floor stops in areas to be carpeted shall be installed directly on the concrete surface before the carpet is installed.
   7. Keep levers and pulls covered with heavy cloth or plastic wraps until final acceptance of the building. Upon completion, leave hardware clean, undamaged, and in proper working order.

B. Weatherstripping,: Install weatherstripping, along both jambs and across the head of each door in accordance with the manufacturer's instructions.
   1. Fit tightly at corners for continuity.
   2. Adjust so that door closer can fully close and latch door against pressure of weatherstripping, and smoke seals.
   3. Install astragals at pairs of doors in accordance with manufacturer's instructions.
   4. Door Bottom Seals:
      a. Attach door bottom seals to lower edge of exterior doors.
      b. Mount UL rated automatic door bottom in accordance with manufacturer's instructions. Adjust for desired drop and install end cover plate to lock adjustment in place.
   5. Install thresholds at all exterior doors in accordance with manufacturer's instructions. Set thresholds for exterior and acoustical doors in full bed of sealant.

3.2 HARDWARE LOCATIONS

A. Locate hardware for doors as follows, unless specifically detailed otherwise:

Locksets and Latch sets:	40" (±1") floor to centerline of strike.
Push Plates	45" from floor to centerline of plate.
Pulls (interior)	43" from floor to centerline of grip.
Push/pull (exterior/vestibule)	38" from floor to centerline of push bar and pull.
Deadlocks (with Locks & Latches)	48" from floor to centerline of cylinder.
Deadlocks (with Push/Pull)	37" from floor to centerline of cylinder.
Panic Hardware	38" from floor to centerline of cross bar.
Hinges	Manufacturer's standard locations.

For offset door pulls and push bars mounted on exterior/interior doors which specify a deadlock, coordinate length of push bar so that it does not conflict with installation of deadlock.

3.3 ADJUST AND CLEAN

A. Adjust and clean the operating hardware at each door. Lubricate parts with lubricant recommended by manufacturer (graphite type, if no other recommended). Replace units which cannot be adjusted to operate freely and smoothly.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 HARDWARE SCHEDULE

A. This schedule is intended to include hardware required. Verify doors shown and scheduled on the drawings with doors listed in this schedule. In the event of omissions in the schedule, furnish hardware of the kind, quantity, and quality scheduled for similar locations. Hardware for a complete installation is required, whether specifically mentioned herein or not.

B. Designations in hardware schedule are taken from the following manufacturers:

Adams Rite	(A)	National Guard	(NG)
Best	(B)	Norton	(N)
Corbin/Russwin	(C)	Rixson Firemark	(RF)
Glynn-Johnson	(G)	Schlage	(S)
Hager	(H)	Stanley	(ST)
Hewi	(HE)	Trimco	(T)
Locknetics	(LO)	Von Duprin	(V)
Lund	(L)	Yale	(Y)

EXTERIOR HOLLOW METAL DOORS

EXTERIOR HOLLOW METAL DOORS

Hardware Set No. 01: [Pair exterior hollow metal doors w/removable mullion > 50]

Doors No. 200, each pair shall receive:

2 rim cylinders	30-008	(S)
1 mortise cylinder	20-057	(S)
1 removable mullion	KR1654 x MT54 storage kit	(V)
2 sets stabilizers	154	(V)
2 closers	PRO7500	(N)
2 kick plates	194S 10" x 2" LDW	(H)
2 overhead stops	904S	(G)
2 exterior stops	269F	(H)
1 overhead rain drip	16A	(NG)
2 set head & jamb weatherstripping	130SA	(NG)
1 set astragal	125NA	(NG)
2 bottom rail weatherstripping	200NA	(NG)
1 threshold	896	(NG)

OVERHEAD COILING DOORS OR GRILLES

Hardware Set No. 02 [Overhead coiling doors or grilles]

Doors No. 100; each shall receive:

2 mortise cylinders	1080	(C)

END OF SECTION

SECTION 08 91 00

LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Fixed, extruded-aluminum wall louvers.

1.2 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLESSAMPLES .

B. Product Data: Include manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

A. Comply with SMACNA (ASMM) Architectural Sheet Metal Manual recommendations for fabrication, construction details and installation procedures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Louver Type: Provide 5" depth stationary, wind-driven rain resistant type louvers fabricated of 6063-T6 extruded aluminum alloy, minimum 0.080" thick frame and minimum 0.060" thick blades. Product/ manufacturer; one of the following:
Model RSH-5700; Construction Specialties, Inc.
Model SP-537; Industrial Louvers, Inc.
Model IL-59; Louvers & Dampers, Inc.

2.2 MATERIALS

A. Aluminum Sheet: ASTM B209/B209M, Alloy 3003 or 5005 with temper as required for forming.

B. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

C. Fasteners shall be aluminum. Provide types, gages and lengths to suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners.

D. Screens: Provide removable screens consisting of U-shaped metal for permanently securing screen mesh. Provide bird screens of 1/4" sq. mesh, 0.063" aluminum.

E. Insulated Metal Blank-off Panel: Provide insulated metal blank-off panel (painted black) at all louver areas not utilized by mechanical ducts at mechanical rooms.

F. Aluminum Finish: Aluminum surfaces of louvers and all their associated parts shall be Architectural Class I AA-M12C22A41 Clear Anodic Coating. Screw and bolt heads exposed to view shall be finished to match the exposed aluminum surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the louvers in accordance with the manufacturer's recommendations. Erect to be straight and plumb with horizontal lines level. The completed installation shall be rigid and weathertight.

B. Use concealed anchorages wherever possible.

C. Provide concealed gaskets and flashings and install as work progresses to make installations weathertight.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: On-the-job painting and finishing of exterior and interior surfaces.
   1. Included: Paint and finish the following materials, fittings, and equipment items which are exposed-to-view.
      a. Iron, steel, and galvanized metal.
      b. Bare and insulation covered piping and ductwork, conduit, hangers, grilles and registers, and primed metal surfaces and factory-finished surfaces of mechanical and electrical equipment.
   2. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, including the following:
      a. Factory-finished metal lockers and finished light fixtures.
      b. Architectural aluminum and stainless steel.
      c. Interior concrete floors and steps and all exterior concrete.
      d. Operating parts: Moving parts of operating mechanical and electrical equipment, such as: valve and damper operators, linkages, sensing devices, motor and fan shafts
      e. Labels: UL, FM, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
   3. Contractor shall examine the drawings for mechanical and electrical work, and all materials installed throughout the building which require painting shall be painted under this section of the specifications.

B. Related Sections:
   1. Section 05 12 00 - STRUCTURAL STEEL FRAMING: shop priming of structural steel.
   2. Section 05 21 00 - STEEL JOISTS FRAMING: shop priming of steel joists.
   3. Section 05 50 00 - METAL FABRICATIONS: shop priming of metal fabrications.

1.2 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020 (Reapproved 2025).

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.3 SYSTEM DESCRIPTION

A. For purposes of this painting specification, the following areas and spaces are not considered finished, occupied areas and there will be no painting therein except for doors and frames and as may be specifically scheduled in article paint schedule.
   1. Mechanical chases.
   2. Spaces above suspended ceilings.
   3. Underfloor crawl spaces.
   4. Elevator hoistways.

1.4 SUBMITTALS

A. Samples:
   1. Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   2. Submit two 8-1/2" x 11" samples of each paint color scheduled on the color schedule prepared by the Architect. Samples shall be on heavy cardboard and shall be made with the actual mixed paints to be used on the project.
   3. Samples for Initial Selection of each type of texture finish product.

B. Paint Schedule:

1. If painting materials other than those specified are proposed for use, submit a complete schedule of the materials to be substituted.
2. This schedule shall be in the same form as the paint schedule included in this section, and shall list materials by manufacturer, brand name, and type for each surface to be finished.
3. Provide data sheet for each paint type listed in schedule.

C. Federal law requires renovation firms (including sole proprietorships) to be certified and requires individuals to be trained in the use of lead-safe work practices. Contractors who perform renovation, repairs, and painting jobs shall:
1. Provide a copy of your EPA lead training certificate.
2. Show what lead-safe methods you will use to perform the job.
3. Provide references from at least three recent jobs involving projects before 1978.
4. Keep records to demonstrate that you and your workers have been trained in lead-safe work practices and that you follow lead-safe work practices on the job.

D. Close-out Schedule: Upon completion of work, furnish a full schedule of paint types and colors actually used and formulas for each to the Owner.

1.5 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with 3 years' experience.

B. Applicator: Company specializing in commercial painting and finishing with 2 years' experience.

C. Product Labels: Include manufacturer's name, type of paint, stock number, color and label analysis on label of containers.

D. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as final coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

E. V.O.C. (Volatile Organic Compound) Compliance: Products listed in the schedules and/or substitutes proposed for use by Contractor must be formulated to meet all applicable ordinances and regulations regarding maximum V.O.C. content. Utilize products which have been specially formulated to meet such requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in original containers with seals unbroken and labels intact.

B. Storage: Contractor shall designate a specific space at the project site for storing and mixing materials. Protect this space and repair all damage resulting from use. Do not store kerosene nor gasoline in this space. Remove oily rags at the end of each day's work.

1.7 PROJECT CONDITIONS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 65°F. for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Minimum application temperatures for latex paints: 45°F. for interiors; 50°F. for exterior; unless required otherwise by manufacturer's instructions.

C. Minimum application temperature for varnish and finishes: 65°F. for interior or exterior, unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 ft.-candles measured mid-height at substrate surface.

E. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified during application and drying periods of 24 hours between coats and 72 hours after final coat.

F. Protection: Provide sufficient drop cloths to fully protect adjacent finished work.

1.8 PRECAUTIONS

A. Do not store paints, oils, thinners and other flammable items inside the building. They shall be stored in approved containers when not in actual use during the painting job. The fire hazard shall be kept at a minimum.

B. Take precautions to protect the public and construction workers during the progress of the work.

C. Furnish a temporary fire extinguisher of suitable chemicals and capacity, located near flammable materials.

1.9 MAINTENANCE

A. Extra Materials: Upon completion of the work, deliver to project site 2 gallons of each type and color of paint applied to interior and exterior surfaces. Provide formula for custom match colors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide paint as manufactured by one of the following:
Benjamin Moore & Co. (http://www.benjaminmoore.com)
Pittsburgh Paints (http://www.ppgpaints.com)
The Sherwin-Williams Co. (http://www.sherwin.com/default.asp)

B. Materials described are based on the specifications of the above listed manufacturers, and are given to designate the quality of materials required. Materials of best quality grade are representative of the standard of quality required. Materials not displaying manufacturer's identification as a first line, best-grade product will not be acceptable.

C. Colors: Reference "Material Finish Schedule" in drawings for colors scheduled. Regardless of which brand of paint is selected for use the Contractor shall intermix and blend as required to obtain an exact match to each color in the "Material Finish Schedule".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report to Architect any condition that may potentially affect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum wallboard: 12 percent.
2. Interior located wood: 15 percent, measured in accordance with ASTM D4442.
3. Concrete: 12 percent.
4. Masonry: 12 percent.
5. Plaster: 12 percent

D. Test shop-applied primers for compatibility with subsequent cover materials.

E. Perform the following Test procedure prior to painting. This will determine if Passivators exist on galvanized metal. This procedure is not necessary on galvanized metal with G 90 Paint Grip.
   1. Prepare a solution by dissolving 20 grams of copper sulfate in one liter (1000 grams) of water. Copper sulfate crystals may be purchased at most drug stores.
   2. Solvent wash a small area per the procedure of SSPC-SP 1.
   3. Sand a small washed area using emery cloth.
   4. Using a cotton swab saturated with the copper sulfate solution, apply a swipe to both sanded and unsanded washed areas.
   5. If the sanded and unsanded surfaces turn black at the same time and that time is less than 10 seconds, there is no passivation on the surface other than light oil, and a normal degreasing/cleaning operation is sufficient preparation prior to the coating application. If the unsanded surface turns slower than the sanded surface, or not at all, a passivator of some type is present on the surface. If neither surface turns, the surface is probably an alloy of zinc or some other metal.
   6. If the galvanized steel has been treated or passivated, the treatment or passivator must be removed by brush blasting. If this method is prohibited by environmental regulations, then chemical etching with Amchem's GALVAPREP SG-3 will be acceptable, if previously approved by the Architect. The chemical etching manufacturer’s procedures should be followed carefully.
   7. If the surface is determined to be an alloy by this test procedure, notify Architect and adhesion tests of the proposed coating applied over the proposed surface preparation must be conducted.
   8. If no passivators are present, wash galvanized metal surfaces with mineral spirits to remove residual grease and oil.

F. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION

A. Perform preparation and cleaning procedures in accordance with coating manufacturer's instructions for each substrate condition.

B. Fill open joints, cracks and crevices on steel buck frames with metal putty and sand smooth before painting.

C. Sand woodwork surfaces smooth before priming.

D. Coat pine knots and pitch streaks with shellac before painting.

E. Putty nail holes after the prime coat.

F. Remove hardware and accessories, plates, lighting fixtures and similar items which are not to be finish-painted or provide adequate surface-applied protection for these items in place.

G. Uncoated steel and iron surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

H. Shop primed steel surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

3.3 APPLICATION

A. Workmanship shall be of the highest quality. Mix and use paint materials in accord with the manufacturer's directions. Spread materials evenly, flow smoothly, and brush out without sags or runs.

B. Provide finish coats which are compatible with primer paints used. Provide barrier coats over incompatible primers where required.

C. When undercoats, stains or other conditions show through final paint coat, apply additional coats until paint film is of uniform color and sheen.

D. Between coats, sand enamel and lacquer finish on wood and metal surfaces to produce a smooth, even finish. Use #220 grit sandpaper or finer.

E. Tint priming coats and undercoats to approximate shade of final coat to assure uniformity of color in the finish. Touch up suction spots and "hot spots" before applying the last coat to produce an even result in the finish coat.

F. Exposed ductwork, piping and conduit in finished, occupied areas shall be painted the same color as the wall or ceiling against which it is installed, unless otherwise noted.

3.4 TOUCH UP AND CLEAN

A. Touching Up: On completion, carefully touch up all holidays, marred and damaged spots, and work over all surfaces that have been repaired by other trades.

B. Cleaning: Remove spilled, splashed, and splattered paint from all surfaces. Do not mar surface finish of item being cleaned.

C. Reinstall the items removed under the provisions of paragraph above.

3.5 PAINT SCHEDULE

A. The products listed below represent top of the line products of each manufacturer. These products are not presented as being equivalent, as there are too many variables to match each product across the board. Manufacturer's designations are:
PPG Pittsburgh Paints
SW The Sherwin-Williams Co.

B. Interior Metal
1. Steel door frames, borrowed light frames, louvers and vision panel frames in doors, hollow metal doors, sound retardant doors, and ladders.
1 primer coat
PPG Red Inhibitive Steel Primer, 6-208
SW Kem Kromik Metal Primer B50WZ0001
2 finish coats
PPG Speedhide 6-1110
SW ProMar 200 Alkyd Semi-Gloss Enamel, Series B34 W 200
2. Grilles, diffusers and registers in walls and ceilings.
1 finish coat
PPG Speedhide Alkyd Lo-Sheen, 6-90
SW ProMar 200 Alkyd Eg-Shel Enamel, Series B33 W 200
3. Other exposed iron and steel.
1 primer coat
PPG Speedhide Inhibitive Steel Primer, 6-208
SW Kem Kromik Metal Primer B50WZ0001
1 finish coat
PPG Speedhide Alkyd Lo-Sheen, 6-90
SW ProMar 200 Alkyd Eg-Shel Enamel, Series B33 W 200
4. Metal pipe, conduit, ductwork, hangers, supports and brackets.
1 primer coat
PPG Speedhide White Galvanized Steel Primer, 6-209
SW Galvite Paint, B50 WZ30
1 finish coat
PPG Speedhide Alkyd Lo-Sheen, 6-90
SW ProMar 200 Alkyd Eg-Shel Enamel, Series B33 W 200
5. Other exposed galvanized metal.
1 primer coat
PPG Speedhide White Galvanized Steel Primer, 6-209
SW Galvite Paint, B50 WZ30
2 finish coat
PPG Speedhide Alkyd Lo-Sheen, 6-90

SW ProMar 200 Alkyd Eg-Shel Enamel, Series B33 W 200

6. Fire extinguisher cabinets, including door and frame inside and outside.
   1 finish coat
      PPG Aquapon 35 Gloss Polyamide Epoxy Enamel 95-1 Series
      SW Tile Clad II Epoxy, Series B62

C. Exterior Metal
   1. Steel door frames and hollow metal doors.
      1 primer coat
         PPG Speedhide Int/Ext Rust Inhibitive Steel Primer 6-208 Series
         SW Kem Kromik Metal Primer B50WZ0001
      2 finish coats
         PPG Int/Ext Industrial Gloss Alkyd Enamel 7-282 Series
         SW Industrial Enamel, Series B54
   2. Galvanized steel pipe handrails, railings, lintels, gates, metal fencing, ladders, ductwork, flashings, copings, roof hatches, tubular steel downspouts, galvanized gutters and downspouts, scuppers, ventilators, and louvers. (Reference test procedure for Passivators)
      1 primer coat
         PPG Speedhide Int/Ext Galvanized Steel Primer 6-209
         SW Galvite Paint, B50 WZ30
      2 finish coats
         PPG Int/Ext Industrial Gloss Alkyd Enamel 7-282 Series
         SW Industrial Enamel, Series B54

END OF SECTION

SECTION 10 44 13

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Fire extinguishers and fire extinguisher cabinets.

1.2 REFERENCE STANDARDS

A. ANSI/UL 711 - Rating and Fire Testing of Fire Extinguishers; 2018.

B. NFPA 10 - Standard for Portable Fire Extinguishers; 2026.

1.3 DEFINITIONS

A. Where indicated on the drawings the abbreviation "F.E.C." defines a fire extinguisher and cabinet and the abbreviation "F.E." is for fire extinguisher without cabinet.

1.4 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: Include physical dimensions, operational features, color and finish, anchorage details, material descriptions and type of hardware.

C. Shop Drawings: Include rough-in measurements, locations, and details for cabinets.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA.

B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain products in this Section from one manufacturer.

B. Certifications
1. Provide extinguishers which are U.L. listed and bear the U.L. "Listing Work" for type, rating, and classification.
2. Conform to NFPA 10 requirements for extinguishers.
3. Provide units conforming with ANSI/UL 711.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with SECTION 01 65 00 - PRODUCT DELIVERY REQUIREMENTS and SECTION 01 66 00 - PRODUCT STORAGE AND HANDLING REQUIREMENTS.

B. Store extinguishers in protected location until after final cleaning is completed.

1.8 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Do not store products subject to freeze damage in environments where damage could occur.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Provide multi-purpose dry chemical type fire extinguisher, 10 lbs. nominal capacity. Provide manufacturer's standard hook type bracket where fire extinguishers are noted without cabinets. Product/manufacturer; one of the following:
   Cosmic 10E; J.L. Industries, Div. of Activar, Inc.
   MP10; Larsen's Manufacturing Co.
   Wing 10HB; Modern Metal Products
   Model 3010; Potter-Roemer

2.2 FIRE EXTINGUISHER CABINETS

A. Provide powder coated steel trim and door. Doors shall be solid with vertical window and have continuous piano hinge. “Fire Extinguisher” vertical ascending silk-screened lettering in red. Product/manufacturer; one of the following:
   Fire-FX 1017V10 Ambassador; J.L. Industries, Div. of Activar, Inc.
   FS 2409-R4 Vertical Duo, Acrylic; Larsen’s Manufacturing Co.
   “Alta” Series No. 7023-DV-6; Potter-Roemer.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer’s standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for type and capacity of fire extinguisher indicated, with plated or baked-enamel finish. Color shall be red.

B. Identification: Identify bracket-mounted fire extinguishers with the words “FIRE EXTINGUISHER” in red letter decals applied to mounting surface. Orientation shall be horizontal.

2.4 FABRICATION

A. Form body of cabinet with tight inside corners and seams.

B. Predrill holes for anchorage.

C. Form perimeter trim and door stiles by welding, filling, and grinding smooth.

D. Hinge doors for 180° opening with continuous piano hinge. Provide nylon roller type catch.

2.5 FINISHES

A. Extinguisher: Red enamel.

B. Cabinet Trim and Door: Primed.

C. Cabinet Interior: White enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire extinguisher cabinets at locations indicated in accordance with the manufacturer's instructions. Install level, plumb, secure. Install fire extinguisher cabinets with operable part of extinguisher at 48" above finished floor.

B. Install fire extinguishers within cabinets on mounting brackets, placed in such a manner that operating instructions face outward.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb. Apply identification decals above bracket-mounted fire extinguishers.

D. Service, charge (if required), and tag each fire extinguisher not more than five calendar days prior to substantial completion.

E. Maintain design of fire-rated partitions associated with cabinets.

END OF SECTION

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SECTION 10 75 00

FLAGPOLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Flagpoles with external halyards.

B. Related Sections:
1. Section 32 13 13 - Concrete Paving: concrete for flagpole base.
2. Division 26 - Electrical: Lighting for flagpole and flags.

1.2 REFERENCE STANDARDS

A. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2023.

B. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.3 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: Submit product data for flags.

C. Shop Drawings: Include manufacturer's installation instructions.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide flagpole assemblies, including anchorages and supports, capable of withstanding the effects of wind loads, determined according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles”.

B. Basic Wind Speed: 90 mph; 3-second gust speed at 30 feet above ground.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide flagpoles as manufactured by one of the following:
American Flagpole; a Kearney-National Inc. Co.
Baartol Co., Inc.
Concord American Flagpole
Concord Industries, Inc.
Ewing International
Morgan-Francis Div.; Original Tractor Cab Co., Inc.

B. Basis of Design Flags shall be “United States Flag Store”. Provide flags as manufactured in the United States as supplied by one of the following:
Concord American Flagpole (phone 800-527-3902)
In the Wind (phone 817-626-3524)
United States Flag Store (phone 877-732-2458)

2.2 FLAGPOLE

A. Pole: External halyard, cone tapered aluminum.
   1. Material: Seamless alloy 6063-T6 aluminum tubing uniformly cone tapered.
   2. Height: 30'-0" exposed.
   3. Finish: Clear anodized.

B. Fittings: Furnish fittings equal to the following:
   1. Anodized aluminum ball: Sized to match pole butt diameter.
   2. Collar: Spun aluminum, same finish as flagpole, 14" diameter, 2-1/2" high.
   3. Two-Flag Arrangement: Provide two beaded retaining loops (one at the bottom of each flag) and four swivel snaps per flagpole, of bronze with neoprene or nylon covers.
   4. External Halyard
      a. External Halyard Ball-Bearing, Nonfouling, Revolving Truck assembly of cast metal with continuous braided polypropylene halyard and 9" cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
      b. Provide one halyard and one cleat.
      c. Provide cast-metal cleat covers, finished to match flagpole, secured with cylinder locks.

C. Foundation Tubes: Standard weight steel pipe having self-centering fins, centering bolts, and lightning ground spike. Hot-dip galvanize the assembly after fabrication.

PART 3 EXECUTION

3.1 PREPARATION

A. Paint portions of pole below grade with heavy coat of bituminous paint.

3.2 INSTALLATION

A. Set foundation tube accurately and hold in position until concrete is placed.

B. Install flagpole and fittings in accord with shop drawings and manufacturer's instructions.

C. Reeve the halyard through the truck sheave and connect the free ends together as recommended by the pole manufacturer to form a closed loop halyard.

D. Deliver United States flag and Texas flag to the Owner at project site.

3.3 ADJUSTING

A. Adjust fittings for smooth operation of halyard.

END OF SECTION

SECTION 10 81 13

BIRD CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Bird control devices.

1.2 SUBMITTALS

A. Product Data: Manufacturer's complete product information and installation instructions.

B. Sample: Submit a pigeon spike plastic sample, not less than 2 inches in length.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Nixalite of America Inc., (phone 800.624.1189 web site: www.nixalite.com).

2.2 SPIKE PLASTIC

A. Material:
1. Clear, UV stabilized Durolon polycarbonate resin.
2. Non-conductive, will not interfere with electronic communications.

B. Strip Lengths: 12 feet.

C. Width and Height: 5 inches high x 6 inches wide.

D. Points per Inch: Minimum 20 plastic wire points per foot.

E. Finish: Clear polycarbonate.

2.3 FASTENING

A. Adhesive: As recommended by Manufacturer for substrate.

PART 3 - EXECUTION

3.1 INSPECTION

A. Visually inspect installation surfaces. Ensure surfaces are clean, dry and free of debris and other conditions that could impede installation and performance.

B. Do not proceed until all unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Refer to construction documents for Tomball Memorial High School and Alternate No. 1 under specification Section 01 23 00.

B. Install pigeon spike plastic according to manufacturer's written installation instructions and recommendations.

C. Protect the entire surface, not just the outside edges. Adjust length of spike base by using the quick part seams. For narrow surfaces, remove ONE row of plastic spikes along ONE side of the spike strip.

D. Install spikes flush with the outside edge of surface. At open ends of surface, overhang first spike on base at least 1/2-inch. Use base alignment notch to align spike strips that meet end-to-end.

E. Gaps between end-to-end spike strips, and where spike strips meet other surfaces (walls) are not acceptable.

F. Fasten to the surface with manufacturer’s recommended adhesive.

END OF SECTION

SECTION 11 68 00

PLAY FIELD EQUIPMENT AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Miscellaneous items such as track finish line markers and goal posts.

B. Related Sections:
1. Section 32 18 13.10 - Synthetic Grass Surfacing.
2. Section 32 18 23.39 - SYNTHETIC RUNNING TRACK SURFACING.
3. Section 32 31 13 - CHAIN LINK FENCES AND GATES.
4. Section 32 13 15 - VINYL-CLAD CHAIN LINK FENCING.

1.2 SUBMITTALS

A. Product Data: Provide product data for each type of equipment.

B. Shop Drawings:
1. Submit shop drawings for each product in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
2. Indicate details of fabrication, anchorage, and related construction. Indicate accessories and finishes.

C. Delegated Design: Submit structural calculations and shop drawings for all scoreboard structures, prepared by manufacturer for review by project engineer. Shop drawings and calculations shall be sealed by a professional engineer registered in the State of Texas. Engineer shall have a minimum of 5 years' experience with projects of similar scope.

1.3 WARRANTY

A. Provide 3-year warranty.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Goal Posts: Provide 20'-0" uprights with an 8'-0" offset, "slingshot" type high school goal posts of aluminum pipe per detail shown on Drawings. Color shall be powder coat of "Saturn Yellow." Provide two (2) goal posts (1 pair) at each field as manufactured by the following or approved equal:
Gill Athletics www.gillathletics.com
Gilman Gear www.gilmangear.com
1. Reference Tomball Junior High School & Willow Wood Junior High School contract documents.

B. Field Event Equipment: Field event equipment shall be as manufactured by Aluminum Athletic Equipment Co., (800) 523-5471, as listed below or approved equal.
1. Long Jump/Triple Jump Off Boards - HTB-8.

C. Netting at Backstops, Batting Cages, and Dugouts: Netting shall be supplied by Flex Nets (www.practicesports.com) or approved equal, #42 nylon treated with "netseal" varnish waterproof treatment and minimum break strength of 190 lbs., black color.
1. Backstop Netting: Mesh should be fitted with 5/16" rope borders. Hang in square view pattern. Backstop netting shall be knotted.
a. Existing backstop netting is to be removed and salvaged for re-use at current batting cages. Refer to construction documents for Tomball memorial High School.

2. Outdoor Batting Cage Netting: Each piece shall be hemmed with a 5/16" three strand twisted poly rope spliced to the edge. Accessories shall include corner reinforcing plates, access door, and steel cable support, freestanding, heavy-duty steel tube powder coated batting cage frame and door, including netting, lacing, hinges and hasp for Owner's padlock, door shall be installed in netting wall. Sizes shall be as indicated on the plans. Hang in square view pattern. Batting cage netting shall be knotted. Outdoor Batting Cage Net shall come standard with one "netshield" baffle.
   a. Outdoor Batting Cage Baffle: Provide NetShield heavy duty batting cage impact mesh.
      1) Vinyl Coated Mesh
      2) 13.5 oz per sq yd
      3) Double-Hemmed Vinyl Border
      4) Grommets Every 12 - 18"
      5) Color: Color Shall be as selected by Architect.

D. Protective Padding: Provide padding as manufactured by:
   C&H Baseball, (941) 727-1533;
   Porter Outdoor Products, (708) 338-2000
   M. Putterman, (800) 621-0146;
   Sportsfield Specialties, Inc., (888) 975-3343
      Fieldwallpads.com (800-257-6405, website: www.fieldwallpads.com)
   Porter Outdoor Products (Academic Specialities - 844-847-5897, website: wwwastexas.com)
   Sportsfield Specialties (888-975-3343, website: www.sportsfield.com)
   1. Backstop Retaining Wall: Padding shall be 4” thick high impact foam with vinyl cover. Length and height shall be as per drawings. Filler foam is glued to exterior grade plywood backing. Exposed plywood surface shall be painted to match vinyl color. Vinyl laminated cover shall have UV inhibitors. Vinyl cover shall be wrapped around the backside of the plywood and secured with galvanized steel staples. Each pad shall have a min. of 3 weep holes to evacuate moisture. Adhesive shall be water, heat and cold resistant with a high bonding factor. Mounting shall be by concealed Z-clips. All attachment and clips shall be engineered and provided by wall pad manufacturer.
   2. School logo, in school colors, to be provided on center pad at both the First and Third base lines, both fields. Refer to architectural drawings for size and locations. Color of pads to selected by Architect.
   3. Dugout Guardrail and Batting Cage Posts: Padding shall be high-density polyurethane foam with vinyl cover. Padding shall be 4" thick, with length and height as per drawings. Seams at posts shall contain #2 brass grommets spaced 6" apart. Padding at posts to be attached with 14" Ty-raps with 50-120 lb. break strength or with manufacturer recommended lacing materials. Color to be selected by Architect.

2.2 SCOREBOARDS

A. Structure for all Scoreboards shall be delegated design. Reference Submittals Article in Part 1 - General for more information.

B. Football Scoreboard: Provide Model FB-2021 customized with the wording of, “the schools mascot name" in lieu of “HOME” as manufactured by Daktronics. **"Reference Add Alternate No. 05"**
   1. Provide hardwired All Sport 5010 Controller Console Kit.
      a. One-pair shielded cable of 22 AWG minimum is required.
      b. A cover plate with mounted connector and standard 2" x 4" x 2" outlet box.
      c. Connector mates with signal cable from control console.
   2. Provide TI-2035 25-Second Clock
   3. Provide DA-1001-25, Arch Truss; Aluminum, 4ft. tall x 25ft long with 50% non-backlit lettering/logo and screen backing.
   4. Provide Custom backlit filler panel, 6’-9”H x 7’-2”W to go beside outdoor message center/video display.
   5. Provide DVXMC-96X160-19.8-RGB-SF, 19.8mm LED Electronic Message Center including a Spare Parts Kit.
      a. Matrix: 96 lines by 160 columns
      b. Line Spacing: 19.8mm
      c. LED Color: RGB- - 281 Trillion Colors
      d. Cabinet Dimensions: 6' 9" H X 10' 8" W X 0' 5" D (Approx. Dimensions)
      e. Max Power: 2585 watts/display
      f. Weight: Unpackaged 520 lbs per display; Packaged 685 lbs per display
   6. DVNMC, DVXMC, or LVX w/ SCS Control Kit #1 (Primary Player & Processor) and Laptop. Show Control Communication Kit to control 1 or more signs displaying the same content; Includes Laptop
   7. Fiber patch panels: Control room and display fiber patch panels; 6 fiber

8. W-2121: Fiber Optic Cable; 50 µm Multimode; 4 Fiber with non-terminated ends
9. Standard Video All Sport® RTD Input Kit: Displays Game-In-Progress Information
10. Protective Netting for the DVXMC-19.8-96 x 160-RGBSF@1
11. Include personalized package with 20 animations from any Team Spirit Animations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Backstop Netting: Nets shall be attached to one half (1/2) inch diameter steel cables per the structural Drawings. Nets shall be stretched and secured to the cables and to the top of the backstop wall so that the nets do not sag or bellow. The nets shall be lashed to the cables to eliminate gaps or openings. Net should be installed in a diamond pattern at backstop.

END OF SECTION

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SECTION 13 34 16.53

FRAME-TYPE BLEACHER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Bleachers
   2. Press Box

1.2 SYSTEM DESCRIPTION

A. Design and fabrication of Frame Type Bleacher - Elevated. Bleacher addition to match existing bleacher style and details. Refer to the construction documents for Tomball Memorial High School.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2026.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer must have ten years of experience in the manufacture of bleachers and grandstands.

B. Welders must be AWS certified.

C. Source Quality Control: Mill Test Certification.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s descriptive product date for project.

B. Delegated Design Shop Drawings: Manufacturer to submit shop drawings sealed by a registered engineer in the State of Texas and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the applicable code and relevant laws.

C. Product Sample: Submit one 18-inch seat sample.

1.6 WARRANTY

A. Provide manufacturer's 5-year warranty from date of Substantial Completion. Manufacurer agrees to repair or replace components of bleacher that fail in materials or workmanship. Failures include, but are not limited to:
   1. Structural failures, including all components.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide bleachers as manufactured by Southern Bleacher Co. (phone 800.433.0912 website: www.southernbleacher.com). Subject to compliance with requirements of this specification, the following manufacturers are acceptable:
   Outdoor Aluminum, Inc. (800-225-4249, website: www.outdooraluminum.com)
   Southern Bleacher Co. (phone 800-433-0912, website: www.southernbleacher.com)
   Sturdisteel (800-433-3116; website: www.sturdisteel.com)

2.2 ANGLE FRAME BLEACHERS

A. Elevated Bleachers:
   1. Rise and Depth Dimensions: Vertical rise and horizontal depth per row: 14 inches x 30 inches. Seat is 17 inches above its respective tread.
   2. Framework: Prefabricated angle frames are space at 6-foot (max.) intervals and connected by crossbraces.
   3. Seats: Nominal 2 x 10 anodized aluminum plank with 2 x 10 anodized end caps.
   4. Treads: Formed from nominal 2 x 11 mill aluminum planks with 2 x 11 anodized end caps.
   5. Risers: Nominal 1 x 6-1/2 anodized aluminum riser planks beginning at Row 1; two 1 x 6-1/2 aluminum riser plank on top row.
   6. Guardrailing: Two lines of aluminum rail with chain link 48 inches above seat on both sides of bleacher, at ramp, and across back of bleacher. Front rail, 3 line with chain link 42 inches above front walk. Provide chain link around bottom of bleachers and ramps at height per drawings.
   7. Entry Steps: Frames with 2 x 12 mill aluminum plank with step riser, contrasting aluminum stair nose and 2 line rail 36 inches above nose of step. Handrails shall extend in the direction of the exit steps 12 inches beyond the end of the steps. Ends shall terminate in newel posts.
   8. Front Walkway: Elevation as shown on drawings and 68-inch clear width.
   9. Aisle (if required): Aisle to be provided with 34” high handrail and intermediate rail at approximately 22” above tread. Handrails with rounded ends are discontinuous to allow access to seating through a 24” wide space. Aluminum tread nosing of contrasting color on aisle steps.

B. Wheelchair Area:
   1. Wheelchair are to be 6’-0” wide for two wheelchairs and 36” for single.
   2. Ramp:
      a. Slope: 1 in 12.
      b. Guardrailing: Two line aluminum rail 36 inches above ramp tread with intermediate rail at approximately 20 inches. Railing shall be continuous the full length of the ramp, and shall extend in the direction of the ramp 12 inches beyond the end of the ramp, returning to end at a newel post.

C. Landing: 74” Return Landing: 74” Landing to have 3-line 36” chain link with rail at 42” above front walk plank.

D. Materials/Finishes
   1. Framework:
      a. Galvanized Steel: Structural fabrication with ASTM A529/A529M steel. Shop connections are seal welded. After fabrication, all steel is hot-dipped galvanized to ASTM A123/A123M specification.
      b. Aluminum: Extruded aluminum angle alloy 6061-T6, mill finish.
   2. Extruded Aluminum:
      a. Seat Planks, Riser Planks, Step Risers: Extruded aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II, and a wall thickness of .094”.
      b. Tread Planks: Extruded aluminum alloy 6063-T6, mill finish and wall thickness of .094”.
   3. Accessories:
      a. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II.
      b. Hardware:
         1) Bolts, Nuts: Galvanized or plated.
         2) Hold Clip Assembly: Aluminum alloy 6061-T6.

c. Guardrailing: Front, sides and back anodized aluminum rail 1-5/8” O.D. with galvanized chain link.
d. Handrails: Anodized aluminum rail 1-5/8” O.D.
e. Crossbraces: Extruded aluminum angle alloy 6061-T6, mill finish.
f. Aisle Nose and Stair Nose: Aluminum alloy, 6063-T6, contrasting powder coat finish.

E. Manufactured Units:
1. 2 Line Chain link from Row 1 to Top
2. (2) 2 x 11 Tread Planks on All Rows
3. 1 x 6-1/2 Riser Beginning @ Row 1, (2) 1 x 6-1/2 Riser on Top Row
4. Aisle (s) as Required
5. 74” Width Front Walkway
6. One Ramp and One Stair
7. Wheelchair Seating Area(s) as Noted

F. Fabrication
1. Design Load:
a. Live Load: 100 psf gross horizontal projection
b. Lateral Sway Load: 24 plf seat plank
c. Perpendicular Sway Load: 10 plf seat plank
d. Live Load of Seat and Tread Plank: 120 plf
e. Guardrail: 100 plf vertical and 50 plf horizontal
2. All connections made in shop to be shop welded.
a. Manufactured by certified welders conforming to AWS Standards.

2.3 PRESS BOX

A. Product Description: Type II Construction
1. Press Box Support Structure: Independently supported but connected to rear of existing bleachers. Support Structure to be 11 feet wide x 30 feet long.
2. Press Box Dimensions: 11 feet wide x 20 feet long.
3. Electrical wiring, switches and other components per NEC Specifications.

B. Materials/Finishes
1. Press Box Support Structure:
a. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
b. Shop connections are seal welds.
c. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications.
2. Press Box: All materials shall be new and shall comply with ASTM specifications.
a. Floor
1) Floor to be INTERLOCK Aluminum Decking System, extruded aluminum alloy 6063-T6, mill finish. Attach Decking System to steel floor frame with mechanical fasteners at end of plank and at intermediate supports. (Tongue & Groove or Standard extrusion is not acceptable.)
2) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-11, 3 1/2 inches thick. Batt or roll as manufactured by Johns Manville, or equal.
b. Wall Structure
1) 4 inch x 4 inch x 11 gauge square tubing with maximum span of 14 feet on front wall and maximum span of 6 feet on back wall and 4 inch x 2 1/2 inch x 14 gauge steel "cees" with maximum spacing of 5 feet for all walls with siding. Spans greater than these require engineered calculations for design.
2) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-11, 3 1/2 inches thick. Batt or roll as manufactured by Johns Manville or equal.
3) Interior Finish
a) 1/2 inch vinyl coated gypsum panels, Gold Bond vinyl-surfaced Durasan- Harvest Cotton.
b) Cove Base: Vinyl 4 inches x .080 equal to PRO CB-35 Nubian.

4) Exterior Finish
   a) 26 gauge pre-finished R-Panel paneling as manufactured by MBCI, Signature 200 color series, or equal. Color as selected by Architect and Owner.
   b) Wall panels are attached with #12 TEK screws - 6" O.C. at the top, midpoint and bottom of the panels.
   c) Lap screws are placed at each end of the panels, at the intermediate supports, and at the mid point between supports (TEK #14).
   d) All fasteners to be painted same color as exterior paneling.

c. Roof Structure
   1) 4 inch x 4 inch x 11 gauge square tubing with maximum spacing of 6 feet on center and 4 inches x 2 1/2 inches x 14 gauge steel "cees" with maximum spacing of 2 feet on center.
   2) Roof: 1/8 inch fourway steel plate roof, continuous welded seams coated with acrylic metal primer as manufactured by Coronado and 36 mils of acrylink roof coating as manufactured by Isothermal Protective Coatings, or equal. Plate is welded on both sides of rafters with 1-1/2 inch long 1/8 inch fillet welds on 12 inch centers.
   3) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation, R-19 (minimum) 6 inches thick. Batt or roll as manufactured by Johns Manville or equal.
   4) Cornice: 26 gauge steel prefinished to match metal siding.
   5) Ceiling: 24 inch x 24 inch x 5/8 inch acoustical ceiling tile (model #- USG Fissured 560) with USG grid main tee (model # DXL24), cross tee (model # DXL 216), wall angle (model # M7), wind clips and other components as manufactured by USG, or equal.

d. Exterior Door(s)
   1) Full flush steel construction with honeycomb core. 18 gauge skin sheets. Dimensions: 3 feet 0 inches x 6 feet 8 inches. Color: As selected by Architect and Owner.
   2) Steel door frame (16 gauge) complete with 1/2 inch threshold and weather-stripping.
   3) Exterior Hardware: Handles shall be lever type that allows operation without tight grasping or twisting of the wrist. Keyed alike locks.
   4) Interior Hardware: Handle shall be panic bar that allows for opening without any grasping, twisting or turning.

e. Windows
   1) Frame: Extruded aluminum single hung, vertical sliding unit, thermal break.
   2) Sash: Tilt toward inside for easy cleaning.
   3) Glazing: Clear tempered panes.
   4) Dimensions of each unit: Dependent on compartment size. At interior wall locations or structural support locations the dimension between windows shall be no greater than 6 inches.
   5) Finish: acrylic enamel.

f. Work Bench
   1) 18 inch wide work bench constructed of 4 inch x 2 1/2 inch x 14 gauge steel, and 3/4" wood.
   2) Plastic laminate top: Equal to Wilsonart Laminates. Finish: Color as selected by Architect and Owner. Thickness: 050
   3) Glue: 3M Green Contact Adhesive, or equal.

g. Painting: Reference SECTION 09 10 00 - PAINTING.
   1) Surfaces: Exterior Door(s), Door Frame(s)
      a) Primer: Applied by Door Manufacturer.
      b) Finish: 2 coats acrylic latex semi-gloss enamel applied by press box manufacturer.
   2) Surfaces: Exterior Siding
      a) Primer: Applied by Siding Manufacturer.
      b) Finish: Applied by Siding Manufacturer.
      c) Touchup: If applicable
   3) Surfaces: Wall and Roof Structure
      a) Primer: DTM Industrial acrylic metal primer applied after welding, or equal.

h. Caulking: MasterSeal NP1 – Polyurethane sealant, All temperature, UV resistant, or equal. Silicone products are not acceptable.

i. Provide window Air Conditioning/Heating Unit.

j. Electrical

1) Submittal drawing shall indicate devices and circuitry. At a minimum provide the following devices;
   a) (3) 120v, 20A quad receptacles equally spaced at front window, below the counter.
   b) (3) 120v, 20A duplex receptacles equally spaced at back wall.
   c) (2) each, dedicated 120v, 20A IG duplex receptacles (to be located in shop drawings for AV equipment rack.
   d) (2) each, dedicated 120v, 20A duplex receptacles (to be located in shop drawings for IT equipment.
   e) At Football Field scorers booth, provide with (1) J-box, below the floor with (1) 120v 20A circuit.
2) Fixtures: Surface Mounted LED lighting design as manufactured by Lithonia Lighting, or equal. Fixtures shall be located above countertop and be maximized to full length of compartment space.
3) Flush mounted N.E.C. panel to be 100 amp main circuit breaker, 120/240V, 1ph 60hz, provide with isolated ground bus. Prepared ready for service line to be connected.
4) Electrical outlet(s) installed per NEC shall be standard duty. All outlets shall be recessed in wall.
5) Sound, Telephone, Clock, Field Communication:
   a) (3) 4x4 j-box with single gang ring and cover, with 3/4” conduit stub-out to below floor, equally spaced at front window, below the counter. (Adjacent to receptacles). Outlet boxes to be flush mounted into wall. Any wiring completed on-site will be responsibility of such contractor for inspections. Quantity: Three will be provided.
   b) Provide support for wall mounted AV rack and concealed conduits for AV pathway to all device locations at booth as required. Refer to AV drawings for locations and requirements.
6) Sleeves:
   a) Provide (4) 2” Sleeves to be located through floor for AV equipment. Exact locations to be location by architect & AV/Technology consultants.

k. Warranty: The Press Box is warranted to be free from defect in materials and workmanship in the course of manufacture. This warranty excludes any other defects resulting from abnormal use in service, accidental or intentional damage or any occurrences beyond manufacturer's control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install bleacher unit in accordance with manufacturer’s installation procedures.

B. Install per approved shop drawings.

C. Bleacher unit shall be securely anchored to a flat, level concrete slab.

3.2 CLEAN-UP

A. Clean up all debris caused by work of this section.

END OF SECTION

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SECTION 13 34 19

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pre-engineered building system including the structural steel system primary and secondary per Design Criteria, metal roof system, canopy, wall system and all roof and wall insulation, trim and accessories as required.

B. Related Sections:
1. Section 03 30 00 - CAST-IN-PLACE CONCRETE.
2. Section 05 50 00 - METAL FABRICATIONS; structural frames for overhead doors.
3. Section 08 33 23 - OVERHEAD COILING DOORS.
4. Section 09 91 00 - PAINTING; field painting exposed structure.
5. Section 31 63 29 - DRILLED CONCRETE PIERS.
6. Division 26 - ELECTRICAL; piping and supports.
7. Division 27 - COMMUNICATIONS; piping and supports.

1.2 REFERENCE STANDARDS

A. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).

B. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process; 2025b.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

D. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

E. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

F. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel; 1997 (Ed. 2004).

G. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.3 SUBMITTALS

A. General: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Include complete erection drawings showing anchor bolt sizing, patterns and embedment lengths from datum, sidewall, endwall and roof framing, transverse cross sections, panel layout, flashing and trim details, and foundation loads.

C. Samples: Submit a 12" long by actual width sample of roofing and siding panels, with required finish.

D. Letter of Certification: Submit written Certification prepared and signed by a Professional Engineer, registered to practice in the State of Texas, verifying that building design and metal roof system (including panels, clips and support system components) meet indicated loading requirements and codes of authorities having jurisdiction. The certification must reference specific dead loads, live loads, snow loads, wind loads/speeds, tributary area load reductions (if applicable), concentrated loads, collateral loads, seismic loads, end use categories, governing code bodies including year and load applications.

E. Welders Certification: Provide copy of welder's certification. Welders must show proof of certification/ qualification prior to starting any welding on the project.

1.4 QUALITY ASSURANCE

A. Design Criteria:
   1. Design of metal building systems shall be based upon both strength and deflection requirements. These requirements shall meet the more stringent of the 2021 IBC or the criteria listed herein.
   2. Structural Framing: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturer's Association's (MBMA) "Design Practices Manual" and applicable Building Code.
   3. Structural Steel: Comply with the requirements of the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
   4. Light Gage Steel: Comply with the requirements of the American Iron and Steel Institute's (AISI) "Specifications for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
   5. Welders must show proof of certification/qualification prior to starting any welding on the project. For welded connections, comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures. Welding procedure and operator qualifications and welding quality standard shall be in accordance with the American Welding Society structural welding code. Inspection other than visual inspection as defined by AWS, Paragraph 8.15.1, shall be identified and negotiated prior to bidding.
   6. Roof Live Load = **20 psf** with code-allowable area reductions.
   7. Total Roof Dead Load and Collateral Load = 5 psf plus frame weight.
   8. Roof purlins shall be capable of supporting concentrated loads such as mechanical loads, sprinkler loads, sectional overhead doors.
   9. Wind Load = 126 **mph**, Exposure C.
   10. Building Drift = Limited to H/400 at masonry.
   11. Metal roof panels shall not provide a diaphragm or lateral stability for purlins.
   12. Roof Panel System shall meet UL Class 90 uplift requirements, and Factory Mutual System Class 1-90 uplift requirements and Class 1 fire requirements.
   13. The General Contractor is responsible for obtaining and installing the building frame anchor bolts. The manufacturer shall provide design loads and/or the anchor bolt size required. The General Contractor shall verify the anchor bolt lengths do not extend beyond the concrete foundation dimensions. The General Contractor shall verify that all bids meet the above minimum design criteria, including the requirements for Collateral Load of 5 psf and Factory Mutual System Class 1-90 uplift

B. Certain characteristics as dimensioned, detailed and specified shall not vary, including:
   1. Roof decking and insulation systems.
   2. Wall enclosure systems, insulation, etc. Including locations and sizes of openings, etc.
   3. Column locations, except to reduce quantity of columns .
   4. Primary frame locations and spacing.
   5. Secondary frame spacing (purlins, girts, etc.), except to reduce dimensions.
   6. Shape or gauge of exposed sheet metal gutters, fascia, flashing, etc.
   7. Roof slope or direction of slope.
   8. Provide standard columns.

C. Certain characteristics as dimensioned, detailed and specified shall be allowed to vary to accommodate alternate framing, including:
   1. Member sizes, except where clearances with scheduled ceiling heights, ductwork and piping, etc., as designed, create conflicts.
   2. Concealed portions of flashings, except as required to maintain watertightness and system integrity.
   3. Bracing methods, except where architectural elements create conflicts. Minor adjustments may be made by the Architect to accommodate bracing requirements. [**No X-bracing allowed, may make modifications to portal frame locations and numbers.]**

D. Installation of the pre-engineered building system shall be performed by one of the following:
   1. Authorized builder or contractor of the manufacturer having a minimum of 5 years' experience in installations of this type.
   2. Contractor Contractor authorized by the manufacturer as trained and qualified to erect the manufacturer's product and have a minimum of 5 years' experience in installations of this type.

E. Manufacturer's Qualifications:
1. Provide pre-engineered metal buildings as produced by a manufacturer with not less than 10 years successful experience in the fabrication of pre-engineered metal buildings of the type and quality required.
2. IAS accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems", as set forth in the International Building Code, Section 1704.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver preformed metal roofing panels and trim items to the project site with no dents, scratches, or abraded areas. Deliver in manufacturer's standard bundles, securely bound and store at the project site raised above slab or ground level on pallets.

1.6 WARRANTY

A. Special Project Warranty: Submit two executed copies of standard 2-year "Roofing Guarantee" on form included at the end of this section, covering work of this section, including roofing panels, trim, sheet metal flashing, roof insulation and roofing accessories, signed by installer (roofer).

B. Furnish to the Owner written 20-year warranties for the following:
1. 20-year material failure warranty covering the cost of material and labor to repair, repaint, or replace materials not to exceed $.80/SF for the aggregate of all claims.
2. 20-year weathertightness warranty to repair or stop any leaks not to exceed $.50/SF for the aggregate of all claims.
3. The warranty dollar limits noted in items 1. and 2. above, shall be additive so that the aggregate value of the dollar limit of all claims shall not exceed $1.30/SF.
4. 20-year warranty that coating shall not blister, peel, crack, chip or experience material rust-through for 20 years. For a period of 20 years, chalking shall not exceed #8-ASTM and fading shall be 5 dE Color Difference Units or less.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS/MANUFACTURERS

A. Basis of Design shall be Butler Manufacturing Co. Provide pre-engineered building as manufactured by one of the following:
Alliance Seam 24 -AS24 Panel/PBR Panel; Alliance Steel
(phone 800.624.1579 web site: www.allianceokc.com)
MR 24 Roof Panels/BR II Wall Panels; Butler Manufacturing Co.
(phone 816.968.3304 web site: www.butlermfg.com)
Starshield Standing Seam Roof Panels/Dura-Rib Wall Panels; Star Manufacturing Co.
(phone 800.879.7827 web site: www.starbldg.com)
SSR Roof Panels/VP Panel Rib Wall Panels; VP Buildings, Inc.
(phone 800.238.3246 web site: www.vp.com)

2.2 MATERIALS: STRUCTURAL FRAMING SYSTEM

A. Structural Steel Design:
1. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
2. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses
4. The structural system will be designed in accordance with a specified building code. (Refer to Design Loads and Building Codes).
5. Anchor bolts shall be designed using loads provided by manufacturer.

B. Primary Framing:
1. Rigid Frames

a. Frames shall consist of welded-up plate section columns and roof beams complete with necessary splice plates for bolted field assembly.
   1) All base plates, cap plates, compression splice plates and stiffener plates shall be factory welded into place and have the connection holes shop fabricated.
   2) Columns and roof beams shall be fabricated complete with holes in webs and flanges for the attachment of secondary structural members and bracing except for field work as noted on manufacturer's erection drawings.
b. All bolts for field assembly of frame members shall be high strength bolts as indicated on erection drawings.
c. Provide standard columns

2. Endwall Structurals:
   a. The endwall structurals shall be cold-formed channel members designed in accordance with the 1986 AISI Specification or welded-up plate sections designed in accordance with the 1989 AISC Specification.
   b. Endwall frames shall consist of endwall corner posts, endwall roof beams and endwall posts as required by design criteria.
      1) All splice plates and base clips shall be shop fabricated complete with bolt connection holes. All base plates, cap plates, compression splice plates and stiffener plates shall be factory welded into place and have the connection holes shop fabricated.
      2) Beams and posts shall be shop fabricated complete with holes for the attachment of secondary structural members except for field work as noted on manufacturer's erection drawings.
   c. Intermediate frames shall be substituted for endwall roof beams when specified.
      1) Necessary endwall posts and holes for connection to the intermediate frame used in the endwall shall be shop fabricated.

C. Secondary Structural Members:
   1. Purlins and Girts
      a. Purlins and girts shall be "Z" shaped, precision roll formed.
   2. Eave Struts: "C" sections.
   3. Bracing
      a. Bracing shall be located as indicated on drawings.
      b. Diagonal bracing shall be hot-rolled rod of size indicated on drawings, and attached to columns and roof beams as shown on the drawings.
      c. Optional fixed base wind posts or pinned base portal frames may be substituted for wall rod bracing on buildings as required.
      d. Flange braces, purlin braces, etc., when required, shall be cold-formed and installed as indicated on drawings.

D. Finish: Factory Primed Structural Painting
   1. General:
      a. Apply specified primer immediately after cleaning and pretreating.
      b. All structural steel shall be prime painted as temporary protection against ordinary atmospheric conditions. Subsequent finish, painting, if required, shall be performed in the field by others.
      c. Prior to painting all steel shall be cleaned of loose rust, loose mill scale, dirt and other foreign material. Unless otherwise specified the fabricator shall not sand-blast, flame clean or pickle prior to painting.
      d. Factory cover all steel with one coat of red oxide primer paint formulated to equal or exceed the performance requirements of Federal Specification TT-P-636D, TT-P-664C and SSPC-Paint 25.
   2. Primary Frames:
      a. Clean all steel per SSPC-SP 2.
      b. Apply one coat of water reducible alkyd primer by spray or dip method to a minimum coating thickness of 1.0 mil.
   3. Secondary Structural Members:
      a. Clean all steel per SSPC-SP8.
      b. Apply one coat of coil applied polyester primer to a minimum coating thickness of 0.5 mil. (purlins and girts).

E. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 to meet requirements of ASTM A780/A780M.

2.3 MATERIALS - WALL PANELS

A. Exterior walls shall be covered with precision roll-formed Butlerib® II panels as furnished by Butler Manufacturing Company or approved equal.
   1. Panels shall be 3' wide with four major corrugations, 1-1/2" high 12" on center with two minor corrugations between each of the major corrugations the entire length of the panel.
   2. Panels shall be one piece from base to building eave.
   3. The upper end of panels shall be fabricated with a mitered cut to match corrugations of Butlerib® II roof panels and square cut for all other roof panels.
   4. The bottom end of the panels shall be straight cut.
   5. Wall panels shall be properly aligned with structurals.
   6. Panel Design: Panel design shall be in accordance with AISI "Specifications for the Design of Light-Gage, Cold Formed Steel Structural Members," and in accordance with sound engineering methods and practices.
   7. 26 gage galvanized, per ASTM A653/A653M, and painted with exterior colors of Butler-Cote® 500 FP finish system, a full strength, 70% Kynar® 500/Hylar 5000™ fluoropolymer coating. Manufacturer warrants that coating shall not blister, peel, crack, chip, or experience material rust-through for 20 years. For a period of 20 years chalking shall not exceed #8 - ASTM and fading shall be 5ΔE Color Difference Units or less.

B. Trim material should be as follows:
   1. Exterior trim shall be of the same color as the exterior color of the Butlerib® II wall panel except the following:
      a. Eave trim, gable trim, door side flashings and header flashings to be galvanized prepainted steel with Butler-Cote® 500 FP finish system, a full strength, 70% Kynar® 500/Hylar 5000™ fluoropolymer coating.
      b. Downspouts and gutters shall be 24 gauge preprimed galvanized steel ready for field painting.
      c. Interior trim shall be painted.
      d. Flashings, trims, closures and similar items shall be as detailed on drawings as supplied by the manufacturer of the panel.

C. Fasteners:
   1. Butlerib® II wall panel-to-structural connections shall be made with Torx® head Scrubolt™ fasteners, Torx® head self-drilling screws or Lock-Rivet™ fasteners. Panel-to-panel connections shall be made with Torx® head self-drilling screws, or Lock-Rivets™.
   2. Lock-Rivets (optional) shall be set by a special Lock-Rivet tool.
   3. Fastener locations shall be as shown on erection drawings as furnished by Butler Manufacturing Company.
   4. All exposed fasteners shall be either pre-painted to match wall color or shall be covered with plastic color caps to match wall color.

2.4 MATERIALS - ROOF PANELS

A. Roof panels shall be roll formed MR-24 panels as manufactured by Butler Manufacturing Co. or approved equal.
   1. Architect shall choose from the manufacturer's standard colors.

B. Roof Panels: Provide drawing quality aluminum coated steel sheets complying with requirements of ASTM A463/A463M; coated both sides with a layer of aluminum-zinc alloy (approximately 55% aluminum, 45% zinc) applied by the continuous hot-dip method. Metal thickness not less than 24 gage (0.0239").
   1. Color: Painted with exterior colors of Butler-Cote® 500 FP finish system, a full strength, 70% Kynar® 500/Hylar™ 5000 fluoropolymer coating. Manufacturer warrants that coating shall not blister, peel, crack, chip, or experience material rust-through for 20 years. For a period of 20 years chalking shall not exceed #8 - ASTM and fading shall be 5ΔE Color Difference Units or less.
   2. The panels shall be 2' wide with two major corrugations, with a minimum rib height of 2-3/4" including the seam, 24" on center. Minor corrugations (cross fluting) at 6" on center between and perpendicular to the major corrugations, will be required to stiffen panel and reduce wind noise. Panels of 9", 12", 15", 18" and 21", in lengths up to 25' shall be provided as required.

3. Provision for a full 2-1/2" thermal movement of the roof panel shall be accomplished by the use of clips with self-centering movable tabs and shall be non-friction creating during thermal expansion cycles. The movable tab shall be made of high strength 304 stainless steel. The clip base shall be a minimum of 16 ga. galvanized steel. The clip system shall provide a self-centering mechanism to center the clip during erection. The force required to move the movable tab shall not exceed 8 lbs.
4. The roof shall provide for thermal expansion/contraction without detrimental effect to the roof panel when there is a 100°F. temperature difference between the inside structural framework of the building and the temperature of the roof panels.
5. Roofing assemblies shall be installed on a minimum 1/4" in 12" downslope to drain, except at endwalls which may be warped to a lesser elevation when "flat roofed" appearance is desired. All gable end panels installed below 1/4" to 12" shall have sufficient elevation to provide positive drainage.
6. Panels of maximum possible lengths shall be used to minimize end laps. Panel end splices shall allow the roof panels to expand and contract with roof panel temperature changes, with a floating splice connection. Endlaps shall be staggered 5'-0" at alternating panels. Continuous in line splices will not be permitted. Panel end laps shall be not less than 6", sealed with sealants and fastened together by aluminum clamping plates, forming a free floating splice. Sealant at end laps shall contain PVC beads to prevent expulsion of the sealant during fastening process.
7. Ridge assembly shall be designed to allow roof panels to move lengthwise with expansion/contraction as the roof panel temperature changes, and the ridge assembly itself shall be designed to accommodate expansion/contraction in its own length caused by thermal movement.
8. All endwall trim and roof transition flashing shall allow the roof panel to move relative to the wall panels as the roof expands and contracts with temperature changes.
9. All sidelap sealant shall be factory applied.
10. Material used in flashing and transition parts shall match the roof panel materials, be compatible, and shall not cause a corrosive condition. Copper and lead materials shall not be used with zinc or aluminum coated panels.

C. Fasteners:
1. All connections to roof panels shall be made with clips with movable tabs that are seamed into the standing seam sidelaps. Panel-to-panel connections shall be made with positive field formed double lock standing seam.
2. Exposed fasteners are permitted at the eave and splice only.
3. Exposed eave fasteners shall be aluminum-zinc coated or stainless steel.
4. Splice fasteners shall be stainless steel.

D. Metal Accessories: Provide miscellaneous items as required for installation of work; all trim and metal flashing associated with the preformed metal panels shall receive the same finish as panels.
1. Pipe flashing units shall be constructed of E.P.D.M. (ethylene Propylene Diene Monomer) rubber as manufactured by DuPont (Nordel 1440 Hydrocarbon). Unit shall be black in color with a ductile aluminum (Alloy A1100-0) reinforcing ring bonded to a rubber flange on the base of the flashing unit.

E. Sealant: Provide one-part elastomeric polyurethane, polysulfide or silicone rubber sealant as recommended by roofing panel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION AND ERECTION

A. General: Install preformed metal roofing and wall panels and related items in accordance with roofing panel manufacturer's instructions.

B. Framing: Erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

C. Purlins and Girts: Provide rake purlins with tight fitting closure channels. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.

D. Bracing: Provide diagonal rod or angle bracing in both roof and sidewalls as indicated.

E. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical or electrical work. Securely attach to building structural frame.

F. Roof Panels:
   1. Position and align panel with the eave structural member and align the panel with the panel clip.
   2. All side laps shall be field sealed by a lock-seaming device. Side lap sealant shall be factory applied.
   3. Panel end laps shall be not less than 6", sealed with sealants and fastened together by clamping plates, forming a free floating splice.
   4. Panel clips shall be attached to the secondary structural members.

G. All connections of roof panels to structural members shall be made with clips with movable tabs that are seamed into the double lock standing seam side lap. Panel clips shall be attached to the secondary structural members.

H. Panel-to-panel connections shall be made with positive field formed Pittsburgh double lock standing seam.

I. Standing seams shall be formed by an electrically powered mechanical lock seaming device. Hand seaming devices may be required in some areas.

J. Anchor components parts of the preformed metal roofing securely in place, providing for necessary thermal and structural movement.

K. Install and securely anchor metal flashing, trim, gutters and related items to provide a weatherproof enclosure, no fasteners shall be exposed on the exterior face of the work.

L. Upon completion of installation of gutters, test gutters for leaks. Block off downspouts and fill gutters with water. Inspect gutters for leaks, repair leaks and re-test sections of gutters until all sections are leak-proof.

M. Upon completion and during all roofing operations roof panels, gutters and other system components shall be thoroughly cleaned of filings, tailings, spatters and excess materials.

N. During all mechanical and painting operations, provide temporary protective coverings to prevent damage by overspray, solders or other contaminants.

O. Structural system shall be plumb before wall panels are attached.

P. Panels shall be aligned and attached in accordance with erection drawings furnished by Butler Manufacturing Company.

Q. All sidelaps shall be at least one full corrugation.

R. Panels shall be sealed at the base with metal closures.

END OF SECTION

ROOFING WARRANTY

WHEREAS _____

OF (ADDRESS) _____

HEREIN CALLED THE "ROOFING CONTRACTOR", AS PERFORMED ROOFING AND ASSOCIATED WORK ("WORK") ON FOLLOWING PROJECT:

OWNER: _____

ADDRESS: _____

NAME AND TYPE OF BUILDING: _____

ADDRESS: _____

AREA OF WORK: _____ DATE OF ACCEPTANCE: _____

WARRANTY PERIOD: _____ DATE OF EXPIRATION: _____

AND WHEREAS Roofing Contractor has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

NOW THEREFORE Roofing Contractor hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in watertight condition.

This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. Peak gust wind speed exceeding 120 miles per hour;
   c. fire;
   d. failure of roofing system substrate including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others including construction contractors, maintenance personnel, other persons, and animals whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Contractor, and until cost and expense thereof has been paid by Owner or by another responsible party so designated.
3. The Roofing Contractor is responsible for damage to work covered by this Warranty, but is not liable for consequential damages to building or building contents, resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Contractor, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void upon date of said alterations, but only to extent said alterations affect work covered by this Warranty. If Owner engages Roofing Contractor to perform said alterations, Warranty shall not become null and void, unless Roofing Contractor, prior to proceeding with said work, shall have notified Owner in writing, showing reasonable cause for claim that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this warranty.
5. The Owner shall promptly notify Roofing Contractor of observed, known or suspected leaks, defect, or deterioration, and shall afford reasonable opportunity for Roofing Contractor to inspect work, and to examine evidence of such leaks, defects, or deterioration.
6. This Warranty is recognized to be the only warranty of Roofing Contractor on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to him in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Contractor of responsibility for performance of original work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

_____
Installation Company

_____
By

_____
Title

_____
Business Address

_____
Telephone Number

ATTEST:

_____

Secretary

IN WITNESS THEREOF, this instrument has been duly executed this

_____ day of _____, 20_____

(INSERT APPROPRIATE EXECUTION FORM)

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SECTION 26 02 00

BASIC MATERIALS AND METHODS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. Any discrepancies within the Contract Documents or between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least seven (7) working days prior to bid, the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning electrical system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronic's Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.
   1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must

be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

2. Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by the latest ASHRAE Fundamentals Handbook, Chapter 39 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the Work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In the event of discrepancy between

Drawings and Specifications, or within either Drawings or Specifications, the greater or more costly of the discrepancy shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least seven (7) working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is the equivalent of the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer's standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equivalent capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 calendar days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equivalent construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUIVALENT" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUIVALENT" product, material or method may be used if it complies with the Specifications and is submitted for review to the Engineer as outline herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with the requirements listed above; and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the

substituting Contractor to coordinate space requirements, building provisions and connection requirements with their respective trade(s) and all other trades; and to pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:
   1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
   2. An index page with a listing of all data included in the Submittal.
   3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
   4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
   5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
   6. Identification of each item of material or equipment matching that indicated on the Drawings.
   7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
   8. Additional information as required in other Sections of this Division.
   9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed

in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:
   1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
   2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
   3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
   4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
   5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
   6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Provide detailed shop drawings, descriptive literature, table of contents listing all items being submitted at the beginning of each submittal package, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:
   1. Switchboards
   2. Distribution Panelboards
   3. Panelboards
   4. Wiring Gutters
   5. Heavy Duty Disconnect Switches
   6. Lighting Fixtures
   7. Lighting Contactors
   8. Time Clocks
   9. Lighting Control System
   10. Photocells
   11. Wiring Devices and Plates

12. Conduit and Fittings
13. Wire
14. General Purpose Dry Type Transformers
15. Harmonic Mitigating Type Transformers
16. Emergency Generator
17. Automatic Transfer Switches
18. Sound Reinforcing System
19. Fire Alarm System
20. Surge Protection Devices (SPD)
21. Lightning Protection

I. Refer to each specification section for additional requirements.

1.14 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
   1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   4. Servicing instructions and lubrication charts and schedules.

1.15 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
      a. Wall and type locations.
      b. Clearances for installing and maintaining insulation.
      c. Locations of light fixtures and sprinkler heads.
      d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      e. Equipment connections and support details.
      f. Exterior wall and foundation penetrations.
      g. Routing of storm and sanitary sewer piping.
      h. Fire-rated wall and floor penetrations.
      i. Sizes and location of required concrete pads and bases.
      j. Valve stem movement.
      k. Structural floor, wall and roof opening sizes and details.
   2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
   4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.16 RECORD DRAWINGS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 26.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

E. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

F. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____

(SIGNATURE)

1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.18 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow 1/4” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and ed for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:
   1. Identifying names, name tags designations and locations for all equipment.
   2. Fault Current calculations and Coordination Study.
   3. Reviewed shop drawing submittals with exceptions noted compliance letter.
   4. Fabrication drawings.
   5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
   6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
   8. Equipment name plate data.
   9. Wiring diagrams.
   10. Exploded parts views and parts lists for all equipment and devices.
   11. Color coding charts for all painted equipment and conduit.
   12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
   13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.19 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.20 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.21 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.22 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application

packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.
   1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
   2. If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
   3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:
   1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
   2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
   3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 PRODUCT LISTING

A. Products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
   1. Plaster Surfaces: Milcor Style K.
   2. Ceramic Tile Surfaces: Milcor Style M.
   3. Drywall Surfaces: Milcor Style DW.
   4. Install panels only in locations approved by the Architect.

2.4 EQUIPMENT PADS

A. Provide 4-inch-high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

B. Provide 6-inch-high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Provide a 4-foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

C. Provide a minimum 6-inch-high, steel reinforced concrete pad for generators. Pads shall be sized 6” larger that the outside perimeter dimensions. Provide a 4-foot monolithic extension to the pad around the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.). Refer to structural details. Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise. The generator shall be bolted to the concrete pad per the manufacturers details.

D. Provide steel reinforced concrete pad for utility transformers. Pads shall comply with Utility Company Standards.

2.5 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.6 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.7 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.8 ELECTRICAL SYSTEM IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Indicate voltage for that raceway. Locate markers at ends of conduit runs, on pull boxes, on junction boxes, near switches and other control devices, near items of equipment served by the conductors, at points where

conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit. Switch-leg conduit and short branches for power connections do not have to be marked, except where conduit is larger than ¾ inch. Branch circuit conduits, junction boxes and pull boxes shall be marked with a permanent marker indicating panel name and branch circuit numbers.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:
   1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way. Provide black back plate with white letters and numbers for normal equipment. Provide red back plate with white letters and numbers for optional emergency equipment. Provide yellow back plate with white letters and numbers for Life safety equipment.
   2. A black-white-black laminated plastic engraved identifying nameplate shall be secured by stainless steel screws to each automatic transfer switch, switchboard, distribution panel, motor control center, motor starter panels and panelboards.
      a. Identifying nameplates shall have ¼ inch high engraved letters and shall contain the following information:
         1) Name
         2) Voltage
         3) Phase
         4) "3" or "4" wire, and
         5) Where it is fed from.
      b. An example of a panelboard nameplate is:
         Center Panel – 1HB
         480/277 volt, 3 phase, 4 wire
         Center Fed from DP2
      c. An example of an automatic transfer switch nameplate is:
         Center ATS #2
         480/277 volt, 3 phase, 4 wire, 4 pole
         Center Fed from MSB and DPE
   3. Each feeder device in a switchboard, distribution panel, and motor control center device shall have a nameplate showing the load served in ½ inch high engraved letters.
   4. A black-white-black laminated plastic engraved identifying nameplate shall be secured by screws to each transformer, safety switch, disconnect switch, individual motor starter, enclosed circuit breaker, wireway, and terminal cabinet.
      a. Identifying nameplates shall have 1/4 inch high engraved letters and shall indicate the equipment served.
      b. An example of a disconnect switch is: AHU-1.
   5. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories, Inc.), and approval labels are exceptions to this requirement.
   6. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
   7. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING."

D. Identification of Wiring Devices
   1. Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside face of the coverplate on all surface mounted devices.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:
   1. Where shown to be exposed.
   2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. Contractor shall install underground raceways including but not limited to feeders, service laterals, branch circuit and telecommunications. Contractor shall saw cut existing hard surfaces, when required for installation. Contractor shall patch surface to match existing conditions. Contractor shall replace all landscaping material when raceways are installed in these areas. Submit proposed method for patching for review.

C. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

D. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by "3M" or approved equal.

E. Refer to 26 05 33 for additional requirements.

3.4 ELECTRICAL GEAR

A. Install all electrical equipment in accordance with the National Electrical Code and as shown on the drawings.

B. Lighting contactors, time clocks, fire alarm equipment, security equipment disconnect switches, etc. mounted in mechanical/electrical rooms shall be mounted at a working height not requiring a ladder, when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

C. Fire retardant back boards secured to drywall studs may be used for contactors, time clocks, fire alarm equipment, security equipment, and disconnect switches 60 amp or smaller. All other wall mounted devices shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

3.5 CLEANING

A. Clean lighting fixtures and equipment.

B. Touch-up and refinish scratches and marred surfaces on panels, switches, starters, and transformers.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:
   1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
   2. Panelboards, switches, fixtures, etc., shall be cleaned and in operating condition.
   3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
   4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
   5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

F. The contractor shall provide a thermographic test using an independent testing laboratory using an infrared scanning device. This test shall include but not limited to all switchboards, distribution panelboards, panelboards, automatic transfer switches and other electrical distribution devices. This test shall be conducted to locate high temperature levels. This test shall be conducted between 3 to 8 months after occupancy, but not beyond the one year warranty period. Submit test to the architect and engineer using test reporting forms. All unacceptable conditions shall be corrected prior to the end of the warranty period.

END OF SECTION

SECTION 26 02 01

COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 01 31 00 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Mechanical, Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT, but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4" scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
      a. Wall and type locations.
      b. Clearances for installing and maintaining insulation.
      c. Locations of light fixtures and sprinkler heads.
      d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      e. Equipment connections and support details.
      f. Exterior wall and foundation penetrations.
      g. Routing of storm and sanitary sewer piping.
      h. Fire-rated wall and floor penetrations.
      i. Sizes and location of required concrete pads and bases.
      j. Valve stem movement.
      k. Structural floor, wall and roof opening sizes and details.
   2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination
1. Below is hierarchy of model elements and the sequencing by which the models will be coordinated:
   a. Structural and Architectural model
   b. Miscellaneous steel
   c. Perform preliminary space allocation
   d. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
   e. Main and medium pressure ducts from the shaft out
   f. Main graded plumbing lines and vents
   g. Sprinkler mains and branches
   h. Cold and hot water mains and branches
   i. Lighting fixtures and plumbing fixtures
   j. Smaller sized ducts and flex ducts
   k. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

END OF SECTION

SECTION 26 03 13

ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing such loss or damage. The contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

B. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The contractor shall allow the Owner 2 weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

C. The contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

1.2 RELATED SECTIONS

A. Section 01120 - Alteration Project Procedures.

B. Section 02072 - Minor Demolition for Remodeling.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

B. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner and Telephone Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing Public Address System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner and at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Section 01120, Section 02072, and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets, which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

L. Where existing construction is removed to provide working and extension access to existing utilities, contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

M. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

N. During the construction and remodeling, portions of the project shall remain in service. Construction equipment, materials, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building.

O. Certain work during the demolition phase of construction may require overtime or nighttime shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner`s Representative at least 72 hours in advance.

P. All existing lighting fixtures, switches, outlets, speakers, materials, equipment and appurtenances not included in the remodel or alteration areas are to remain in place and shall remain in service.

Q. Electrical equipment, outlets, speakers, circuits to mechanical and building systems equipment, etc., which are to remain but which are served by conduit and/or circuiting that is disturbed by the remodeling work, shall be reconnected in such as manner as to leave it in proper operating condition.

R. Existing branch circuit wiring which is to be removed, shall be pulled from the raceways and the empty conduit shall be removed to a point of permanent concealment.

S. Within the remodeled or alteration areas where existing walls are being removed, all existing lighting fixtures, switches, receptacles, other materials and equipment and their appurtenances shall be removed, where required by the remodel work either shown or specified.

T. New circuiting indicated to be connected to existing panels shall be connected to "spares" and/or "released" breakers as applicable, or new breakers provided where space is available. Contractor shall verify the existing panel load and feeder capacity prior to adding any additional loads.

U. In all the remodeled areas where existing ceilings are being removed and reinstalled, all existing lighting fixtures, other ceiling mounted devices (i.e. smoked detectors, speakers, etc.) and their appurtenances shall be removed and reinstalled, unless otherwise shown or specified. This also applies to new ceiling installations.

V. Existing lighting fixtures shown to be removed and indicated to be reused, shall be cleaned, repaired, and provided with new accessories as required for the proper operation in their new locations. Provide new lamps and ballast as required.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Section 01120.

3.6 REMOVAL OF MATERIALS

A. The contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor`s responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

END OF SECTION

SECTION 26 05 19

WIRE, CABLE AND RELATED MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 600 volt building wire, cable and connectors and 300 volt wire, cable and connectors.

B. WORK INCLUDED: Include the following Work in addition to items normally part of this Section.
1. Wiring for lighting, dimming controls and power.
2. Automatic Control Wiring.
3. Connection of equipment shown.
4. Fire Alarm System.
5. Voice Communications and Sound System.
6. Mineral Insulated Cable (MI)

C. WORK SPECIFIED ELSEWHERE:
1. Heating, ventilating, and air conditioning equipment.
2. Structured cabling system.
3. Coaxial cables

1.2 REFERENCE STANDARDS

A. UL 4 - Armored Cable

B. UL 83 - Thermoplastic-Insulated Wires and Cables

C. UL 1063 - Standard for Machine-Tool Wires and Cables

D. UL 1569 - Metal-Clad Cables

E. UL 1685 - Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

F. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire

G. NFPA 70 - National Electrical Code

H. All wire cable and connectors shall be UL approved.

I. NEMA

J. NEMA Bulletin 119

1.3 ACCEPTABLE MANUFACTURERS

A. 600 VOLT WIRE AND CABLE
1. Southwire
2. Encore
3. Cerro
4. Atkore

B. 300 VOLT WIRE AND CABLE
   1. Westpenn
   2. Beldon
   3. Alpha
   4. Tappan - Southwire

C. FLEXIBLE CABLE SYSTEMS
   1. AFC Modular Cable Systems
   2. Kaf-Tech

D. CONNECTORS
   1. Ilsco
   2. Cooper
   3. AMP - TYCO
   4. Burndy
   5. Ideal
   6. 3M
   7. O.Z. Gedney
   8. Thomas & Betts
   9. Buchanan

1.4 SUBMITTALS

A. Shop drawings shall include, but not limited to:
   1. Cutsheets of wire, cable and connectors to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electrical Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 WIRING

A. All wire shall be new and continuous without weld, splice, or joints throughout its length. It must be uniform in cross-section, free from flaws, scales and other imperfections.

B. WIRE MATERIAL: Conductors shall be soft drawn, annealed copper. Aluminum wiring is not acceptable unless otherwise noted on drawings.

C. TYPES:
   1. Provide type “THHN/THWN-2” insulation for all buried feeders and service entrance conductors.
   2. Provide type “THHN/THWN-2” insulation for all branch circuits and above grade feeders.
   3. All wire No. 8 and larger shall be stranded. All wire No. 10 and smaller shall be stranded or solid.
   4. Provide type "XHHW" or other 90 degrees insulation wiring for branch circuit wiring installed through continuous rows of fixture bodies.
   5. All 300-volt cable including but not limited to telephone, fire alarm, data, CATV and security shall be UL listed for use in return air plenums.
   6. All dimming conductors shall be 300 volt, 75 C plenum rated. Dimming conductors shall be solid. Stranded conductors are not acceptable.

D. CONDUCTOR SIZES
   1. Feeder conductors shall be sized for a maximum of 2% drop in rated voltage at scheduled load.

2. Branch circuit conductors shall be sized for a maximum 3% drop in the rated voltage to the longest outlet on the circuit.
3. Minimum wire shall be 12 AWG, unless otherwise shown on Drawings or required by Code.
4. Minimum wire size for 0-10v dimming controls shall be 18 AWG for conductors not exceeding 300 feet circuit length (one-way) and 16 AWG for those exceeding 300 feet (one-way).

E. COLOR CODING: No. 6 or larger shall use tape for color coding. No. 8 and smaller wire shall be color coded in accordance with the governing authority requirements or as follows:

120/208 Volt
Neutral: White
Phase A: Black
Phase B: Red
Phase C: Blue
Ground: Green

277/480 Volt
Neutral: Gray
Phase A: Brown
Phase B: Purple
Phase C: Yellow
Ground: Green

120/240 Volt
Neutral: White
Phase A: Black
Phase B: Orange
Phase C: Blue
Ground: Green

0-10 Volt dimming conductors
Purple (source)
Pink (common)

2.2 METAL CLAD CABLE - TYPE MC (600 VOLT)

A. Provide soft drawn solid copper conductors with type THHN/ THWN-2 insulation rated 90° C in dry locations. All conductors shall be color coded. Include a white neutral and green insulated grounding conductor. Branch circuits shall include a double sized neutral when more than one phase conductors are being utilized. The conductors shall use a binding tape with a printed legend and assembled in an interlocking steel armor raceway.

PART 3 - EXECUTION

3.1 WIRE

A. Do not pull wire into conduit until Work of an injurious nature is completed. Where two or more circuits run to a single outlet box, each circuit shall be properly tagged. Wyreze or approved equal may be used as a lubricant where necessary.

B. Splices shall be fully made up in outlet boxes with compression crimp-on type splice connectors.

C. Joints and splices will not be permitted in service entrance or in feeders. Joints in branch circuits will be permitted where branch circuits divide, and then shall consist of one through-circuit to which the branch shall be spliced. Joints shall not be left for the fixture hanger to make. Connect joints and splices with Buchanan Series "2000" solderless connectors complete with insulating caps or properly sized twist on wire nuts. “Wago” push-in connectors are not acceptable.

D. All stranded conductors shall be furnished with lugs or connectors.

E. Connectors furnished with circuit breakers or switches shall be suitable for copper wire termination.

F. “Sta-Cons” shall be used to terminate stranded conductors on all switches and receptacles.

G. Metal Clad Cable - Type MC
   1. All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'-0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring installed in accessible ceiling is not permitted. Fixture whips shall not lay on ceiling tile or grid. Provide caddy clips to provide additional support.

H. All stranded #10 and small conductors shall be terminated with an approved solderless terminal if the device or light fixture does not have provisions for clamp type securing of the conductor.

I. The jacket for all travelers used on 3-way and 4-way switches shall be pink.

J. Route conductors for 480Y/277 systems in a separate raceway. Do not combine with 208Y/120 volt or 120/240 volt systems.

K. Emergency circuits shall not be routed with normal conductors.

3.2 BALANCING SYSTEM

A. The load on each distribution and lighting panel shall be balanced to within 10% by proper arrangement of branch circuits on the different phase legs. Provide written documentation showing results. Submit with O & M manuals.

3.3 LOW VOLTAGE WIRING

A. Low voltage wiring, including dimming conductors, shall be plenum rated. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

B. Low voltage wiring shall be routed in separate raceways from power wiring systems.

C. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.

E. Provide a junction box to make up all joints and splices.

F. Provide dimming conductors for all lighting circuits located in spaces with dimmer switches and theatrical lighting as indicated on the drawings and as specified.

3.4 GROUNDING

A. Permanently connect all conduit work, motors, starters, and other electrical equipment to grounding system in accordance with NFPA 70.

3.5 CABLE SUPPORTS

A. Provide cable supports in all vertical raceways in accordance with Article 300.19 of NFPA 70.

3.6 DEFECTS

A. Defects shall include, but are not to limited to, the following:
   1. Tripping circuit breakers under normal operation.
   2. Improperly connected equipment.
   3. Damaged, torn, or skinned insulation.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. WORK COMBINED WITH OTHER SECTIONS: Combine the work specified herein with the following Sections to form a single responsibility for the Work:
   1. Electrical.
   2. Basic materials and methods.

B. Provide electrical service, equipment and wiring device grounding as shown, scheduled and as specified.

C. The types of grounding include, but not limited to, the grounding bonding of all equipment devices, building steel piping, and as required by the National Electrical Code, Local Inspection Department and Power Company.

1.3 STANDARDS

A. National Electrical Code (NFPA-70)

B. Local municipal and State codes that have jurisdiction.

C. NECA

1.4 ACCEPTABLE MANUFACTURES

A. Provide grounding products manufactured by Copperweld and Cadweld.

1.5 SUBMITTALS

A. Shop drawings shall include, but not limited to the following:
   1. Cut sheets of ground rods, clamps and connectors.
   2. Grounding system diagram.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all materials required to construct a complete grounded electrical system.

B. GROUND RODS: Ground rods shall be 3/4" inch diameter by 10 feet long construction with copper jacket and a steel core.

C. CLAMPS: Ground clamps shall be copper except for steel or iron pipes in which the clamps shall be galvanized iron.

D. CONDUCTORS: Conductors shall be connected by means of an approved pressure connector or clamp.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install grounding system as shown and specified to ensure a properly grounded system.

B. SERVICE ENTRANCE GROUNDING SYSTEM: Provide a main bonding jumper between the neutral and ground bus of each switchboard. Route a separate grounding electrode conductor in conduit from each main distribution panel to the ground rod grid, incoming cold water piping system, and to the "lightning protection system" (250 - 106 of NEC) under ground bonding loop. Provide a bonding jumper around water meter. The grounding electrode conductor shall be stranded copper, 98% conductivity and shall be run continuous without splices or joints and installed at least 12" below grade.

C. BUILDING STEEL AND PIPING SYSTEM: Install a bonding jumper between building steel and metallic piping systems to bond them to the electrical grounding system.

D. NEUTRAL: The neutral shall be grounded only at the service entrance and other separately derived systems. The neutral shall be kept separate from the grounding system and shall not be used as a ground.

E. GROUNDING SEPARATELY DERIVED ALTERNATING CURRENT SYSTEM
1. TRANSFORMERS: The center point (neutral) of each wye connected transformer shall be bonded to the case and the grounding electrode conductor shall be connected to the grounded conductor (neutral).
2. STANDBY EMERGENCY GENERATOR: The generator neutral shall be bonded to the generator when a 4-pole switched neutral automatic transfer switch is specified.

F. GROUNDING CONDUCTOR: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

G. CONDUIT GROUNDING BUSHING: Conduit terminating in equipment that has a ground bus such as switchboards, panelboards, etc., shall have grounding bushings installed. Ground each conduit by means of a grounding bushing and to the ground bus in the equipment.

H. MOTORS: The frame of all motors shall be grounded.

I. SPECIAL GROUNDING: Provide a #6 AWG copper grounding conductor for each telephone board, television system, etc. Terminate the grounding conductor on ground bus and to the building electrical grounding system. Refer to 800-40(d) and 820-40(d) of the NEC.

J. REMOTE PANELBOARDS: Provide a grounding electrode conductor all remote panels as required by the NEC and shown on drawings.

K. LIGHTING FIXTURES: Flexible fixture whips containing a green grounding conductor shall be used to connect light fixtures. Flexible fixture whips shall not exceed ten feet.

L. RECEPTACLES: All receptacles shall be grounded using the branch circuit grounding conductor. Receptacles shall use an approved grounding yoke.

M. POLES SUPPORTING OUTDOOR LIGHTING FIXTURES: Provide grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.2 TESTING

A. Perform a ground resistance test using a biddle analog or digital portable earth/ground resistance tester. The system resistance shall not exceed 5 Ohms. Provide additional electrodes as required (refer to 250-84 and 250-56 of the most current edition NEC). Test shall not be conducted following wet weather. Provide personal instruments to conduct these tests and submit certified test for review. Test shall be verified by Engineer.

END OF SECTION

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical raceways and fittings as shown, scheduled and specified.

B. The types of raceways and fittings required are as follows:
1. Rigid hot-dipped galvanized steel conduit (GRC) (RMC)
2. Intermediate hot-dipped galvanized steel conduit (IMC)
3. Electrical metallic tubing (EMT)
4. PVC (Sch. 40 & 80)
5. Flexible metal conduit (FMC)
6. Liquid-tight flexible metal conduit (LFMC)
7. PVC coated rigid galvanized steel conduit (GRCC)
8. Rigid Aluminum Conduit (RAC)

1.2 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit - Aluminum (ERMC-A); 2025.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

F. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

G. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

H. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

I. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

J. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

K. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

L. NEMA FB-1

M. NEMA TC3

1.3 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Allied
2. Republic
3. Prime Conduit (Carlon)
4. Wheatland Tube
5. Cantex
6. Western Tube
7. Robroy Industries

B. Fittings
1. Appleton
2. Crouse Hinds
3. Steel City
4. O.Z. Gedney
5. Carlon
6. Raco, Inc.
7. Bridgeport

C. Boxes
1. RACO
2. Thomas and Betts
3. EATON
4. Crouse-Hinds
5. Appleton

D. Surface
1. Hubbell
2. Wiremold

1.4 SUBMITTALS

A. Product data shall include but not be limited to:
1. Cutsheets for raceways, fitting, solvents, primers, etc.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. NFPA 70

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Rigid Galvanized Steel Conduit (GRC/RMC)
1. Construction, Materials, Codes, Standards:
a. Article 344 - NFPA 70.
b. Hot-dip galvanized rigid steel conduit, galvanized after fabrication. Products shall comply with UL 6 and ANSI C80.1. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.
c. Fittings shall be threaded and shipped with thread protectors. Set Screw are not acceptable. Die Cast Fittings are not acceptable.
2. Permitted for use in the following locations:
a. Outdoor or Exterior (Exposed)
b. Indoors, Conditioned Spaces
c. Unconditioned Spaces
d. Underslab (Void Form Slab): where not in contact with earth – only permitted where indicated on plan.
e. Underslab (Suspended Slab): Permitted – only where indicated on plan.

3. Prohibited Locations: Underground, Corrosive environments, Underslab (Slab on Grade), Foundation penetrations.
4. Specific Uses: Exposed Exterior installations, where within or attached to masonry or concrete, where subject to damage.

B. Intermediate Metal Conduit (IMC)
1. Construction, Materials, Codes, Standards:
   a. Article 342 - NFPA 70.
   b. Conduit shall be similar to rigid steel conduit except thinner wall.
   c. Fittings shall be threaded hot-dipped galvanized and shipped with thread protectors. Set Screw or Die Cast Fittings are not acceptable
   d. Products shall comply with UL 1242.
2. Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces
   d. Underslab (Void Form Slab): not in contact with earth only as indicated on plan.
   e. Underslab (Suspended Slab): only where indicated on plan.
3. Prohibited Locations: Corrosive Environment, Underground, Underslab (Slab on Grade), Foundation Penetrations
4. Specific Uses: Exposed exterior locations, Rooftops exposed to sunlight

C. Electrical Metallic Tubing (EMT)
1. Construction, Materials, Codes, Standards:
   a. Article 358 - NFPA 70.
   b. EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wiring pulling.
   c. Shall utilize steel insulated throat, set-screw connectors and steel set-screw couplings in all indoor conditioned spaces.
   d. Shall utilize steel insulated throat, threadless, watertight compression type connectors and steel threadless watertight compression type coupling in all non-conditioned spaces and in grout filled CMU walls.
   e. Products shall comply with UL 797 and ANSI C80.3.
2. Permitted for use in the following locations:
   a. Indoors, Conditioned Spaces
   b. Unconditioned Spaces
3. Prohibited Locations: Corrosive Environment, Underground, Underslab (all types), Wet or Damp Locations, Exteriors, Within Concrete, foundation penetrations.
4. Specific Uses: Primary use conduit for indoor spaces, where conditioned. Unconditioned locations shall require use of insulated throat water tight fittings.

D. Rigid Nonmetallic Conduit (PVC Schedule 40 & 80)
1. Construction, Materials, Codes, Standards:
   a. Article 352 and 300.6 - NFPA 70.
   b. Conduit shall be schedule 40 or 80 polyvinyl chloride (PVC), UV stabilized, rated for 90°C conductors.
   c. Fittings shall be solvent weld socket type.
   d. Products shall comply with UL 651.
2. Permitted for use in the following locations:
   a. Underground (Earth, outside foundation perimeter)
   b. Underslab (Slab on Grade): only where indicated on plan.
   c. Under Driveways, roadways, or vehicular crossings, and where required by Utility Company: PVC Schedule 80
      1) PVC Schedule 40 allowed where concrete encased.
3. Prohibited Locations: return air Plenums, interstitial spaces, Outdoor or Exterior (Exposed), Unconditioned spaces, corrosive environments, underslab (suspended or void form), foundation penetrations.

4. Specific Uses: For use underground or underslab (Slab on grade). Underground use is approved for all locations where transiting a project site, not underneath any foundation. For locations under the footprint of building/foundation, use only authorized where indicated on drawings.

E. Flexible Metal Conduit (FMC/Greenfield)
1. Construction, Materials, Codes, Standards:
   a. Article 348 - NFPA 70.
   b. Spirally wound continuously interlocked zinc coated strip steel.
   c. Fittings shall be one screw for smaller than 1-1/2-inch, two screw for 1-1/2-inch and larger, double clamp steel or malleable iron, either cadmium plated or hot-dip galvanized.
   d. Products shall comply with UL 360.
2. Permitted for use in the following locations:
   a. Indoors, Conditioned Spaces.
3. Prohibited Locations: outdoors/Exterior, unconditioned spaces, Corrosive, Wet, Concrete, underslab(all types), underground, foundation penetrations.
4. Specific Uses and Applications: For use in connection to rotating equipment within conditioned spaces, including plenums. Also permitted for use with empty raceways in walls for use with Low Voltage, AV, telecom cabling.

F. Liquid-Tight Flexible Steel Conduit (LFMC/Seal Tite)
1. Construction, Materials, Codes, Standards
   a. Article 350 - NFPA 70.
   b. Spirally wound continuously interlocked zinc coated strip steel with a UV stabilized polyvinyl chloride (PVC) outer jacket bonded to the conduit.
   c. Fittings shall be compression type, malleable iron, with insulated throat, either cadmium plated or hot-dip galvanized. Plastic is not acceptable.
2. Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces
3. Prohibited Locations: Concrete, corrosive, underground, underslab (all types), foundation penetrations.
4. Specific Uses and Applications: Primary use is connection to rotating equipment at unconditioned spaces. Transformer Primaries and Secondaries (excluding service transformer).

G. PVC Coated Rigid Galvanized Steel Conduit (GRCC/Plastibond)
1. Construction, Materials, Codes, Standards:
   a. Article 344 and 300.6 - NFPA 70.
   b. Conduit shall be same as rigid metal conduit with a factory-applied 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal, coated inside and outside.
2. Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed): except for stub-ups and penetrations.
   b. Corrosive Environment: required throughout
      1) Where corrosive environments exist, such as pools, pool pump room, corrosive chemical storage, GRCC shall be provided throughout, up to the point of sealed penetration into a non-corrosive environment.
   c. Underground (Earth, outside foundation perimeter): Required at bends of 15° or greater, Penetrations through concrete, Stub-ups through foundation or grade at concrete.
   d. Foundation Penetrations
3. Prohibited Locations: extended runs exposed to sunlight, Plenums, Underslab except for penetrations (all foundation types).
4. Specific Uses: For use at Cooling Towers, Natatoriums, Pools, Pool Decks, Pool pump rooms, chemical storage, corrosive environments.

H. Rigid Aluminum Conduit (RAC)
1. Construction, Materials, Codes, Standards:
   a. Article 344 - NFPA 70.
   b. Rigid aluminum (alloy 6063-T1) conduit shall be manufactured using 6063 Alloy in temper designation T-1.

c. Fittings for rigid aluminum conduit shall be threaded aluminum shipped with thread protectors. Set Screw or Die Cast Fittings are not acceptable
d. Products shall comply with UL 6A and ANSI C80.5.

2. Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces
3. Prohibited Locations: Corrosive environments, underground, within concrete, underslab (all types), foundation penetrations.
4. Specific Uses and Applications: Exposed Exterior such as rooftops or canopies.

2.2 PULL BOXES

A. Exterior in-ground pull boxes shall be concrete or polymer as manufactured by Brooks, Dalworth, Hubbell Quazite, or approved equivalent. Covers shall include identification of systems contained.

B. Where located in Roadways, Parking Lots, or Traffic zones, Pullboxes shall be rated to accept a minimum 22,500 lb. load per ANSI/SCTE 77.

C. All Pullboxes shall be sized based on NEC wire-bending requirements at each individual location.

D. Covers shall include identification of systems contained, such as:
   1. Electrical
   2. Telecom
   3. Communications
   4. Others, as required.

E. Pull boxes in pole bases shall be as manufactured by Carlon.

F. Pullboxes shall be provided in all raceway systems upon exceeding the following conditions:
   1. The equivalent of 270° in conduit bends, or after (3) 90° bends.
   2. Any 400ft of linear conduit or duct bank continuous segments.
   3. Where required to make transitions to prevent the damaging of conductor insulation.

2.3 WIREWAYS

A. Wireways shall be made of not less than 16-gauge sheet steel for 4 inch and 6 inch square sizes and 14 gauge steel for 8 inch and 12 inch square sizes. Couplings end plates, and knockouts shall be furnished as required. Each section of wireways shall be rigidly supported.

B. The finish shall be ANSI-49 gray epoxy paint applied by a cathodic electrode position paint process over a corrosion resistant phosphate preparation for NEMA 1 wireways. Provide galvanized steel for NEMA 3R wireways. NEMA 3R wireways and auxiliary gutters are for horizontal mounting only.

2.4 BUSHINGS

A. Provide nylon bushing on end of all low voltage cabling system conduits (sleeves, rough-ins, etc.).

B. Provide Grounding Bushing as required in 26 05 26 - Grounding.

PART 3 - EXECUTION

3.1 PROVIDE CONDUIT AS FOLLOWS:

A. GENERAL: The Drawings are diagrammatic and are intended to show the general location of outlets, devices, fixtures, and arrangement and control of circuits. The Contractor shall determine exact locations by actual measurement of the building or by reference to the Architectural Drawings.

B. All wiring shall be installed in galvanized rigid steel, rigid aluminum conduit or electrical steel tube (EMT) unless otherwise noted or specified. Each raceway shall be sized to contain the number of conductors required to comply with the latest edition of NFPA 70. Conduit sizes that are scheduled or shown on the drawings shall take preference.

C. Raceways shall not be routed below or within slab-on-grade foundations, or below grade of suspended slab structures, unless specifically noted or indicated otherwise on plan.

D. EMT in sizes up to 4 inches when concealed or not exposed to damage and located indoors only. (EMT is not acceptable in wet and damp location.)

E. MINIMUM SIZE: 3/4 inch.

F. Flexible conduit of any type shall not be used except for connections to rotating or vibrating equipment, or where use for low voltage raceways. All conduit shall be provided as a rigid type conduit for homeruns, runs between termination boxes, outlets, etc.

G. Fixture whips: Refer to 26 51 19 for additional information.

H. Of such size, and so installed that conductors may be drawn in without injury or excessive strain.

I. Where entering panels, pull boxes, junction boxes, or outlet boxes, shall be secured in place with lock nuts inside and outside, and insulated bushings inside.

J. Have Red seal type VCC or approved equal cable supports in risers, as required by NFPA 70.

K. Have ends reamed after cutting and application of die.

L. Keep conduit corked and dry during construction and swab out before conductors are pulled.

M. Have bends and offsets made with approved tools. Bends or offsets in which the pipe is crushed or deformed shall not be installed.

N. Have O.Z. Gedney or approved equal expansion fittings where crossing building expansion joints.

O. Fixtures in finished areas having suspended acoustical ceilings shall be connected to outlet boxes of lighting grid by flexible metal conduit; length not to exceed ten feet (six feet if using 3/8” manufactured fixture “whips”).

P. Outlet boxes in partitions shall never be set back-to-back. They shall be offset to prevent undue noise transmission from room to room.

Q. Each entire conduit system shall be installed complete before any conductors are drawn in. Every run of conduit shall be finished before covering up to guard against obstructions and omissions.

R. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of conduits. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel with a minimum thickness of 1.07MM and set to extend 4” above slab.

S. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty. All fire rating material shall be installed in accordance with manufacturer`s printed instructions.

T. All conduit shall be cleaned and swabbed to remove all foreign matter and moisture prior to pulling wire and cable. All boxes in which conduits terminate shall be cleaned of all concrete mortar and other foreign matter.

U. Provide #30 nylon pulling line in all conduits in which permanent wiring is not installed.

V. All conduit shall be securely fastened and supported using hot galvanized malleable iron one-hole pipe straps, clamps, hanger or other means approved by the engineer. Supports shall be as required per NEC. Tie wire shall not be used as support or securing means. Support conduit independently of ceiling hanger wire. Use all thread rods to support outlet boxes, junction boxes and conduit.

W. Contact the Architect and Engineer for an installation review before covering any below grade or above grade conduit.

X. All new outlets shall be flush mounted. In remodeled areas where wall construction prohibits flush mounting, provide Hubbell 2400 series, unless noted otherwise. Verify exact location and routing with architect before installation.

Y. Contractor shall not penetrate waterproof barriers without using proper fitting to maintain barriers. This shall include exterior walls and slabs. Coordinate with Architect for proper methods.

3.2 CONDUIT ROUTING

A. Conduit shall be concealed and by using the shortest practicable route between outlets, including where located on CMU walls.

B. Conduit may be exposed in electrical and mechanical rooms, and central plants, or other industrial type facilities such as warehouses or production plants.

C. Install risers, drops, offsets to avoid ductwork and structural components. Ductwork and structural systems shall take precedence to conduit.

D. Any exposed and visible conduit shall be parallel and perpendicular based on the lines of the building (such as ceiling lines, wall blocking lines, or architectural feature lines) using structural systems to conceal conduit visibility at all opportunities.

E. Concealed conduit shall be run in as direct manner as possible, using long bends. All bend radii shall be 12x conduit diameter. Condulets in lieu of elbows where ease of installation and appearance warrant their use – confirmation with architect is required for this use.

F. Conduit shall be continuous, with no more than (4) quarter bends between terminals, cabinets, boxes, or pullboxes is acceptable. Contractor is expected to provide wireway or boxes at appropriate intervals, in accordance with NFPA 70 for wire bending space. All conduit shall be electrically continuous throughout, including across boxes and cabinets. Terminals of all conduit shall be provided with double lock nuts and bushing, or terminated on conduit hubs. Use of Running Threads prohibited.

3.3 CONDUIT CORROSION PROTECTION

A. Branch circuit conduits installed in concrete slabs on fill or grade shall be positioned in a manner to ensure complete concrete cover. In no case shall such conduits be exposed below or above the slab surfaces, or penetrate the waterproof membrane.

B. At locations where metallic conduits pass through slabs on grade or transitions below grade, PVC coated rigid galvanized conduit shall be used.

C. Conduit installed in the air gap between the water-resistant barrier and finish brick shall not exceed 2-ft. in length.

3.4 EXPANSION JOINTS

A. Install approved expansion fitting in all conduit runs in excess of 150 feet or when crossing building expansion joints.

3.5 OUTLET AND JUNCTION BOXES

A. Provide an approved galvanized outlet box with adequate volume for number of conductors installed.

B. Provide standard galvanized switch boxes of the required number of gangs. Switch boxes where conduit is exposed shall be handy boxes or approved equal.

C. Outlet boxes for receptacles shall be similar to Universal 52151 with suitable raised cover. Receptacle boxes where conduit is exposed shall be handy boxes or approved equal.

D. Weatherproof boxes shall be FS or FD. Provide these boxes in all non-conditioned areas, exterior areas and natatoriums.

E. Outdoor boxes shall be NEMA 3R, with conduit connections made by Myers Hubs.

F. See notes and details on Drawings for special box requirements.

G. Provide junction boxes required to facilitate installation of the various conduit systems. Provide support boxes required for risers, each complete with approved cable supports as described elsewhere in this Division.

H. Outlet boxes for drywall shall be standard galvanized 4" square boxes with the appropriate device cover. Secure all outlet boxes with a backing brace connected to two adjacent studs. Mounting brackets with a single ear to rest against the backing sheet rock are not acceptable.

I. Provide floor outlet fittings for telephone to match fittings for duplex floor receptacles.

J. Provide 3-1/2” deep gangable masonry boxes in all masonry wall (CMU). Steel City GW-135-G or approved equal.

K. Provide shallow 4”x4” boxes in all demountable partitions.

L. Metallic boxes located in fire rated walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “ Wall Opening Protective Materials” (CLIV) are installed according to the requirements of their Classification. Metallic boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

M. Junction, pull boxes, condulets, gutters, disconnects, contactors, etc., above 2-foot x 2-foot grid ceilings shall be mounted within 18-inches of ceiling grid. Above 2-foot x 4-foot grid ceiling they shall be mounted within 30-inches of ceiling grid. All junction box, pull box, gutter openings shall be side or bottom accessible.

N. Junction boxes are prohibited above drywall or plaster ceilings except for lighting; and those must be mounted directly over light fixture opening. Route power, PA, fire alarm conduits to nearest lay-in ceiling.

3.6 THRU-WALL SEALS

A. Provide O.Z. Gedney “Thru-wall” seals for all conduits passing through concrete structure below grade, above grade, and floor penetrations below grade. These prevent moisture from entering the building.

B. Straight sleeves are not acceptable.

3.7 PULL BOXES

A. Interior Pull boxes shall be provided for conduit systems as required and shall be constructed of galvanized steel of not less than gauge and size specified by National Electrical Code. Size pull boxes per Article 314.28 - NFPA 70.

B. Where two or more feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation.

C. Exterior in-ground pull boxes shall have open bottoms with sand and rock beds below box for drainage of water. Provide closed bottom boxes where specified. Closed bottom boxes shall be provided with sumps for portable pump to allow for extracting water. Refer to details on the drawings.

D. Pull boxes mounted in pole bases shall be coordinated with the pour of the pole base and shall be flush with finished footing.

3.8 WIREWAYS

A. Wireways shall be installed as indicated or required and locations shall be coordinated with architect.

B. Wiring in wireways shall be neatly bundled, tied and suitably tagged.

END OF SECTION

SECTION 26 06 34

LOW VOLTAGE RACEWAY SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 WORK INCLUDED

A. Provide a complete raceway system for telephone system, consisting of cabinets, conduit, junction boxes, etc. This shall include but not limited to fire alarm, access control, structured cabling, audio-video, intercommunications, sound reinforcing, intrusion detection, telephone.

1.3 WORK SPECIFIED ELSEWHERE

A. Section 26 02 00 - Basic Materials and Methods for Electrical

B. Section 26 05 33 - Raceways

C. Section 26 05 19 - Wire, Cable and Related Materials

1.4 WORK NOT INCLUDED

A. Cabling

B. Equipment

C. Division 27

D. Division 28

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Conduit - Refer to Section 26 05 33.

B. Backboards - 3/4" X 4' X 8' fire rated plywood painted white.

C. Outlet Boxes - Refer to Section 26 05 33.

D. Pull and junction boxes - Refer to Section 26 05 33.

E. Floor Boxes - Refer to Section 26 05 33.

F. Cabinets - Consult low voltage system installer/supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 26 05 33 for underground service entrance.

B. Provide pull boxes in telephone conduit runs spaced not greater than 100 ft. apart, and on backboard side of runs with more than two right angle bends.

C. Place telephone label on pull and junction boxes.

D. Provide pull wire in each telephone run.

E. Provide plywood backboards and duplex receptacle in the telephone equipment room. Confirm location on jobsite prior to installation.

F. All terminal cabinets/backboards and conduit shall be sized per the recommendations of the telephone system installer.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 RELATED SECTIONS

A. Section 01 91 00 - General Commissioning Requirements

B. Section 23 09 63 - Energy Management and Control System (EMCS)

1.3 SUMMARY

A. The commissioning of the lighting system and associated controls as well as the service and distribution equipment shall be performed by an impartial technical firm hired by the owner or shall be performed by the installing contractor if the owner has not hired a commissioning firm. The commissioning provider shall be certified under one or more of the following certifications:
   1. CxA - Certified Commissioning Authority - ACG
   2. CBCP - Certified Building Commissioning Professional - AEE
   3. CCP - Certified Commissioning Professional - BCA
   4. CPMP - Certified Process Management Professional - ASHRAE
   5. BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as relate to Commissioning Process include, but are not limited to the following:
   1. Facilitate coordination of Commissioning work by Commissioning authority.
   2. Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
   3. Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
   4. Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.
   5. Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.
   6. Provide As-built drawings and documentation to facilitate Testing.
   7. Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.
   8. Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.
   9. Install systems and equipment in strict conformance with project specifications, manufacturer’s recommended installation procedures, and Pre-Functional Checklists.
   10. Provide data concerning performance, installation, and start-up of systems.

11. Provide copy of manufacturers filled-out start-up forms for equipment and systems.
12. Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.
    a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
    b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.
13. Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.
14. Provide qualified personnel to assist and participate in Commissioning.
15. Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.
16. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
17. Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.
18. Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.
19. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.
20. Prepare and submit to Commissioning authority proposed Training Program outline for each system.
21. Coordinate and provide training of Owner's personnel.
22. Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority's comments.
23. Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning Agent proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority.

C. Electrical contractor shall provide a letter certifying the installed lighting controls meet documented performance criteria specified in the commissioning plan within 90 days of substantial completion.

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:
    1. Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.
    2. Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.
    3. Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.
    4. Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications.

5. Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.
6. Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.
7. Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Electrical System Equipment to be tested
   1. Occupancy sensors.
   2. Time switch controls
   3. Daylighting controls.
   4. Automatic receptacle controls.
   5. Electrical Service and Distribution System.

C. Testing functions and conditions
   1. Daylighting control devices
      a. Verify the devices have been calibrated, properly located and adjusted.
      b. Loads adjust to light level set points in response to daylight.
      c. Location of calibration equipment is accessible to authorized personnel only.
   2. Time switches
      a. Verify schedule, time, date and programming is accurate.
      b. Verify override time limit is set, battery is installed and switch operates the lights that are specified in the design documents.
      c. All specified lights can be turned on and off by area control switch.
      d. Manual override switch allows only the lights in the space where the switch is located turn on or remain on until next scheduled shut off.
   3. Occupant sensors:
      a. Certify the sensor has been located and aimed in accordance with manufacturer recommendations.
      b. For projects with fewer than seven sensors, each sensor shall be tested.
      c. Fore projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each combination are provided not less than 10 percent shall be tested.
      d. Verify correct operation of status indicators.
      e. Controlled lights turn off or down to the permitted level with in the required time.
      f. For auto-on sensor, the lights turn-on to the permitted level when an occupant enters space.
      g. Verify the lights are not incorrectly turned-on by movement in adjacent areas or by HVAC operation.
   4. Electrical Service and Distribution System
      a. Document the ground resistance testing performed by contractors.
      b. Document electrical subcontractor has adjusted breakers to setting recommended by coordination study.
      c. Document that any required infrared studies are performed.
      d. Document testing of transformer insulation and voltage drop.
      e. Document any other testing requirements have been fulfilled as required within specifications.

D. Performance criteria
   1. Daylighting controls shall maintain specified light levels within 5% of design.
   2. All time switches shall be accurate to time on cellular network devices.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist Commissioning Agent with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of seven (7) days prior to date of system startup, submit to Commissioning Agent for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor’s responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division's systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

E. Sampling
   1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
   2. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
   3. A common sampling strategy is the "xx% Sampling - yy% Failure Rule", defined by the following example.
      a. xx = the percent of the group of identical equipment to be included in each sample.
      b. yy = the percent of the sample that if failing, will require another sample to be tested.
      c. The example below describes a 20% Sampling - 10% Failure Rule.
      d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."
      e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).
      f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
      g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

F. Re-Testing And Failure To Remedy Deficiencies
   1. Despite Contractor's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
   2. It is Contractor's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.
   3. It is Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.
      a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor's control to resolve expeditiously.
      b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.
   a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA's expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

G. Deferred Testing
1. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
2. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
3. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
4. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.
5. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
6. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:
1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

D. Commissioning Agent shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning Agent with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall compile and prepare documentation for equipment and systems specified in this Division, and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority's copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:
   1. Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.
   2. Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION

SECTION 26 09 36

LIGHTING CONTROLS (STAND-ALONE)

PART 1 - GENERAL

1.1 SCOPE

A. Electrical contractor shall provide a complete lighting control system that controls all interior and exterior lighting fixtures, including emergency fixtures. All lighting controls shall be stand-alone, and shall not have any communication with adjacent spaces. It is the contractor's responsibility to provide a complete and functional system, including, but not limited to all room controllers, switch packs, power packs, occupancy sensors, low voltage control stations, emergency bypass controllers, low voltage control cable, even if not specifically called out on the plans.

1.2 SUMMARY

A. Section Includes:
   1. Digital Occupancy and Daylighting Sensor Control
   2. Emergency Lighting Control
   3. Control Intent – Control Intent includes, but is not limited to:
      a. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
      b. Initial sensor and switching zones
      c. Initial time switch settings
      d. Task lighting and receptacle controls
      e. Emergency Lighting control

1.3 RELATED SECTIONS

A. Drawings and general provision of the Contact, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section

B. Section 26 02 00 - Basic Materials and Methods for Electrical

C. Section 26 05 19 - Wire, Cable and Related Materials: line and low voltage conductors, dimming conductors, securement requirements.

D. Section 26 27 26 - Wiring Devices

E. Section 26 29 26 - Miscellaneous Electrical Controls and Wiring

F. Section 26 51 19 - Lighting Fixtures - Light Emitting Diode (LED)

1.4 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

E. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

F. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.5 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control system as defined under this section covers the following equipment:
   1. Room Controllers – Self-configuring and field-configurable, one, two or three relays controllers, 0-10 volt control for drivers (if applicable).
   2. Low Voltage Occupancy/Vacancy Sensors – Self-configuring or field-configurable, Low Voltage, calibrated occupancy sensors, Dual technology or PIR as described by this specification.
   3. Low Voltage On/Off Switches – Self-configuring or field-configurable, Low Voltage pushbutton switches, that may contain one, two, three, or four control zone capability per device.
   4. Low Voltage On/Off Dimmer Switches – Self-configuring or field-configurable, Low Voltage pushbutton switches, Dimmer and scene switches that may contain one, two, three, or four control zone capability per device.
   5. Photosensors – Low Voltage Single-zone closed loop daylighting sensors with switching or dimming control for daylight harvesting.
   6. Configuration Tools – Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have, at a minimum, simple pushbutton interface and allow send/receive of room variables and occupancy/vacancy/photo/daylight sensor settings.
   7. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building. Under loss of normal power, the ELCU shall bypass any control device and ensure fixtures are enabled at 100% light output. Comply with UL 924 and UL 1008 as applicable for each instance. Comply with 26 51 19.

B. System shall accommodate the square-footage coverage requirements for each area controlled, utilizing power packs, occupancy and vacancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

C. Lighting control system shall be configured to fail "on".

D. System shall conform to requirements of NFPA 70.

1.6 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:
   1. Composite wiring and/or schematic riser diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
   3. Riser diagrams to express lighting control hardware and wiring required to meet lighting control sequence of operations.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.
2. Prove that the sensor is suitable for the proposed application.

1.7 QUALITY ASSURANCE

A. Manufacturer: Minimum 7 years experience in manufacture of lighting controls, unless specifically listed in this specification.

B. Lighting controls shall meet the minimum requirements of ICC (IECC) and ASHRAE Std 90.1 I-P as applicable.

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40° C (32° to 104° F).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

A. Provide a five year complete manufacturer’s warranty on all products to be free of manufacturers’ defects.

1.10 MAINTENANCE

A. Spare Parts:
   1. Provide 5 spares of each product listed below to be used for maintenance.
      a. Room Controllers
      b. Power packs
      c. Emergency Bypass controllers
      d. Low voltage on/off switches
      e. Low voltage wall sensor switch

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. WattStopper

B. Acuity Brands

C. Cooper/ILC/Greengate

D. Sensorworx

E. Steinel

F. ETC

2.2 ALL OCCUPANCY SENSORS (CEILING OR WALL SWITCH)

A. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

B. Passive infrared sensors shall utilize Processing protocols to respond only to those signals caused by human motion.

C. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

D. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

E. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

F. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

G. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

H. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

I. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

J. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

K. All sensors shall have UL 94V-0 rated plastic enclosures.

L. Outdoor sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1598 ratings.

M. Outdoor sensors shall have an operating temperature range of -40°F to +130°F

N. To ensure complete protection from weather elements and exposure, outdoor sensors shall be rated and listed for outdoor use.

O. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology room system. No additional configuration will be required.

P. All devices shall be hard wired. No wireless devices shall be permitted.

2.3 WALL-SWITCH OCCUPANCY SENSOR

A. Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. Furnish the Company’s model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled;

B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180˚ coverage capability.

D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

E. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

2.4 WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. provide the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.

B. Occupancy Sensors shall provide Features include the following: digital or analog calibration and pushbutton/dip-switch/dial programming for the following variables:
   1. Sensitivity – 0-100% in 10% increments
   2. Time delay – 1-30 minutes in 1 minute increments
   3. Test mode – Five second time delay
   4. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   5. Walk-through mode
   6. Load parameters including Auto/Manual-ON, and daylight enable/disable when photosensors

C. Device Status LEDs including:
   1. PIR Detection
   2. Ultrasonic detection
   3. Configuration mode
   4. Load binding

D. Manual override of controlled loads.

2.5 WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 6 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
   1. Two-way infrared (IR) transceiver for use with configuration remote controls.
   2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
   3. Configuration LED on each switch that blinks to indicate data transmission.

B. RJ-45 ports, or other manufacturer provided wiring method, for connection of devices on a common system.

C. Plug and play technology. Devices in the same room may be interconnected together and operate in default mode without any programming. Devices in a common space may be connected together, in a manner to be described and installed by the manufacturer's installation guidelines and requirements.

2.6 ROOM CONTROLLERS

A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers shall be simple to install and may contain dip switches, potentiometers, or other easily adjustable field devices to allow for easy modification. All shall include the following features:
   1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
   2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
   3. Quick installation features including:

a. Standard junction box mounting
b. Quick low voltage connections using standard RJ-45 patch cable

4. Plenum rated
5. Manual override and LED indication for each load
6. Dual voltage (120/277 VAC, 60 Hz)
7. Zero cross circuitry for each load.

2.7 PHOTOSENSORS

A. Digital photosensors work with room controllers or dimming relay packs to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller/relay pack. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:
1. An internal photodiode that measures only within the visible spectrum and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrum. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-1,000 footcandles (fc).
3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
6. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.

C. Closed loop digital photosensors include the following additional features:
1. An internal photodiode that can be located within a space to remove unwanted light collection from the diode. Wide open light receptors are not permitted. Sensors must be sensitive enough to only detect ambient lighting in the intended detection zone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes setpoints following self-calibration.
4. A sliding setpoint control algorithm for dimming daylight harvesting with a “Day Setpoint” and the “Night Setpoint” to prevent the lights from cycling.

D. Open loop digital photosensors include the following additional features:
1. An internal photodiode that can be located within a space to remove unwanted light collection from the diode. Wide open light receptors are not permitted. Sensors must be sensitive enough to only detect ambient lighting in the intended detection zone.
2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
3. A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.

2.8 POWER PACKS

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of five (5) sensors.

B. Relay Contacts shall have ratings of 20A, 16A continuous, LED Lighting loads, switched receptacle and associated common motor loads that can be fed by common 5-20R receptacles.

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Contractor must arrange virtual or phone meeting with the manufacturer before project rough-in to ensure the hardware, cabling, and overall system requirements are understood and met.

B. All line voltage connections shall be tagged to indicate circuit and switched legs.

C. Test all devices to ensure proper communication.

D. Electrical contractor shall calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

E. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

F. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

G. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

H. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for device cable at least 1 week before bid.

I. Install all devices as required by manufacturer submitted shop drawings and installation guidelines. Wiring details included with the construction documents are for general scope of work, and exact wiring and connections may vary by manufacturer.

J. The contractor shall coordinate rough-in size and quantity with the number of devices necessary. Since many control devices may accommodate multiple switch legs in a single gang, there may be an indirect relationship between number of devices and number of control zones.

K. Provide J-hooks for supporting all low-voltage cabling at a spacing not to exceed 5 ft. between hooks.

L. Provide dimming conductors for all dimming zones, as indicated by presence of dimmer devices on the plans.

M. The lighting control system must function within the guidelines stated in the lighting control sequence of operation notes, details, matrices, and narratives on the plans.

3.3 COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by a commissioning agent representative who will verify a complete fully functional system is installed as required by plans and specifications.

B. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   1. Purpose of equipment.
   2. Principle of how the equipment works.
   3. Important parts and assemblies.
   4. How the equipment achieves its purpose and necessary operating conditions.
   5. Most likely failure modes, causes and corrections.
   6. On site demonstration.

END OF SECTION

SECTION 26 22 22

LOW VOLTAGE HARMONIC MITIGATING DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

2.1 SCOPE

A. Provide 480 - 208Y/120 volt 3 phase, 4 wire transformers as shown, scheduled and as specified.

B. The type of transformers required are dry-type harmonic mitigating transformers.

2.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable ANSI/IEE and NEMA standards.
   1. All low voltage transformers shall be UL listed and labeled.
   2. All low voltage transformers 15 kVA and larger shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016.
   3. All low voltage transformers 15 kVA and larger shall be tested for efficiency in accordance with U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015).

2.3 ACCEPTABLE MANUFACTURERS

A. Power Quality International, Inc. (PQI)

2.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   1. Cutsheets of transformers with sound and load ratings, dimensions, weights, impedance rating, insulation type, temperature rise, phase displacement and tap configurations.

2.5 REQUIREMENTS OF REGULATORY AGENCIES

A. National Electrical Code.

B. Local, municipal, and/or state codes that have jurisdiction.

2.6 DESIGN OBJECTIVES

A. The design of the electrical distribution system, as described by this specification and detailed in the accompanying electrical drawings, provides for control of the harmonic currents that are generated by non-linear electronic loads. These design objectives, and the various standards that apply, are detailed herein as follows:
   1. To reduce the ‘penalty losses’ that are produced by harmonic currents, which would otherwise result in an increase in the cost-of-power, apparatus heating and the cost of air-conditioning, within economic limits.
   2. To limit harmonic current injection into the Point of Common Coupling (PCC), as required in IEEE 519 , Section 10.4, Table 10.3.
   3. To limit positive, negative and zero sequence harmonic currents in the distribution system so that the Individual Harmonic Distortion of Voltage (IHDv) levels do not exceed 3% at the loads and the Total

Harmonic Distortion of Voltage (THDv) levels do not exceed 5% at the loads, as recommended in IEEE 519, Section 6.6, Paragraph 2.

4. To limit zero sequence harmonic currents in the neutral conductors so that their ratings are not exceeded and Common Mode Noise (CMN) neutral-ground voltage levels do not exceed 5 volts at the loads, as recommended by CBEMA. Where computers and/or audio/visual devices are interconnected into a communications 'network', to limit the difference in CMN to < 2 volts at all loads, as recommended by EPRI.

2.7 FACTORY TESTING

A. The manufacturer shall provide linear and non-linear efficiency test on each transformer. Transformers not meeting the following criteria will not be used on this job. The data shall be included in the Operations and Maintenance Manuals. The tests shall be conducted between 0% and 100% full load and shall be plotted for each transformer.
   1. Linear Load Efficiency: Transformer shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016. Proof of compliance Type Tests, for each transformer type and rating, must be based on U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015). Type Test are required with each submission.
   2. Non-Linear Load Efficiency: This requirement is defined as meeting the efficiency requirements of NEMA TP1-2002 under non-linear loading, which has 100% THDI and a harmonic profile that is based on IEEE 519, Table 4.3 - 'Spectrum of Typical Switch Mode Power Supplies'. Proof of compliance Type Tests, for each transformer type and rating, must be based on the Voltage and Current Difference Loss Measurement Method using laboratory grade CTs and 0.1% accuracy Wattmeters OR shall be calculated in accordance with IEEE C57.110. Type Tests are required with each submission. The Power In – Power Out Measurements Method is not an acceptable test method due to the limitations associated with CT, PT and WattMeter accuracy.

2.8 FACTORY NAME PLATES

A. Provide two (2) – name plates per transformer indicating all code required items (i.e. kVA voltage, phase etc.). Name plates shall also include, phase shift and a name as indicated on transformer schedule or one-line diagram. The name plates shall be located on a non removable section of the outer shell.

2.9 ALTERNATES

A. In the event the contractor wishes to propose an alternative to the specified Harmonic Mitigating Transformers and/or Zero Sequence Harmonic Filters, the contractor shall provide the engineer with a detailed alternate Harmonic Mitigation Plan, which includes a schedule of proposed replacement devices that will meet all of the requirements described in this specification. The equipment proposal from the non-specified vendor(s) shall include the following information:
   1. Evidence of significant relevant application experience.
   2. Quantitative performance data including before/after effect on voltage distortion at the loads that demonstrates the vendor's capability to achieve the harmonic treatment called for in this specification.
   3. Product technical specification and installation wiring diagram.
   4. Pertinent product application information.

PART 2 - PRODUCTS

3.1 MATERIALS

A. Type 'DV', Single Output, Harmonic Filtering Distribution Transformers (Dry Type) shall be provided for all transformers indicated with a zero (0), thirty (30), fifteen (15), forty-five (45), twenty (20) and forty (40) degree primary to secondary phase shifts.

B. Harmonic mitigating transformers with Wye configured primary windings are not acceptable.

C. Harmonic mitigating transformers without zig-zag configured secondary windings that completely cancel zero-sequence flux under balanced load conditions are not acceptable.

3.2 PRODUCT DESCRIPTION

A. The design of the harmonic filtering transformers, described in this Specification, shall be optimized for harmonic rich environments that are characterized by high neutral currents. These transformers shall:
   1. Provide an ultra-low zero sequence impedance path for all load-generated zero sequence harmonic currents, including I_3, I_9, I_{15}, I_{21}, etc.
   2. Provide for the cancellation of the 5th, 7th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0° and 30° (15° and 45°) phase-shifting units are used in combination.
   3. Provide for the cancellation of the 5th, 7th, 11th, 13th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0°, 20° and 40° phase-shifting units are used in combination.
   4. Provide for the cancellation of 5th, 7th, 11th, 13th, 17th, 19th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0°, 15°, 30° and 45° phase-shifting units are used in combination.
   5. Harmonic cancellation shall be by electromagnetic means only. No capacitors or electronics shall be used.
   6. Reduce voltage and current distortion and imbalance at the primary terminals of the unit.
   7. Reduce current crest factor at the primary terminals of the unit.
   8. Reduce average and peak phase current on the primary terminals of the unit.
   9. Reduce system losses.
   10. Improve system power factor.
   11. Reduce voltage distortion in the secondary sub-system.

3.3 DEVICE CONFIGURATION

A. Type: ANN

B. Insulation Class: 220°C

C. Temperature Rise: 150°C

D. System Frequency: 60 Hertz

E. Primary Voltage: 480 Volts Delta (Wye configured primary is not acceptable)

F. Secondary Voltage: 208/120 Volts Zig-Zag with two (2) windings per core leg for 0 degree phase shift and 208/120 Volt modified zig-zag with three (3) windings per core leg for 30, 15, 45, 20 and 40 degree phase shifts.

G. Phase: Three Phase

H. Rating: as scheduled on drawings

I. Primary-Secondary Phase-Shift: as scheduled on drawings

3.4 TRANSFORMER CHARACTERISTICS

A. Key Requirements
   1. Positive & negative sequence impedance: standard %
   2. Zero sequence reactance at 60Hz: < 0.3 %
   3. Zero sequence impedance at 60Hz: < 0.9 %
   4. Crest Factor suitability: 5
   5. BIL: 10,000 Volts (windings 1000V

6. Capability to deliver full nameplate kVA to loads of K-factor up to: 30
7. Neutral connection shall be rated at two times the ampacity of the secondary phase current.

B. Basic Requirements:
1. Built to the following Standards: CSA C9-M1981, CSA22.2 No.47-1977, UL 506, IEEE C57.110, and NEMA ST 20
2. Three-phase, common core construction
3. Convection air-cooled
4. Copper or Aluminum Windings
5. Insulation Class: R(200 degree C)
6. Magnetic field at 1.5 feet: max. 0.1 Gauss
7. Full load Efficiency at 170°C
8. Magnetizing Inrush Current: max. 10 times full load rating
9. Taps: 2 x ± 2.5%
10. Sound level: per C57.12.91
11. Enclosure: ventilated, drip-proof NEMA-1 totally enclosed
12. Finish: PQI white power coat
13. Anti-vibration pads shall be used between the core and the enclosure

3.5 VENDOR INFORMATION

A. Evidence of significant relevant application experience.

B. Quantitative performance data including before/after effect on voltage distortion at load panels that demonstrates the capability to achieve the harmonic mitigation called for in this specification.

C. Product technical specification.

D. Pertinent product application information.

PART 3 - EXECUTION

4.1 INSTALLATION

A. General: Install transformer in accordance with manufacturer's written instructions, and recognized industry practices.

B. Housekeeping Pad: Provide a nominal 3-½" high, 2500 PSI (28 Day) concrete reinforced pad with number 6 welded wire mesh. The pad shall conform to the shape of the transformer and extend at least 3 inches beyond the length and width of the transformer. All corners of the pad shall be rounded.

C. Mounting: Install floor mounted transformers on properly sized rubber-in-shear vibration isolators. Trapeze mounted transformers shall use rubber-in-shear hangers. Wall mounted transformers shall not be mounted directly to the wall without vibration isolation.

D. Connection: Route conductors in a minimum of 2 feet of flexible steel conduit to transformer enclosure. Provide grounding conductor sized per NEC, connected to the building grounding electrode system.

4.2 FIELD TESTING

A. Insulation, Tests: Prior to energization, check transformers windings for continuity and test the insulation resistance. Tests shall be made using a Biddle Megger or equivalent test instrument, per manufacturers' recommendations.

Continuity Check

Primary	Pass / Fail		Secondary	Pass / Fail

H_1-H_2			X_1-X_0	
H_2-H_3			X_2-X_0	
H_3-X_1			X_3-X_0	

Insulation Resistance Test (1000V, DC)

Connections	Megohms
High to Low, Gnd	
Low to High, Gnd	
High, Low to Gnd	

B. Tap Setting: Measure current and voltage under load conditions to provide correct tap settings.

Tap Setting	Primary Voltage Reading		Secondary Voltage Reading	
	H_1-H_2		X_1-X_0	
	H_2-H_3		X_2-X_0	
	H_3-X_1		X_3-X_0	

C. Receptacle Tests: At the furthest receptacle from each panel serving a computer or copier, a power quality meter shall be used to determine the following:

Receptacle Test	
Panel Name (Fed From)	
Circuit Number	
Room Name or Number	
Location Inside Room	
Voltage (Line-Neutral)	
THD_V	
Voltage (Neutral-Ground)	
Current (Phase)	
THD_I	

D. Conduct all tests 3 to 6 months after building occupation. Submit all tests for Engineer's review.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Provide panelboards as shown, scheduled and as specified herein.

B. The types of panelboards include:
   1. Panelboards.
   2. Power distribution panelboards.

1.2 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

C. UL 67 - Panelboards; Current Edition, Including All Revisions.

D. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

E. UL 943 - Ground fault Circuit Interrupters

F. NEMA PB 1 - Panelboards

G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

H. NEMA, ABI, Molded Car Circuit Breakers and Molded Case Switches

I. Federal Spec W-P 115, Rev C, Panel, Power Distribution

J. NEMA KSI, Enclosed and Miscellaneous Distribution Equipment Switches (600V)

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   1. General Electric Company/ABB
   2. Square D Company
   3. Siemens
   4. Eaton

B. All panelboards shall be designed, factory-manufactured, factory-assembled, and factory-tested by a single manufacturer listed above. The manufacturer shall be fully responsible for the complete panelboard assembly, including enclosures, bus, overcurrent devices, controls, metering (as applicable) and all internal wiring.

C. Panelboards assembled by third-party panel shops, system integrators, or channel partners not owned or operated by the listed manufacturer are strictly prohibited.

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   1. Cutsheets of all enclosures, circuit breakers, fusible switches, bussing, rating, schedules and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   1. NFPA 70
   2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General
   1. Provide power distribution and panelboards as indicated in the panelboard schedule and as shown on the plans. Load centers are acceptable for use in dwelling units. Power distribution panelboards shall be equipped with fusible switches or circuit breakers as shown on the schedule. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.

B. Busing Assembly and Temperature Rise
   1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 65°C. rise above 40°C ambient. Heat rise test shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All current carrying parts of the bus shall be tin or silver plated copper.
   2. Bus structure shall be isolated. Bus bar connections to the branch circuit breakers shall be distributed phase or phase sequence type and shall accept bolt-on circuit breakers for lighting and appliance panelboards.
   3. The lugs for terminating conductors shall be rated at 75°C on all panel boards and circuit breakers.
   4. Provide a non-insulated bare copper ground bus. Provide an isolated ground copper bus in each panel serving isolated ground circuits as indicated on panel schedule or one-line diagram. Provide a full size copper neutral bus in each panelboard enclosure. Provide a 200% neutral buss when served by a harmonic mitigating transformer and any K4 or higher rated transformers.

C. 480/277 Volt Panelboards
   1. Main breakers shall be vertically mounted. Branch mounted main breakers are not acceptable. Provide electronic trip mains with long term, short term and instantaneous trips as indicated on drawings and required for selective coordination.
   2. Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2 or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breaker shall have an over-center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have “ON”, “OFF” and “TRIPPED” positions. Circuit breakers shall be UL listed in accordance with UL Standard 489 and shall be rated 277 volt ac (single pole, 15-30 amperes) or 480Y/277 volts ac (2 and 3 pole) with continuous current ratings as noted on the plan. Interrupting ratings shall be a minimum of 18,000 rms symmetrical amperes at 277 volts ac (single pole) or 480Y/277 volts ac (2 and 3 pole) unless otherwise noted on plans.
   3. Provide circuit breakers with lock-on devices for applications where dedicated branch circuits are serving battery-equipped emergency lighting fixtures, exit signs or fire alarm equipment per Article 700 of NFPA 70.

D. 240 Volt Panelboards
1. Main breakers shall be vertically mounted. Branch mounted main breakers are not acceptable. Provide electronic trip mains with long term, short term and instantaneous trips as indicated on drawings and required for selective coordination.
2. Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2, or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breakers shall have an overcenter, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have "ON", "OFF" and "TRIPPED" positions.
3. Circuit breakers shall be UL listed in accordance with UL 489 and shall be rated 240 volts ac maximum with continuous current rating as noted on the plans.
4. Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip settings of the breaker to prevent repeated arcing short resulting from frayed appliance cords. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac and carry the SWD marking.
5. UL Class A 5mA ground fault circuit protection shall be provided on all receptacle circuits serving wet areas and on all 120V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional circuit breaker.
6. UL Class B 30mA ground fault circuit protection (GFEP) shall be provided on all equipment circuits requiring ground fault protection. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring.
7. Provide Shunt Trip Breakers including control power for circuits under cooking hoods and other equipment having this requirement.
8. Provide Breakers with Switched Neutral circuits with common trip for gasoline pumps and other equipment having this requirement.
9. Circuit breakers shall be rated 10,000 AIC at 240V unless otherwise noted on plans or served by transformers greater than 150 kVA.
10. Provide 200% sized neutral bus with panels served from a non-linear transformer and any K4 or higher rated transformers. This shall be a UL approved assembly.
11. Provide circuit breakers with lock-on devices for applications where dedicated branch circuits are serving battery-equipped emergency lighting fixtures, exit signs or fire alarm equipment per Article 700 of NFPA 70.

E. Cabinets and Fronts
1. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL 50 for cabinets. Wiring gutter space shall be in accordance with UL 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. Provide stainless steel front cover for all panels located in all Pool Equipment rooms, Food Labs, Snack Bars, Culinary Arts, Kitchens and Life Skills rooms. All NEMA-1 panels shall have hinged front covers. The front cover shall have a door with hinges, latch and a lock. The piano hinged front covers door-in-door shall allow full access to the circuit breaker gutter area without having to remove the entire front cover. All panelboard lock shall be keyed alike. Circuit breaker and fusible distribution panels shall have four-piece trims. A welded circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Provide NEMA 1 enclosure where installed indoors unless otherwise noted. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

F. Safety Barrier
1. The distribution panelboard interior assembly shall be dead front with panelboard cover removed. Main lugs or main breakers shall have a barrier. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

G. Integrated Equipment Short Circuit Rating
1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall

be established by testing with the over-current devices mounted in the panelboard. The short circuit tests on the over-current devices and on the panelboard structure shall be made simultaneously by connecting the fault to each over-current device with the panelboard connected to its rated voltage source. Method of testing shall be per UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard over-current devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards, including electrical connections, in accordance with manufacturers written instructions, NFPA 70 and recognized industry practices.

B. All panels shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

C. Housekeeping Pads: Mount floor mounted panelboards on 4 inch high concrete housekeeping pads.

D. Fuses: Install fuses of the rating and class as shown in each fusible distribution panel scheduled on drawings.

E. Conduits: Stub up three one inch conduits to an accessible location above the ceiling for each recessed panelboard.

3.2 IDENTIFICATION

A. Nameplate: Each panelboard shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show panel designation. Nameplates shall be attached with stainless steel screws. Refer to Section 26 02 00, paragraph 2.8(C).

B. Directory Card: Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.

C. Replacement Components: Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturers, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state "caution - Series Rated System." (NEC 110-22). Nameplate shall also identify replacement components.

D. Replacement Components: Nameplate shall identify replacement components.

3.3 INFRARED SCANNING

A. After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner. Submit a copy the owner and engineer for review. If O&M manuals are submitted prior to performance of infrared scan, contractor shall submit a signed letter to verify the scan has been arranged. Letter shall indicate the scan provider and the date It will be performed.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

A. Provide wiring devices as shown, scheduled, required and as specified.

B. The types of wiring devices required include:
   1. Switches
   2. Receptacles
   3. Occupancy Sensors
   4. Digital Timer Switches
   5. Coverplates

1.2 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).

C. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

D. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

G. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

H. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

I. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

J. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.3 QUALITY ASSURANCE

A. All wiring devices shall comply with NEMA WD 1 and NEMA WD 6 as well as FS W-C-596 and FS W-S-896 as applicable.

B. All switches shall comply with UL 20 as applicable.

C. All receptacles shall comply with UL 498 as applicable.

D. All GFCI receptacles shall comply with UL 943.

E. All USB charging receptacles shall comply with UL 1310.

F. All AFCI receptacles shall comply with UL 1699.

1.4 ACCEPTABLE MANUFACTURERS

A. Hubbell

B. Leviton

C. Pass & Seymour

1.5 SUBMITTALS

A. Shop drawings shall include but not be limited to:
   1. Cut sheets of all devices indicating NEMA configuration, rating, materials, color, and all accessories.
   2. Cut sheets of all coverplates indicating materials, color and any engraving specified on drawing or in the specifications.

1.6 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. National Electric Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. GENERAL
   1. Provide factory assemble wiring devices with the rating type and color as required and specified for the service indicated.
   2. Provide matching one-piece multiple gang plates where switches are ganged.
   3. Provide wall plates for each receptacle furnished.
   4. Architect reserves the right to select wiring device styles and colors to match wall finish.
   5. Wall plates shall be of same manufacturer as devices.

2.2 SWITCHES

A. Provide specification grade White toggle switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations with architect.
   1. Wall switches shall be 20 amp, 120-277 volt and shall be Hubbell, Leviton or P&S as follows:

TOGGLE SWITCHES	**HUBBELL**	**LEVITON**	**P&S**
SINGLE POLE	HBL1221	1221-2	PS20AC1
DOUBLE POLE	HBL1222	1222-2	PS20AC2
THREE WAY	HBL1223	1223-2	PS20AC3
FOUR WAY	HBL1224	1224-2	PS20AC4
MOMENTARY CONTACT	HBL1557	1257	1251
THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT	HBL1385	1285	1225
KEY TYPE LOCKABLE BARREL KEY OR CORBIN STYLE	HBL1221-RKL	1221-2KL	PS20AC1-KL
PROVIDE WITH EXTRA KEYS	HBL1209RKL	2KL	4609
DISCONNECT SWITCH / INSTA HOT	HBL7810DS	MS303-DSS	7803

   2. Dwelling units shall use Hubbell CS115I, CS120I, P&S CS15AC1, and CS20AC1.

3. Dimmers: Provide Lutron DIVA or equal as shown on drawings. Wall box dimmers shall be sized to handle the load served. Provide phase dimmers to control LED lamps when 0-10 volt dimming drivers are not provided.
4. Light Handle Switches: Provide Hubbell HBL1221-IL, Leviton 1221-LHC, P&S PS20AC1-ISI lighted handles to switch emergency lights where noted on the drawings.

B. Provide specification grade White decora style rocker switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations with architect.
1. Wall switches shall be 20 amp, 120-277 volt and shall be Hubbell Decorator Series, Leviton, Decora or Pass & Seymor Decorator, as follows:

ROCKER/DECORATOR SWITCHES	HUBBELL	LEVITON	P&S
SINGLE POLE	DS120	5621-2	2621
DOUBLE POLE	DS220	5622-2	2622
THREE WAY	DS320	5623-2	2623
FOUR WAY	DS420	5624-2	2624
MOMENTARY CONTACT	HBL1557	1257	1251
THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT	HBL1385	1285	1225
KEY TYPE LOCKABLE BARREL KEY OR CORBIN STYLE	HBL1221-RKL	1221-2KL	PS20AC1-KL
PROVIDE WITH EXTRA KEYS	HBL1209RKL	2KL	4609
DISCONNECT SWITCH / INSTA HOT	HBL7810DS	MS303-DSS	7803

2. Dimmers: Provide Lutron DIVA or equal where required. Wall Box dimmers shall be sized to handle the load. Provide Phase dimmers to control LED lamps when 0-10V drivers are not provided.
3. Light Handle Switches: Provide Leviton 5649-2 or P&S 2625 lighted handles to switch emergency lights where noted on the drawings.

2.3 RECEPTACLES

A. Provide specification grade White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location with architect.
1. Receptacles shall be Hubbell, Leviton or Pass & Seymour as follows:

CONVENTIONAL RECEPTACLES	HUBBELL	LEVITON	P&S
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R DUPLEX	HBL5352	5362	5362
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R SIMPLEX	HBL5361	5361	5361
ISOLATED GROUND 20A, 125V ORANGE NEMA 5-20R DUPLEX	IG5352	5362IG	IG5362
CLOCK HANGER 15A-125V BROWN WITH STAINLESS STEEL PLATE WITH HANGER	HBL5235	5361-CH	S3733-SS
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER RESISTANT FOR LOCATIONS REQUIRING TAMPER RESISTANT INSTALLATION OR AS INDICATED ON THE DRAWINGS	GFRST20	GFTR2	2097TR
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER/WEATHER RESISTANT FOR INSTALLATION IN DAMP/WET LOCATION OR AS INDICATED ON THE DRAWINGS	GFTWRST20	GFWR2	2097TRWR

HEAVY DUTY TAMPER RESISTANT BRASS MOUNTING YOKE	HBL5362WTR	5362-SG	---
TAMPER RESISTANT 20A, 125V DUPLEX	BR20WHITR	8300-SG	TR63-H
SURGE PROTECTION 20A, 125V DUPLEX, BLUE NEMA 5-20R WITH AUDIBLE ALARM	HBL5362SA	7380-B	5362SP
USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, ONE USB TYPE A PORT, ONE USB TYPE C PORT. MIN. OF 5A USB OUTPUT.	USB20AC5 5A OUTPUT	T5833 5.1A OUTPUT	TR20USBAC6 6A OUTPUT
USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, ONE HIGH OUTPUT POWER DELIVERY USB TYPE C PORT, ONE STANDARD USB TYPE A PORT.	USB20ACPD 20V, 55W TYPE C; 5V, 1.5A TYPE A	T5834 20V, 50W TYPE C; 5V, 2A TYPE A	---
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH TWO CONTROLLED FACES	BR20C2WHITR	TBR20-S2W	TR5362CDW
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH ONE CONTROLLED FACE	BR20C1WHITR	TBR20-S1W	TR5362CHW
ARC FAULT CIRCUIT INTERRUPTER RECEPTACLES	AF20TRW	AFTR2-W	AF202TRW
GROUND FAULT CIRCUIT INTERRUPTER / ARC FAULT DUAL FUNCTION	AFGF20TR	AGTR2-W	AFGF202TR

B. Provide specification grade, Decora type White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location with architect.
   1. Receptacles shall be Hubbell, Leviton, or Pass & Seymour as follows:

DECORATOR / DECORA RECEPTACLES	**HUBBELL**	**LEVITON**	**P&S**
DECORATOR DUPLEX 20A, 125V NEMA 5-15R SELF GROUNDING	DR20	16362	26342
DECORATOR SIMPLEX 20A, 125V NEMA 5-15R SELF GROUNDING	---	1635	26361
ISOLATED GROUND DUPLEX 20A, 125V ORANGE NEMA 5-20R	IG20DRx	16362-IG	IG26362
CLOCK HANGER 15A-125V BROWN WITH STAINLESS STEEL PLATE WITH HANGER	HBL5235	5361-CH	S3733-SS
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER RESISTANT FOR LOCATIONS REQUIRING TAMPER RESISTANT INSTALLATION OR AS INDICATED ON THE DRAWINGS	GFRST20	GFTR2	2097TR
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER/WEATHER RESISTANT FOR INSTALLATION IN DAMP/WET LOCATION OR AS INDICATED ON THE DRAWINGS	GFTWRST20	GFWR2	2097TRWR
TAMPER RESISTANT DUPLEX 20A, 125V NEMA 5-20R	DR20WHITR	16362-SG	TR26362
SURGE PROTECTION 20A, 125V DUPLEX, BLUE NEMA 5-20R WITH AUDIBLE ALARM	HBL5362SA	7380-W	5362SP
USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, ONE USB TYPE A PORT, ONE USB TYPE C PORT. MIN. OF 5A USB OUTPUT.	USB20AC5 5A OUTPUT	T5833 5.1A OUTPUT	TR20USBAC6 6A OUTPUT

USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, ONE HIGH OUTPUT POWER DELIVERY USB TYPE C PORT, ONE STANDARD USB TYPE A PORT.	USB20ACPD 20V, 55W TYPE C; 5V, 1.5A TYPE A	T5834 20V, 50W TYPE C; 5V, 2A TYPE A	---
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH TWO CONTROLLED FACE	DR20C2WHITR	16352-2PW	TR26362CDW
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH ONE CONTROLLED FACE	DR20C1WHITR	16352-1PW	TR26362CHW
ARC FAULT CIRCUIT INTERRUPTER RECEPTACLES	AF20TRW	AFTR2-W	AF202TRW
GROUND FAULT CIRCUIT INTERRUPTER / ARC FAULT DUAL FUNCTION	AFGF20TR	AGTR2-W	AFGF202TR

2.4 OCCUPANCY SENSORS

A. Provide White dual technology wall mounted sensors, provide one of the following:
   1. Single Pole:
      a. Wattstopper #DSW301
   2. Double Pole:
      a. Wattstopper # DSW302
   3. Dimmer:
      a. Wattstopper #DW311

B. Provide dual technology ceiling sensor with low voltage controlling switch and power pack.
   1. Single Button:
      a. Wattstopper # DT300 Sensor, BZ150 Power Pack and LVSW101 Digital Switch
      b. Provide isolated relay for additional signaling to HVAC controls.

C. Provide Ultra Sonic Ceiling sensor for restrooms.
   1. Wattstopper #UT3000, BZ150 Power Pack

2.5 DIGITAL TIMER SWITCHES

A. Provide Wattstopper TS-400-G digital timer.

B. The time switch shall provide audible notification and visual notification (blink the room lights) prior to turning lights off.

C. The time switch shall have a 12-hour manual override setting.

2.6 COVERPLATES

A. Furnish and install coverplates on all outlet boxes. Oversize (Jumbo) coverplates are not acceptable.

B. Coverplates shall be smooth nylon and 302/304 smooth stainless steel in kitchen and coffee bar areas.

C. Provide Hubbell WP Series, Bell, Carlon or Leviton NEMA 3R weatherproof coverplates on all exterior wiring devices. Enclosure shall be suitable for wet locations when in use.

D. Coverplates shall be Hubbell SS Series, Leviton, Pass & Seymour 302/304 smooth stainless steel on all receptacles 30 amps and larger.

E. Stainless steel device plates shall be provided at locations with tile or stone walls.

PART 3 - EXECUTION

3.1 WIRING DEVICE MOUNTING HEIGHTS

A. Unless noted to the contrary on plans, or directed otherwise during the progress of the Work, wiring devices shall be set as follows:
   1. Switches 42" above finished floor.
   2. Wall mounted receptacles shall be installed vertically at 15 inches to the bottom outlet above finished floor unless otherwise noted or as required by local codes.
   3. Wall telephone outlets shall be mounted 15 inches to the bottom above finished floor unless otherwise noted. Mount even with wall mounted receptacles.
   4. At locations above counters, set devices at 6 inches above to the centerline counter tops, verify exact mounting height with the architect.

3.2 INSTALLATION (REFER TO 26 05 33 FOR OUTLET BOX SPECIFICATIONS)

A. Wall switches shall be set in a suitable steel box and shall be installed on the strike side of the door as finally hung, whether so indicated on the Drawings or not.

B. Receptacles shall be installed in a suitable steel box.

C. The Architect reserves the right to relocate wiring device up to a distance of 5 feet from the location shown, before rough-in, without additional cost.

D. Provide multi-gang device covers at locations where devices gang together.

E. Device locations are indicated schematically on the drawings along with the type and mounting height. Final locations and mounting heights shall be coordinated with the Architect on the jobsite, and with shop drawings of equipment; including equipment to be furnished and installed by the Owner. Devices installed in walls covered with vinyl, fabric wallpaper or other special finishes shall be coordinated and verified with the Architect on the job site.

F. Stranded wire termination to switches, receptacles, devices and miscellaneous control devices shall be with an approved solderless terminal if clamp type securing is not possible (i.e. Sta-Con crimp on fork tongue connectors; Burndy Type TP-F).

G. Provide keyed switches in all common areas not monitored by the faculty (i.e. gym, corridors, cafeteria, commons natatoriums).

H. All 15 amp and 20 amp receptacles shall be tamper-resistant type.

I. All 20A, 120V receptacles in food service areas shall be GFCI.

J. Provide GFCI circuit breakers for all drinking fountain branch circuits where GFCI receptacles are not indicated on plan.

K. Provide ARC Fault circuit interrupters (AFCI) as required to comply with article 210.12 of NFPA 70. This shall include but not be limited to dwelling units and dormitories. AFCI breakers may be used.

L. Provide ground fault circuit interrupter (GFCI)/ARC Fault circuit interrupter (AFCI) dual function receptacles to comply with articles 210.8, 210.12 and 406.4 of NFPA 70.

M. Provide high output model for USB receptacles for applications where end user charging time is of high priority or where specifically indicated on the drawings. Provide standard output USB receptacles for all other applications.

N. Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside of the coverplate on all surface mounted devices.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SCOPE

A. Provide fuses as shown and scheduled and indicate by this specification section and other specifications sections.

B. The type of fuses include:
1. 600 volt current limiting.
2. 250 volt current limiting.

1.2 STANDARDS

A. ANSI

B. UL

1.3 ACCEPTABLE MANUFACTURERS

A. Eaton Bussmann

B. Mersen

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
1. Cutsheets of all fuses showing ratings and fuse curves.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CURRENT - LIMITING FUSES

A. General: Provide 200,000 amp interrupting capacity current limiting fuses of the ampacity and voltage indicated and scheduled.

B. Mains, Feeders and Branch Circuits
1. Circuits 601 to 6000 ampere shall be protected by current limiting BUSSMANN HI-CAP Time Delay Fuses KRP-C. Fuses shall employ "O" ring as positive seals between the end bells and the glass melamine fuse barrel. The terminals shall be peened. Fuses shall be time-delay and must hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .1 seconds or less and be listed by Underwriters` Laboratories Inc., with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class L.

C. Class J Fuses

1. Circuits 0 to 600 ampere shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses LPJ. All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284 degree Fahrenheit melting point alloy and shall be independent of the short-circuited clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and listed by Underwriters' Laboratories Inc., with an interrupting rating of 200,000 amperes rRMS symmetrical. The fuses shall be UL Class J.
2. Motor Circuits - All individual motor circuits rated 600 amperes or less shall be protected by BUSSMANN LOW-PEAK LPJ. The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. Motor shall be protected by BUSSMANN Type KRP-C HI-CAP Time-Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPJ installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class LPJ or L. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element LPJ as shown on the drawings. The fuses shall be UL Class J.

D. Class RK1 Fuses
1. Circuits 0 to 600 ampere shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284 degree Fahrenheit melting point alloy and shall be independent of the short-circuited clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and listed by Underwriters' Laboratories Inc., with an interrupting rating of 200,000 amperes RMS symmetrical. The fuses shall be UL Class RK1.
2. Motor Circuits - All individual motor circuits rated 600 amperes or less shall be protected by BUSSMANN LOW-PEAK Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. Motor shall be protected by BUSSMANN Type KRP-C HI-CAP Time-Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 or L.
3. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element LPN-RK (250 volts) or LPS-RK (600 volts) as shown on the drawings. The fuses shall be UL Class RK1.

2.2 SPARES

A. Upon completion of the building the contractor shall provide the owner with spare fuses as shown below.
1. 10% (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.
2. BUSSMANN spare fuse cabinets - Catalog No. SFC - shall be provided to store the above spares.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuses: Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job-site or from installation. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.

B. All fuses shall be installed in fuse holders.

END OF SECTION

SECTION 26 28 16

SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide safety and disconnect switches as shown, scheduled and as specified herein.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.
   1. NEMA KS1 - Enclosed switches
   2. Federal specification W-S-865C-Heavy duty switches

B. Products shall conform all applicable UL standards, including UL98 (standard for safety, enclosed and dead front switches) and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   1. General Electric Company/ABB
   2. Square D Company
   3. Siemens
   4. Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   1. Cutsheets of switches with ratings, physical dimensions and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   1. National Electrical Code.
   2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install heavy duty type safety switches with the number of switched poles as indicated on the plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD, and Underwriters Laboratories listed.

2.2 MATERIALS AND COMPONENTS

A. Switch Interior
   1. All switches shall have switch blades that are fully visible in the "OFF" position when the door is open. Switches shall have removable arc suppressor where necessary, to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60ºC and 75ºC copper or aluminum cables. All switches blades and contacts shall be plated copper. Adjust fuse block to accept Class J fuses.

B. Switch Mechanism
   1. Switches shall have a quick-make and quick-break operating handle and mechanism, which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for locking in the "OFF" position with at least three padlocks. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Handle position shall indicate if switch is "ON" or "OFF".

C. Neutral
   1. Provide a solid neutral with the safety switch where a neutral is present in the circuit.

D. Ratings
   1. Switches shall be horsepower rated for ac and/or dc as indicated by the plans. The fused switches shall have Class R rejection fuse clips or adjusted for Class J fuses. UL listed short circuit ratings of the switches, when equipped with Class R fuses, shall be 200,000 symmetrical amperes.

E. Enclosures
   1. Indoor switches shall be furnished in NEMA 1 enclosures.
   2. Outdoor switches, switches located in wet areas or sprinkled areas shall be furnished in NEMA 3R enclosures.
   3. Switches installed in wet areas such as cooling tower areas shall be NEMA 4X stainless steel or fiberglass reinforced polyester.
   4. Switches installed in kitchens shall be stainless steel.
   5. Switches installed in areas of a corrosive nature and subjected to salt air shall be NEMA 4X stainless steel or fiberglass reinforced polyester.

F. Electrical Interlock Contacts
   1. Provide electrical interlock contacts on all disconnect switches serving motors in which remote VFDs are serving the motor. Provide conductors from contacts to the safe circuit inside the VFD. De-energizing the disconnect switch shall signal VFD to stop.

G. Service Entrance
   1. Switch shall be suitable for use as service entrance equipment when installed in accordance with the National Electrical Code.

PART 3 - EXECUTION

3.1 GENERAL

A. Install safety and disconnect switches, including electrical connections, and fuses in accordance with manufacturer’s written instructions, NEC and recognized industry practices.

B. Location: Install switches within sight of controllers.

C. Hubs: Provide bolt-on hubs for rainproof or wet area applications.

3.2 IDENTIFICATION

A. Nameplate: Each disconnect switch shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show equipment served. Nameplates shall be attached with stainless steel screws.

END OF SECTION

SECTION 26 29 26

MISCELLANEOUS ELECTRICAL CONTROLS AND WIRING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. Provide the various miscellaneous control devices, wiring and additional branch circuits as required, shown and specified.

B. The types of miscellaneous control devices and wiring include but not limited to the following.
1. Contactors
2. Relays
3. Photocells
4. Time switches
5. Relay Panels
6. Additional control wiring and safety devices as shown and specified
7. Connect power from fire alarm relays to starters to shut down air handling units
8. Elevator power module switches
9. Motorized Dampers
10. Smoke Dampers and Combination Fire/Smoke Dampers

C. WORK SPECIFIED ELSEWHERE:
1. Various control devices, of an electrical nature, for the safe operation and temperature control of the heating, ventilating, air conditioning and plumbing systems provided under Division 22 and Division 23.
2. All control wiring and conduit shall be furnished under Division 23. All power wiring 120 volt or larger shall be provided by Division 26.
3. Refer to building controls specification, Division 23 for scope of work required to be performed by Division 26 (electrical contractor).
4. Specification 26 05 19 - Wire, Cable and Related Materials.

1.3 REFERENCE STANDARDS

A. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2025.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

E. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

F. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
1. NFPA 70
2. Local municipal or state codes that have jurisdiction.
3. UL 916
4. UL 924

1.5 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
1. LIGHTING CONTACTORS AND RELAYS
a. General Electric Company/ABB
b. Square D Company
c. Automatic Switch Company
d. Eaton
e. Siemens
2. PHOTOCELLS AND TIME SWITCHES
a. Tork, Inc.
b. Intermatic time controls
3. RELAY PANELS
a. Wattstopper
1) LMCP
b. Cooper/Eaton
1) ControlKeeper
4. ELEVATOR POWER MODULE SWITCHES

PART 2 - PRODUCTS

2.1 MATERIAL

A. GENERAL: This Section shall outline the basic installation of electric devices, conduit, boxes, fittings, and wiring required for complete interconnection of several systems, this may not reflect every required appurtenance. It does not cover integral parts of mechanical equipment.

B. CONTACTORS AND RELAYS: Provide control wiring, contactors, and relays with the ampere-rating and number of poles as shown, specified, and required for a complete and functioning system:
1. Rated at 600 volts, 60 hertz.
2. Continuously rated contacts for all types of ballast and tungsten lighting, resistance and motor loads. Contacts shall be sized as scheduled or noted.
3. Shall have totally enclosed, double-break silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. Contact inspection and replacement shall be possible without disturbing line or load wiring.
4. The contactor shall have straight-through wiring with all terminals clearly marked.
5. The contactor shall be approved per UL 508 and/or CSA, and be designed in accordance with NEMA ICS 2-21 1B.
6. They shall be industrial-duty rated for applications to 600 volts maximum.
7. The contactor shall have provisions for factory or field addition of:
a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
8. The contactor shall have a NEMA type 1 enclosure unless otherwise noted.
9. Control power to the contactor 120V control circuit shall be provided from the nearest panelboard 120V circuit. If the 120V control power circuit is not shown, provide a control power transformer for 120 volt control power and a 120 volt coil when required for control. Provide primary and secondary fuses on the control power transformer.
10. Electrically Held Lighting - Contactor coils shall be continuously rated and encapsulated. Electrically held contactors are not to be used unless specifically shown on the plans.

11. Mechanically Held Lighting Contactors - Coil-clearing contacts shall be supplied so that the contactor coils shall be energized only during the instance of operation. Both latch and unlatch coils shall be encapsulated. All contactors shall be mechanically held unless noted otherwise on the plans.
12. Provide 2-wire or 3-wire control modules as required to operate lighting contactors.
13. Provide hand-off-automatic controls (H-O-A) for each lighting contactor.
14. Provide relays and contactors to shut down air handling units.

C. Photocells for Stand-alone controls (not part of relay panel controls): Provide a specification grade self-contained, weatherproof, photoelectric control that shall be mounted on an FS type weatherproof junction box. The photocell shall:
1. Switch "ON" at dusk and "OFF" at dawn.
2. Adjustable from 2 to 50 foot-candles.
3. Rated at 2,000 watts.
4. Use 1" diameter cadmium sulphide cell.
5. Have a 2-minute delay to prevent false switching.

D. TIME SWITCHES: Provide a 7-day digital time clock with battery back-up feature installed in a NEMA 3R enclosure.

E. Control wiring shall be not less than #14 AWG type THWN/THHN and shall be color coded and labeled with Brady markers throughout. Bundle multiple conductors with Ty-Raps.

F. Relay Panels
1. Rated 277V, 60Hz.
2. Panel operating voltage of 120-277V
3. Uses any of the following relays:
   a. Mechanically Latching Relays
   b. Multi-pole Relays
4. 15A, 20A, and 30A rated relays available
5. Basic Capabilities:
   a. 7-Day Clock
   b. Capable of being set for 7 different day types per week
   c. Includes automatic holiday shutoff feature
   d. Has program backup to restore operations after power failure
   e. Can be expanded to include override switches
   f. On-board programming and processing
6. Each individual relay can be individually or group programmable to operate based on user-provided parameters, manual switch operation, photocells and sensors, or automatic program routines.
7. Rated for minimum of 10 million operations.
8. Contains occupant warning features to flash relays prior to time-out to notify occupants of change of state.
9. Capable of interfacing with other systems via RS-232, RS-485, or Ethernet.
10. Capable of interfacing with occupancy sensors for zone control.
11. Capable of Switch-Masking or Lockout features for user-operated switches.
12. Provide Locking Hinged Enclosures as suitable for relay panel environment. At a minimum, all relay panels shall be NEMA 1, and may be included with the relay panel assembly from the manufacturer. Provide enclosures to house relay panels where NEMA 1 is insufficient, as follows:
   a. Outdoors and unconditioned spaces: NEMA 3R
   b. Central Plants, or any plant with process water systems: NEMA 4/12
   c. Outdoors, Within 50-miles of saltwater coastlines: NEMA 4X
13. Dimming Modules shall be furnished with each relay panel, where dimming is required, per plan.
14. Pushbutton switches manufactured as compatible with the relay panel to either be used as override switches, or general control switches.
15. Provide photocells for use by relay panels for exterior ambient light monitoring:
   a. 1 per relay panel, when relay panels are stand alone
   b. 1 per building, when relay panels are networked

G. Elevator Power Module Switches

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install miscellaneous electrical controls and wiring to provide a functioning system.

B. Install contactor and relays in electrical/mechanical rooms unless otherwise noted.

C. Install photocells on the roof unless otherwise directed by the architect. Coordinate any roof penetrations with all other trades and shield from other light sources. Install photocells high on North facing walls, or in accordance with manufacturer's installation instructions.

D. Provide miscellaneous connections including disconnect switches for signs and other furnished equipment as shown on the Drawings.

E. Provide NEMA 3R/4/4X/12 enclosures where located outside.

F. Provide low-voltage cabling between relay panels and all control devices. Cabling shall be furnished by contractor as required by panel manufacturer, including Cat5, Cat6, Belden, dimming pairs, or other as required by the manufacturer. Pre-terminated cabling by manufacturer is acceptable.

G. All Low-Voltage cabling, for all systems, shall be neatly routed using J-Hooks. Cabling is installed above a hard ceiling, conduit shall be used to traverse the hard-ceiling segments.

H. Install elevator power module switches in an elevator machine room, control room, machinery space, or control space in accordance with ASME A17.1. Other installation locations that are readily accessible to qualified persons such as electrical or mechanical rooms may be permissible in the event that machine roomless (MRL) elevators are provided with a control space of inadequate size to accommodate the power module switches.

3.2 DIVISION 22, 23, 27 AND 28 MISCELLANEOUS POWER AND CONTROLS

A. Install electrical devices not an integral part of system equipment providing conduit, boxes, fittings, wiring, circuit breakers, disconnecting means and other devices.

B. Contractor is responsible for providing all line voltage power to devices that require electrical power to operate. This shall include but not be limited to motorized dampers, smoke dampers, combination fire/smoke dampers, motorized gates, overhead rolling doors, and building control panels. Contractor shall terminate line voltage power to termination points. Contractor shall coordinate between all trades to determine sizing and quantities of line voltage circuits to adequately power and control devices. Provide circuits from nearest low voltage panel using spare circuits provided, if device requires power not already available or indicated.

C. Provide GFCI receptacle with weather proof cover within 25 feet of all heating, air conditioning and refrigeration equipment per NFPA 70.

3.3 OPERATIONS PERSONNEL TRAINING

A. All relay panels require manufacturer technician time to meet with owner, set programming conditions, time of day operations, and ensure owner-intended operations are met, based on whichever is most appropriate based on project size:
   1. 8-Hours per relay panel
   2. The amount of time required to successfully meet the criteria of this section and result in a fully working system, accepted by the Owner.

B. A one-time recommissioning site visit, 4 Hours in time, by a manufacturer technician anytime between 90 and 120 days of building occupancy to adjust and reprogram (as required) the system based on owner input. This meeting shall be scheduled by the manufacturer and can only be declined by the owner.

C. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   1. Purpose of equipment.
   2. Principle of how the equipment works.
   3. Important parts and assemblies.
   4. How the equipment achieves its purpose and necessary operating conditions.
   5. Most likely failure modes, causes and corrections.
   6. On site demonstration.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICE (SPD) - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical and mechanical requirements for a modular high-energy surge protective device system (SPD). The system shall provide effective high energy surge current diversion and be suitable for application in IEEE C62.41.1 Category A, B and C3 environments, as tested by IEEE C62.11, IEEE C62.45.

B. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to +/- 1-volt variance and tested for manufacturer's defects. The modules shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable. Device shall utilize a minimum of three (3) MOV's fuse link pair per phase. This will allow redundant protection in the event that MOV's fail.

C. Third Party Test Report verifying surge current rating, longevity, testing, and filtering capabilities shall be provided with submittal.

1.2 STANDARDS

A. The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:
   1. Canadian Standards Association (CSA or CUL)
   2. American National Standards Institute and
   3. Institute of Electrical and Electronic Engineers (IEEE C62.11, IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45)
   4. Institute of Electrical and Electronic Engineers 1100 Emerald Book
   5. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   6. National Electrical Manufacturer Association (NEMA LS-1 1992)
   7. National Fire Protection Association (NFPA 20, NFPA 75 and NFPA 780)
   8. National Electric Code (NFPA 70)
   9. Underwriters Laboratories (UL 1449 and UL 1283)
   10. International Electrotechnical Commission (IEC 801)
   11. International Standards Organization(ISO) Company certified ISO 9001 for manufacturing, design and service
   12. EMC Directive 89/336/EEC - CE compliant

B. The systems individual units shall be UL/ANSI Listed and labeled under UL 1449 (Fourth Edition) Standard for Surge Protection Device type 1 nominal discharge current of 20kA and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and CSA or CUL Listed.

1.3 ACCEPTABLE MANUFACTURERS

A. Southern Tier Technologies

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   1. Cutsheets of surge protection devices with ratings, physical dimensions and all accessories clearly labeled.
   2. Device labels shall be clearly indicated in cutsheets.
   3. All standards and listings, as specified in section 1.2A-B, shall be clearly labeled in cutsheets provided.

4. Cutsheets shall clearly outline that design requirements of this specification have been met.

1.5 QUALITY ASSURANCE

A. The manufacturer shall be ISO 9001 certified. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of line conditioning equipment and Active Tracking Filters. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

1.6 WARRANTY

A. The manufacturer shall provide a full 10 year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL Listing requirements and any applicable national, state or local electrical codes. Direct, factory trained, ISO 9001 certified employees must be available for 48-hour assessment. A 24 hour 800 number must be available to support warranty.

PART 2 - PRODUCTS

2.1 ENCLOSURE

A. The specified system shall be provided in a heavy duty NEMA 4 or better dust-tight, drip-tight enclosure with no ventilation openings. The cover of the enclosure shall be hinged on the left side and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. All monitoring indication must be visible without opening the door. The enclosure maximum dimensions shall be (16) inches/(406) millimeters high, (16) inches/(406) millimeters wide and (8) inches/(203) millimeters deep.

2.2 OVERCURRENT PROTECTION (FUSING)

A. Individual surge components shall be fused to prevent violent failure. The fusing shall be UL listed and shall be capable of interrupting up to 200kA symmetrical fault current with 480VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable. Devices that utilize a single fuse to protect two or more suppression paths are not accepted.

2.3 DESIGN REQUIREMENTS

A. Protection Modes:
1. The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable) Note: L = Line, G = Ground, N = Neutral

B. UL 1449 Ratings:
1. The maximum UL/ANSI 1449 listed surge ratings for each and/or all of the specified protection modes shall not exceed the following:

System Voltage	Voltage Protection Rating			
	L-N	L-G	N-G	L-L
120/240	700-volts	700-volts	700-volts	1200-volts
120/208	700-volts	700-volts	700-volts	1200-volts
240		1200-volts		1000-volts
277/480	1000-volts	1000-volts	1000-volts	1800-volts
480		1800-volts		1800-volts

C. Noise Attenuation:
1. The unit shall be UL 1283 Listed as an electromagnetic interference filter for type 2 locations. The filter shall provide 41dB at 100kHz, 31dB at 1MHz, 35dB at 10MHz, 53dB at 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120-dB insertion loss from 100 kHz to 100 MHz when used in a coordinated facility system.

D. Life Cycle Testing:
1. The SPD system shall be duty life cycle tested to survive, 10kA (8x20µs), 20kV (1.2x50µs), IEEE C62.41.1 Category C surge current with less than 5% degradation of clamping voltage. The minimum numbers of surges the unit shall be able to protect against are:

Model Surge Rating	Number of Life Cycle Surges			
	Per Mode			*Per Phase*
	L-N	L-G	N-G	L-N + L-G
250kA per phase	12000	12000	12000	24000
500kA per phase	24000	24000	24000	48000

2.4 CONNECTIONS

A. The terminals shall be provided to accommodate wire sizes up to #1/0 AWG.

2.5 INTERNAL CONNECTIONS AND SERVICEABILITY

A. All surge current diversion module intra-unit connections shall be by way of low impedance copper. Surge current diversion modules shall use bolted connections to the plates for reliable, low impedance connections. The system shall be designed for simple change out of any or all SPD component modules by a qualified electrician. Designs that require factory service are not acceptable. All connections, conductors and terminals must be appropriately sized for specified surge current capacity.

2.6 STANDARD FEATURES

A. Component Testing and Monitoring:
1. The monitoring circuitry must continually verify the protection status during operation, and display this information on the front cover status panel. The SPD must also contain a built-in-test circuit that will verify the integrity of all fuse links and each associated MOV. The built-in-test circuit must cycle through all phase banks and the neutral-ground bank sending test signals to all modules including N-G. The integrity of all fuses in test must be indicted on the status panel. All testing must be able to be performed without disconnecting power to the SPD. Units that require external test sets or equipment are unacceptable.

B. Unit Status Indicators:
1. Red and green solid state indicators with printed labels shall be provided on the hinged front cover to redundantly indicate on-line unit status. The absence of the green light and the presence of the red light shall reliably indicate that surge protection is reduced and service is needed to restore full operation.

C. Surge Counter:
1. Provide up to 7-digit LED/LCD surge counter to total transient voltage surges.

D. Dry Contacts for remote monitoring:
1. Electrically isolated Form C dry contacts, one normally open and one normally closed set standard on all units for remote monitoring.

E. Undervoltage detection:
1. Unit shall be equipped with 70% undervoltage detection capability.

F. Phase Loss Monitoring:
   1. Unit shall be equipped with phase loss monitoring.

G. Power Loss Monitoring:
   1. Unit shall be equipped with power loss monitoring.

2.7 ENVIRONMENTAL REQUIREMENTS

A. Storage Temperature: -55 to +85 C (-67 to +187 F)

B. Operating Temperature: -40 to +60 C (-40 to 140 F)

C. Relative Humidity: 0% to 95%

D. Audible Noise: less than 45 dBa at 5 feet (1 5 m)

E. Operating Altitude: 0 to 18,000 feet above sea level

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall install the parallel SPD with short and straight conductors as practically possible. Locate adjacent to the switchboard or panel it is serving. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer's recommended installation practices as found in the installation, operation and maintenance manual and comply with all applicable codes. Provide STT Tierguide cable low impedance cable when long lead lengths are needed.

END OF SECTION

SECTION 26 51 19

LIGHTING FIXTURES - LIGHT EMITTING DIODE (LED)

PART 1 - GENERAL

1.1 SCOPE

A. Provide general and emergency lighting fixtures as noted on the drawings. Fixtures shall be completely wired with lamps installed and shall be in perfect operating condition at the time of substantial completion.

B. The types of lighting fixtures required for this project include:
1. LED

1.2 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.

C. NEMA JSC 10410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

F. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

G. UL 1012 - Safety Power Units Other Than Class 2; 2010.

H. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

I. NFPA 101

J. NEMA-LE

K. TM-21

L. LM-80

M. LM-79

N. L70

O. DLC

1.3 QUALITY ASSURANCE

A. All fixtures shall conform to all applicable UL standards and shall be UL label including damp and wet location ratings. “ETL listed” is an acceptable listing.

B. All LED drivers shall be UL recognized Class 2 per UL 1310 or non-Class 2 per UL 1012 as applicable.

C. All LED drivers shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR 15, for Non-Consumer Equipment.

D. All LED drivers shall be RoHS compliant.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide lighting fixtures produced by manufacturers as shown and scheduled.

B. LED DRIVER:
   1. Provide one of the following manufacturers
      a. Eldo
      b. Lutron
      c. Osram
      d. Philips

C. LAMPS:
   1. Provide one of the following LED Chip manufacturers
      a. Cree
      b. Nichia
      c. North American Philips
      d. Seoul
      e. Lumileds

1.5 SUBMITTALS

A. Shop drawings shall include a brochure with a separate cut sheet for each fixture type arranged in alphabetical order with fixture and all accessories/options clearly labeled. Provide performance data for each fixture. Provide an independent test lab report for each fixture if requested by the Architect/Engineer.

B. Provide driver and LED module data brochures for each fixture type.

C. Provide air handling and heat removal data for light fixtures specified with these requirements.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   1. National Electrical Code.
   2. Local, municipal, or state codes that have jurisdiction.
   3. UL fire resistance directory.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:
   1. Provide the size, type and rating of each light fixture shown and scheduled. All light fixtures shall complete with reflectors, lens, trim rings, flanges, LED modules, lamp holders, drivers, fuses, wiring, earthquake clips, etc. to provide a complete functioning light fixture.

B. Lighting Fixture Types:
   1. LED Fixtures
      a. Fixtures shall be pre-wired with frame-in kit and integral thermal management system for fixtures. Driver shall be encased in metal-can construction for optimal thermal performance.
      b. Total fixture lumen output is dependent on the chip, thermal management, driver current and optical system. LED fixtures shall be tested as a complete unit or system. Only DOE recognized CALiPER testing laboratory results shall be utilized.

c. Interior LED fixtures shall have integral common mode and differential mode surge protection of 3kV(1.2/50µs, 2 ohm combination wave).
d. Exterior LED fixtures shall have integral common mode and differential mode surge protection of 10kV/10kA(1.2/50µs, 2 ohm combination wave).

2. Exit signs
a. Exit signs shall meet all federal, state and local codes.
b. Provide fire alarm interface relay when required to flash exit signs.
c. Provide battery packs for emergency operation when not connected to emergency generator power.

2.2 LED MODULES AND DRIVERS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED
1. Driver manufacturer shall have a 10-year history producing electronic drivers for the North American market.
2. Driver shall carry a five year limited warranty from date of manufacture against defects in material or workmanship (including replacement) for operation at a maximum case temperature of 80 degrees Celsius.
3. Drivers shall not contain any Polychlorinated Biphenyl (PCB).
4. Provide driver with integral color-coded leads.
5. Driver shall operate from 50/60 Hz input source of 120 Volt through 277 Volt or 347 Volt through 480 Volt with sustained variations of +/- 10% (voltage) with no damage to the driver.
6. Driver output shall be regulated to +/- 5% across published load range. And shall have a power factor greater than .90 for primary application to 50% of full load rating with an input current Total Harmonic Distortion (THD) of less than 20% to 50% of full load rating.
7. Provide drivers with a Class A sound rating.
8. Provide LED drivers for outdoor fixtures with a minimum operating temperature of -40 degrees Celsius (-40 F). Provide LED drivers for indoor fixtures with a minimum operating temperature of -20 degrees Celsius (-2F).
9. Drivers shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
10. Driver output ripple current shall be less than 15% measured peak-to-average, with ripple frequency being greater than 100Hz.
11. Driver performance requirements shall be met when operated to 50% of full load rating.
12. Driver shall have integral thermal foldback to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
13. Drivers shall comply with NEMA JSC 10410 for in-rush current limits.
14. Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

2.3 LAMPS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED Lamps shall be appropriately matched to the driver with junction-down design for improved thermal management. Maximum DC Forward Current.

2.4 EMERGENCY LED BATTERY BACKUP

A. Provide Bodine #BSL310M for emergency light fixtures in 9 or 10-foot ceiling.

B. Provide Bodine #BSL20 for emergency LED driver for emergency light fixtures in ceiling heights greater than 12 feet.

C. Provide Bodine #BSL17-C2 for emergency LED driver for LED downlights.

D. Provide unswitched hot leg. Hot leg shall originate from the same branch circuit as required in article 700.12 (F) of NFPA 70.

2.5 POLES

A. Provide poles for area lighting fixtures as specified. Poles shall be one piece, anchor base, with 2-piece steel bolt cover and vibration dampers. Poles shall be round straight steel as specified on the Lighting Fixture Schedule.

B. Provide all poles with appropriate mounting accessories including arms, tenons, or bullhorns as required. Anchor bolts shall be hot dipped galvanized, sized as required by the manufacturer of the pole.

C. All poles shall have a normal 3” x 5” hand hole at 18” above the base flange and grounding provision.

D. Poles shall be prime painted interior and exterior. The exterior shall be finished with polyester powder coating and architectural finish as specified by the Architect. The interior with 3 mil thermoplastic hydrocarbon resin, or equivalent to meet 1000-hour salt spray exposure (ASTM B117).

2.6 BRANCH CIRCUIT EMERGENCY TRANSFER SWITCH (BCELTS)

A. Provide 20 amp, 120-277 Volt, UL 1008 listed Branch Circuit Emergency Transfer Switch to control emergency light fixtures transferring from normal to emergency branch circuits Provide Bodine GTD 20A or ETC SC 1008 UL 924 Devices are not acceptable

2.7 AUTOMATIC LOAD CONTROL RELAY (ALCR)

A. Provide 3 amp, 120-277 volt UL 924 listed. Relay to bypass switching controlling emergency branch circuit light fixtures Provide Bodine GTD or Wattstopper ELCU.

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. General
1. Install the type of lighting fixture where shown and indicated in accordance with manufacturer's written instructions.
2. Provide earthquake clips on all recessed lay-in lighting fixtures as required by building code.
3. Adjust all adjustable lighting fixtures, as directed by the Architect.
4. Provide safety chains and wire guards for lighting fixtures located in gymnasium, multi-purpose rooms, play areas, etc.

B. Coordination
1. The contractor shall verify the type of fixtures with the ceiling types as indicated on the drawings. Any discrepancies shall immediately be brought to the architect's attention before the contractor places his order and accepts delivery. Fixtures shall fit exact in the type of ceiling scheduled. Provide plaster frames, trim rings and other accessories required for a correct fit.
2. Provide supports attached to structural member to support fixtures when the ceiling system cannot maintain support. Provide separate supports for all recessed ceiling mounted HID fixtures.
3. Refer to architectural reflected ceiling plan for the exact location of all lighting fixtures. Notify the architect for any discrepancies or conflicts with structural, architectural, mechanical piping or ductwork before installation.

C. Mounting
1. Provide support channels to support outlet boxes used support surface mounted lighting fixtures such as exit signs or downlights.
2. Pendant or surface mounted fixture shall be provided with required mounting devices and accessories, including hickeys and stud-extensions, ball-aligners, canopies and stems. Locations of fixtures in mechanical areas shall be coordinated with mechanical contractor. Mounting stems of pendant fixtures shall be of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field. The allowable variation tolerance in mounting individual fixtures shall not

exceed 1/4 inch and shall not vary more than 1/2 inch from the floor mounting height shown on the Drawings. Fixtures hung in continuous runs shall be installed absolutely level and in line with each other. Hanging devices shall comply with Code requirements. Fixtures shall employ single - not twin - stem hangers unless otherwise noted.

3. All structure mounted fixtures (i.e. bracket mounted, pipe mounted and surface mounted) shall be provided with cables of suitable size and weight to support the weight of the fixture. Cables shall be fastened around or fastened to the housing of the fixture. On pendant fixtures, one safety cable of suitable size and weight to support the weight of the fixture assembly shall connect the top of the pendant to the supporting structure by means of welding or bolting, and one safety cable shall connect the housing of the fixture to the bottom of the pendant. Where more than one pendant per fixture occurs, only one pendant must be cabled. Track fixtures for pendant mounted track shall also be supplied with clip-on safety cables of suitable size and weight to support the weight of the fixture.
4. Provide secondary support wires from all four (4) corners of the lay-in fixtures to the structure above. Do not support fixtures from ceiling grid wire supports, piping, conduit, side walls, or mechanical equipment. Ceiling specifications do not supersede this requirement.
5. Where pole mounted luminaries are provided, provide appropriate anchor base pole as specified with manufacturer's recommended anchor bolts. Verify exact location on site for poles with Architect, Civil, and Landscape documents. Poles shall be installed on proper footing. Refer to details on the drawings. Provide grounding connection to a separately driven ground rod, outside of the footing. Where indicated provide pole with identification plate indicating pole number.
6. Ground mounted flood type fixtures and flagpole lights, or similar fixtures, shall include stanchion and knuckle mount. Stanchion shall be supported by concrete base.
7. Flagpole mounted fixtures called out to be mounted on the flagpole shall be provided with tenon mount adapter and yoke.

D. Electrical Connection
1. All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'- 0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring of fixtures installed in accessible ceiling is not permitted. Fixture whips shall not lay-on ceiling tile or grid. Provide caddy clips to provide additional support.

E. Fire Rated Ceiling
1. Provide fire rated canopy or enclosure for all fixtures recessed in a fire rated ceiling. The fire rated canopy or enclosure shall be as required by the UL design number listed in the UL fire resistance directory. Refer to architectural drawing for the UL design number. Coordinate with ceiling installer and manufacturer. Provide proper rated drivers for lighting fixtures installed within these rated enclosures.

F. Air Handling Fixtures
1. Install all air handling light fixtures with return air slot in the open position, if it is to be as an air handling fixture. Coordinate with mechanical contractor.

3.2 FINAL INSPECTION

A. Remove all plastic and protective coating from all fixtures. Fixtures shall be thoroughly cleaned. Replace any damaged fixture or fixture parts including reflectors, louvers, lens and metal parts that show signs of corrosion.

B. Replace all other defective fixtures showing signs of excessive usage.

C. Demonstrate proper operation of all fixtures and controls. Refer to other sections and details on the drawings for lighting controls.

END OF SECTION

SECTION 26 56 68

EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.1 SCOPE

A. Provide LED Lighting to illuminate the following venues:
   1. Football and Track and Soccer
   2. Baseball
   3. Softball
   4. Tennis

B. Guaranteed Light Levels: Selection of appropriate light levels impacts the safety of players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 25 years.

C. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to players, spectators, and neighbors.

D. Cost of Ownership: To reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.

E. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
   1. Control and monitoring system shall provide contactor control of all existing circuits. Key switches shall be provided to provide field-level control of existing circuit groups.

1.2 REFERENCE STANDARDS

A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2025).

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

E. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel; 2021.

F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

H. IES RP-6 - Recommended Practice: Lighting Sports and Recreational Areas; 2024.

I. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.

J. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

K. UL 96A - Standard for Installation Requirements for Lightning Protection Systems; Current Edition, Including All Revisions.

1.3 PRE-BID SUBMITTAL REQUIREMENTS

A. Design Approval: The Owner/Engineer will review pre-bid submittals from all manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.

B. Approved Product: All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.

D. Bidders are required to bid only products that have been approved by this specification or addendum by the Owner or Owner's representative. Bids received that do not utilize approved system/design will be rejected.

1.4 ONFIELD LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting manufacturers will provide a guarantee that light levels will be sustained over the life of the warranty period. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified below.

B. Manufacturers will provide lumen maintenance data of the LED luminaires used per TM-21-11 and will Incorporate the lumen maintenance projections into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Per IES guidelines, lumen maintenance hours should be reported based on the 6x multiplier of testing hours.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Football/Soccer	50 Footcandles	2:1	72	30' x 30'
Track	22 Footcandles	3:1	44	30' x 30
Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Football/Soccer	50 footcandles	2:1	72	30’ x 30’
Baseball	50 footcandles infield 30 footcandles outfield	2:1 infield 2:5:1 outfield	25 infield 139 outfield	30’ x 30’
Softball	50 footcandles infield 30 footcandles outfield	2:1 infield 2.5:1 outfield	25 infield 71 outfield	20’ x 30’

Tennis	50 footcandles	2:1	120	20’ x 20’

C. Color Temperature: The lighting system shall have a minimum color temperature of <5000K and a CRI of <70.

D. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare on field and providing sufficient uplight.
1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvers. No symmetrical beam patterns are acceptable.
3. Aerial lighting – Adequate illumination must be provided above the field to see the ball in flight. It is recommended that a lighting analysis be performed above the field of play to evaluate the visibility of the ball over its typical trajectory to ensure the participants will adequately see the ball. Calculation planes should be evaluated up to the maximum anticipated height for the level of play.
4. Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaire with lesser glare control to meet field angle requirements.

# of Poles	Pole Designation	Pole Height
4	F1-F4	80'
# of Poles	Pole Designation	Pole Height
12	T1 – T12	50’
8	A1, A2, B1, B2, C1, C2, D1, D2	70'
6	F1-F4, A3, A4	80'
2	B3, B4	90'

1.5 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers, and external shields. No symmetrical beam patterns are accepted.

B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

	Average	Maximum
Specified Spill Line Horizontal Footcandles	0.0187 fc	0.02 fc
Specified Spill Line Max Vertical Footcandles	0.0496 fc	0.05 fc
Specified Spill Line Max Candela (taken at 5 ft above grade)		2149.0583 cd
	Average	Maximum
Tennis / Football 150’ Specified Spill Line Horizontal Footcandles	0.01	0.04
Tennis / Football 150’ Specified Spill Line Max Vertical Footcandles	0.05	0.014
Tennis / Football 150’ Specified Spill Line Max Candela (taken at 5 ft above grade)	1501	4300
Baseball / Softball 150’ Specified Spill Line Horizontal Footcandles	0.12	0.09
Baseball / Softball 150’ Specified Spill Line Max Vertical Footcandles	0.25	1.5

Baseball / Softball 150' Specified Spill Line Max Candela (taken at 5 ft above grade)	6600	29000

C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be provided in 30-foot intervals along the boundary line at 3 ft above grade.

D. Sample Photometry: The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years' experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

E. Field Verification: Lighting manufacturer shall supply field verification of environmental light control using a meter calibrated within the last 12 months.

F. Spill verification: Illumination levels shall be taken in accordance with IES RP-6. The light sensing surface of the light meter should be held 36 inches above the playing surface with the sensing surface horizontal (for horizontal readings) or vertically pointed at the brightest light bank (for max vertical readings)

1.6 COST OF OWNERSHIP

A. Manufacturer shall submit a 25-year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

PART 2 - PRODUCTS

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Approved manufacturers
   1. Musco Lighting
   2. CHM Lighting

B. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

C. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123/A123M. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153/A153M and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

D. System Description: Lighting system shall consist of the following:
   1. Galvanized steel poles and cross-arm assembly.
   2. Non-approved pole technology:
      a. Square static cast concrete poles will not be accepted.
      b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long-term performance concerns.
   3. Lighting systems shall use concrete foundations. See Structural Parameters in Part 2 for details.

a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-enforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.

4. Manufacturer will supply all drivers and supporting electrical equipment.
   a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be in the enclosure. Integral drivers are not allowed.
   b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
7. Control cabinet to provide remote on-off control, monitoring, and entertainment features of the lighting system. See Control Section for further details.
8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
   a. Integrated grounding via concrete encased electrode grounding system.
   b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780.The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

E. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   1. Electric power: 480 Volt, 3-phase
   2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The energy consumption for the field lighting system shall be 60 kW.

2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.

D. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.
   1. The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.
   2. Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

E. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

F. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS and Android devices.
   1. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.
   2. Cumulative hours: shall be tracked to show the total hours used by the facility.
   3. Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

H. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

I. Entertainment Features: Control System shall store four (4) standard preprogrammed lighting effects per field with option for two (2) custom preprogrammed lighting scenes or effects. Programming will additionally include four (4) minutes of custom programming with lights synchronized to music supplied by customer. Shows shall be initiated by a manufacturer-provided touchscreen user interface on the control system network.

2.4 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the ICC (IBC). Wind loads to be calculated using ASCE 7, an ultimate design wind speed of 150 mph and exposure category II.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to AASHTO LTS.

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical and communications conduit to verify actual locations of connections before pole or luminaire installation.

C. Examine foundations for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
   1. Providing engineered foundation embedment design by a registered engineer in the State of Texas for soils other than specified soil conditions.
   2. Additional materials required to achieve alternate foundation.
   3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.3 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 8-12 weeks from receipt of approved submittals and receipt of complete order information.

3.4 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IES RP-6.

B. Field Light Level Accountability
   1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
   2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
   3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, uplight for aerial visibility, and offsite candela readings are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.5 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

END OF SECTION

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID)

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete in Yes/No column to indicate compliance (Y) or noncompliance (N) for each item.

Submit checklist below with submittal.

Yes/No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations.
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing

			pressures. Design must be stamped by a structural engineer in the state of Texas, if required by owner.
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of Texas.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Texas.
	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Texas.
	K	Project References	Manufacturer to provide a list of (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Texas. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all products being provided.
	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	O	Cost of Owners	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years
	P	Environmental Light Control Design	Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area until < 500 or other, F11> candela or less is achieved.

SECTION 27 02 00

BASIC MATERIALS AND METHODS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect and Engineer for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect and Engineer.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all labor, material, tools, equipment and services necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Communications items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least seven (7) working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning Communications system shall be considered a part of the overall "Scope".

H. Coordinate with other contractors on items required for the proper functioning of communications system and indicated as provided by others, such as power, backboxes, conduits, sleeves, air conditioning, structural support, etc..

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. Div 1 and conditions of the contract

B. Div 26 Electrical

C. Div 28 Electronic Safety and Security

1.4 COOPERATION WITH TRADES:

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronics Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

J. BICSI (Building Industry Consulting Services International)

K. Owner’s Design Guidelines and Construction Standards

L. Local, county, state and federal regulations and codes in effect as of date of installation.

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.
   1. Approximate location of communications outlets, devices, equipment cabinets, cable trays, conduits and sleeves, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such items and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.
   2. Communicate with the Architect and secure his approval of any location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of ceiling devices shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical, electrical, plumbing contractor may be required to allow adequate clearances for all building components. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 QUALITY ASSURANCE

A. Contractor shall have a complete working knowledge of the communications system being installed.

B. Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document.

C. Contractor and individual installation crew members shall be experienced and qualified to perform the work specified herein at time of bid submission. All onsite supervision personnel that will be assigned to this project shall be listed in the Pre-Installation Submittal.
   1. 80% shall have a minimum of three (3) years of experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid.
   2. All installation team members must demonstrate knowledge and compliance with all applicable methods, standards, and codes.
   3. All members of the Structured Cabling System installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls under manufacturer’s guidelines necessary to obtain the Manufacturer’s System Assurance Warranty.
   4. Any personnel substitutions shall be noted in writing to the Owner.

D. A BICSI RCDD shall supervise and approve all on-site structured cabling work as a recognized member of the Contractor’s installation team.

E. Contractor shall obtain Communications system product manufacturer’s certification if applicable.

F. Refer to General Conditions for other requirements.

1.9 CONTRACTOR REQUIREMENTS

A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.

B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete communications cabling infrastructure system. Pay all required sales, gross receipts, and other taxes.

C. Insurance
   1. The Contractor shall procure, submit for review, and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance.
   2. The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.

D. Regulatory Requirements
   1. Communications Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).
   2. Communications Contractor shall be licensed and/or bonded as required for telecommunications/low voltage cabling systems.

E. Privacy and Confidentiality
   1. The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.
   2. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.

F. Use of Subcontractors
   1. Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.
   2. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.

G. The Contractor's designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.

H. Coordination
   1. Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.
   2. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications components.
   3. Exchange information and agree on details of equipment arrangements and installation interfaces.
   4. Coordinate with electrical contractors and plan for the pathway routes used communications cabling to minimize cable lengths. Report any potential over distance cable runs for approval before pulling the cables.
   5. Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.

1.10 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty-day (30) time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:
   1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
   2. An index page with a listing of all data included in the Submittal.
   3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
   4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
   5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
   6. Identification of each item of material or equipment matching that indicated on the Drawings.
   7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so

indicated. All applicable information shall be clearly indicated with arrows or another approved method.

B. Shop Drawings
1. Communications Contractor shall submit, for approval, floor plans that identify all device locations, device ID, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
   a. Communication Contractor shall notify A&E team of any cable routes that will exceed the permanent link distance limit and get approval before work to start. Without advance notice and approval from A&E team, the contractor shall be fully responsible for make corrections as needed to bring all installed cables within the distance limit.
2. Communications Contractor shall submit, for approval, diagrams that show communications room layouts, rack layouts (including wall and rack elevations), cabling riser and interconnection diagrams, etc.
3. Communications Contractor shall submit, for approval, labelling scheme for all communications devices and cabling components (faceplates, horizontal cables, riser cables, inter-building cables, racks, patch panels, etc.) installed.
4. The Contractor shall make any corrections as required by the Engineer and submit revised shop drawings to the team for approval.
5. Approval by the Engineer of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.
6. Drawings shall show the proposed firestop systems and locations, (stamped/embossed by the PE) to restore/maintain the designed fire rating of the building structure (walls, ceilings, floors, etc).
7. Shop drawings shall be developed in coordination with other trades (MEP, Architecture, Structural, etc.) to avoid any collision or conflict and to meet all industry standards best practices, codes and regulation requirements. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified
8. Additional coordination with other trade contractors may be required to allow adequate clearances and meet code requirements. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner

C. Product Data Submittals
1. Communications Contractor shall submit catalogue cutsheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.
2. Communications Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.
3. Product information sheets for the proposed system test equipment to include certification of test equipment calibration. Installer is to use test equipment with a calibration date within one year of test date. Installer is to recalibrate and resubmit if necessary.
4. All data sheets shall be organized by specification sections and provided with table of contents. All products required shall be included in one submittal.
5. All product substitutions shall be submitted in advance for review and approval before being included in product submittal package.
6. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

D. Structured Cabling System Warranty
1. The Communications Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.
2. All subsequent work shall be in accordance with approved submittals. The Communications Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty

manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.

E. Qualifications
   1. Communications Contractor shall submit a list of the Contractor's previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:
      a. At least ten (10) other projects in the last five (5) years
      b. Name and location of project
      c. Project contacts, email addresses, and phone numbers
      d. Total square footage
      e. Total number of cables/drops
      f. Types of media
   2. Communications Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.
      a. Communications Contractor Employees
      b. Subcontractors
   3. Manufacturer certifications for Contractor and installers.

F. Cable Testing Plan
   1. The Contractor shall provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber components and accessories prior to beginning cable testing.
   2. The following minimal items shall be submitted for review:
      a. A testing plan that clearly describes procedures and methods.
      b. Product data for test equipment.
      c. Certifications and qualifications of all persons conducting the testing.
      d. Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
      e. Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.

G. Samples
   1. For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

H. Refer to Division 1 for additional information on shop drawings and submittals.

I. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

J. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

K. Submittals shall be reviewed and returned to the Contractor with one of the following categories indicated:
   1. REVIEWED: Contractor does not need to take further submittal action, shall include this submittal in the O&M manual, and verify with Architects and other parties (Owner, etc) reviewing the submittals that no other correction is required before placing orders and starting installations.
   2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

L. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

M. Refer to each specification section for additional requirements.

1.14 COORDINATION DRAWINGS

A. Before submit shop drawings, Contractor shall prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of communications conduits/sleeves, cable trays, equipment, cabinet and other materials. Include the following:
      a. Wall and type locations.
      b. Clearances from other building structure and MEP equipment.
      c. Clearances for servicing and maintaining equipment and cabling, and space for equipment disassembly required for periodic maintenance.
      d. Equipment connections and support details.
      e. Exterior wall and foundation penetrations.
      f. Fire-rated wall and floor penetrations.
      g. Sizes and location of required concrete pads and bases.
      h. Structural floor, wall and roof opening sizes and details.
   2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
   4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: cable routing, equipment location, clearance, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
   1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   4. Servicing instructions and lubrication charts and schedules.
   5. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 27, include the following information for equipment items:
      a. Identifying names, name tags designations and locations for all equipment.
      b. Fault Current calculations and Coordination Study.
      c. Reviewed shop drawing submittals with exceptions noted compliance letter.
      d. Fabrication drawings.
      e. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
      f. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
      g. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
      h. Equipment name plate data.
      i. Wiring diagrams.
      j. Exploded parts views and parts lists for all equipment and devices.
      k. Color coding charts for all painted equipment and conduit.
      l. Location and listing of all spare parts and special keys and tools furnished to the Owner.
      m. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.
   6. The Communications Contractor shall deliver the Installer's Extended Product Warranty and Manufacturer's signed System Assurance Warranty of installed cabling system to include all components that comprise the complete cabling system.
      a. Delivery shall be completed within two (2) weeks of the time of final punch list review.
   7. Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
   8. Cable Testing Report Requirements
      a. Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.
   9. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
   10. Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.
   11. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination components. Include products furnished:
      a. Manufacturer's name
      b. Manufacturer's part numbers
      c. Cable designations

d. Location and riser assignments
e. Product Data

12. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.
13. Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

1.16 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed device and cabling, and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. For all cables and devices served from a wall mounted equipemnt enclosure, provide printed as-built wiring diagram showing all the cable route and type, device IDs and locations, and brand and models of all system components inside the enclosure, and attach the wiring diagram to the interior face of the enclosure's front door.

G. When the option described in paragraph E., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:
(NAME OF GENERAL CONTRACTOR)
BY:_____
(SIGNATURE)
(NAME OF SUBCONTRACTOR)
BY:_____
(SIGNATURE)

1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 27.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4-hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 27 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

C. Structured System Warranty
   1. The Contractor shall be a certified Manufacturer's Value Added Reseller (VAR) and/or Authorized Installer and provide an end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.
   2. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.
   3. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.
      a. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.
      b. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the contract documents, and support all current and future network applications for a minimum of twenty (20) years.
   4. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.
   1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

2. If the client, Architect or Owner of the project requires electronic media for “record purposes”, then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
3. At the Architect/Owner’s request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a “.rvt” or “.dwg” format to permit the end user to revise the drawings.

1.22 PRE-INSTALLATION MEETINGS

A. Communications Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and clarify questions in writing with consultant and/or project manager/Owner representative.

B. Agenda
1. Safety
2. Work to be performed
3. Scheduling
4. Coordination
5. Other topics as necessary

C. Attendance
1. Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner’s representatives, and other parties affected by work of this document.
2. All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of communications cables on the project.

1.23 CONTRACT ADMINISTRATION

A. The Engineer may perform site visits and provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.

B. Job Field Report outline:
1. General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
2. Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.24 POST INSTALLATION MEETINGS

A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.

B. Attendees shall include
1. Communications Contractor
2. Project Manager/Owner Representative
3. General Contractor
4. Communications Engineer.
5. Other trades that the GC deems appropriate.

C. At this meeting the Communications Contractor shall present and explain all documentation.

D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Communications Contractor and resubmitted within one (1) week of the meeting.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:
   1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
   2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
   3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 GENERAL REQUIREMENTS

A. All materials and products used on this project shall be listed by Underwriters' Laboratories.

B. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer’s latest standard design in satisfactory use for at least one year prior to bid opening.

C. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
   1. All shall be typical commercial designs that comply with the requirements specified.
   2. All material and equipment shall be readily available through manufacturers and/or distributors.

D. Installer is to comply in every way with the requirements of local laws, ordinances, and rules, , the National Board of Fire Underwriters, and the National Electrical Code.

E. In the event of any conflicts between documents referenced herein and the contents of this specification, the Installer is to notify in writing to the Architect/Engineer of any such occurrences before the purchasing of any equipment, materials and/or installation by the Installer. The Architect/Engineer will notify the Installer of any actions required to resolve these conflicts.

F. No change in the plans or in the specifications is to be made without written instruction to do so from the Owner or Architect/Engineer.

G. Materials are to be installed in accordance with manufacturer’s recommendations and best industry practices.

H. The Installer is to promptly correct all discrepancies and/or defects for which the Installer is responsible.
   1. The Installer is to maintain a set of working specifications and drawings on site at all times and to make this set available for inspection during site visits.

I. All materials are to be new and of the highest quality.

J. All products installed in the above ceiling space are to meet or exceed the Underwriters Laboratories (UL) fire rated cable insulation requirements and are to be Plenum rated.

K. The Installer is to seal ALL penetrations, conduits, sleeves, cable trays, etc., where cabling has been installed through rated walls/floors with Wiremold Flamestopper intumescent fire- stop system (or approved equivalent) where they pass through rated walls. The Installer is responsible for returning any and all penetrations through rated walls or floors made for communications cable to their pre-penetration rating.

L. All material used to dress cable bundles shall be applied loosely to allow the dressing material to slide around the bundle. Tension of dressing materials shall not deform the cable sheath. Dressing materials should be limited to the telecommunications rooms only. Cabling shall be placed unbundled in cable tray and/or j hooks in the above ceiling spaces. No bundling materials are to be used above ceiling. All j hooks installed shall include the corresponding clip provided by the hook manufacturer. Plastic cable ties will not be permitted.

M. Any discrepancy in the contract documents is to be remedied by the Installer providing and installing the newer, greater quality or quantity of the item or items in question.

N. Horizontal cabling is to have minimum ten (10) feet of service loop coiled and stored above the ladder rack in the telecommunication room.

O. Horizontal cabling is to have no less than twelve (12) and no more than eighteen (18) inches of maintenance loop coiled and stored as close to the entrance to the workstation outlet as possible.

P. Horizontal cabling is to have no less than six (6) and no more than twelve (12) inches of maintenance loop coiled and stored inside the back box at the workstation outlet.

Q. Horizontal cable lengths for individual links shall not exceed 90 m (295 ft) from the point of termination at the connector to the point of termination at the patch panel.

R. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

S. Provide nylon bushings for all conduit openings.

T. All horizontal cables not in a cable tray or conduit shall be supported at a maximum of 48 to 60 inch intervals. Cable support system is to be independent of supports for other trades. At no point shall cable(s) make contact with acoustic ceiling supports, grids, panels, electrical conduits, water pipes or HVAC ductwork or supports.

U. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the installer prior to final acceptance at no cost to the Owner.

V. Pair untwist at the termination shall not exceed 3.18mm.

W. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.

X. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
   1. Plaster Surfaces: Milcor Style K.
   2. Ceramic Tile Surfaces: Milcor Style M.
   3. Drywall Surfaces: Milcor Style DW.
   4. Install panels only in locations approved by the Architect.

2.4 FIRE STOPPING

A. Contractor shall restore the fire rating of penetrations to rated walls, ceiling, flooring after cable pulling. Fire stopping products shall be as follows:
   1. Hilti
   2. SpecSeal
   3. 3M
   4. Owner approved alternate

2.5 IDENTIFICATION (LABELING) SYSTEM

A. Contractor shall label al communications system components installed. Labeling products shall be as follows:
   1. Brady (LAT-19-361-4)
   2. Dymo
   3. Hellerman-Tyton
   4. Owner approved alternate

2.6 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.7 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.8 PAINTING

A. All factory assembled equipment shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements
   1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

B. Established Dimensions
   1. Where field measurements cannot be made without delaying the work, coordinate with the General Contractor to establish dimensions.
   2. When approved in writing, proceed with fabricating units without field measurements.

3. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

C. Pre-installation inspection
1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.
2. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.2 DEMOLITION AND REMODELING

A. Where only portions of the existing Communications system are to be modified as part of the renovation and addition project, devices related to or part of this system outside of the renovation area shall be kept in operations.

B. The Drawings do not show all demolition work required. The Contractor shall make himself familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

C. Utility service outages required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two (2) weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

D. The contractor shall perform a preconstruction walk thru of the site to observe and test the existing systems for operation. The owner assumes that the system is 100% operational and functioning prior to the commencement of construction. If any portion of the system observed or tested to be non-functional or inoperable at the commencement of the project will be noted by the contractor. A written report will be generated by the contractor noting their findings and submitted to the project team for review and handling. The owner will determine if the items found to be non-functional are to be repaired by contractor or repaired by the owner. If this repair of the equipment found to be non-functional is to be added to the contractor's scope of work the contract amount for the Work shall be adjusted accordingly.

E. Work Sequence and Timing. The Owner will cooperate with the Contractor; however, the following provisions must be observed:
1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.
2. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and Sub-subcontractors, and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

F. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing Local Area Network (LAN) and Wide Area Network (WAN) infrastructure and workstation outlets. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

G. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

H. All equipment and/or systems noted on the Drawings "To Be Removed" should be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

I. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility; or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

J. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

K. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

L. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

M. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage which occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

N. When applicable, Include in the contract price all rerouting of existing backbone cabling, , etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing telecommunications rooms in areas scheduled to remain operational with a minimum of interruption.

O. All existing cabling, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

P. Cabling and equipment s serving technology and communications, etc., which is to remain but which is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

Q. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

R. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

S. Field verify measurements, and cabling arrangements are as shown on Drawings.

T. Verify that scheduled cabling and equipment serving only those abandoned devices to be demolished and removed in its entirety.

U. Demolition Drawings are based on casual field observation and existing Record Documents. Report discrepancies to Architect and Engineer before disturbing existing installation.

V. Beginning of demolition means that the contractor accepts existing conditions.

W. Demolish and extend existing communications work under provisions of Division 02 and this Section.

X. Remove, relocate, and extend existing systems to accommodate new construction.

Y. Remove abandoned cabling to source of origination point. Remove racks and other equipment as scheduled on the drawings.

Z. Remove exposed / abandoned cabling systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.

AA. Repair adjacent construction and finishes damaged during demolition and extension work.

BB. Maintain access to existing systems which remain active. Modify installation or provide access doors as appropriate.

CC. Extend existing systems using materials and methods compatible with existing systems, or as specified.

DD. Clean and repair existing materials and equipment which remain or are to be reused. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operating condition. The Contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

EE. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

FF. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

GG. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

HH. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect

temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

II. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

JJ. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

3.3 INSTALLATION

A. General
1. Contractor shall install work in accordance with specifications, drawings, manufacturer’s instructions and approved submittal data.

B. Allowable cable bend radius and pull tension:
1. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation.
2. Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
3. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

C. Pull Strings
1. Provide pull strings in all new conduits, including all conduits with cable installed (trailer strings) as part of this contract.
2. Data and video cables can be pulled in tandem with pull strings.
3. The pull strings must move freely to prevent cable jacket/cable damage during pulls.

3.4 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3” of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.5 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of Communications work shall be concealed in walls, chases, under floors and above ceilings except:
1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.6 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by “3M” or approved equal.

3.7 LABELING

A. All communications system field devices, faceplates, cables, termination devices, equipment enclosures (racks, cabinets, wall mounted boxes, etc) shall be clearly labelled with printed labels showing the device/cable ID, type, and the origination and destination location for cables.

B. All labelling shall conform to Owner's labelling standard and industry standards. Submit labelling scheme as part of the shop drawing for review and approval before work to start.

C. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

D. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.

E. Provide transparent plastic label holders, and 4-pair marked colored labels.

F. In accordance with ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure":
   1. Install colored labels according to the type of field as per color code designations.
   2. Use “designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields”.

G. Pathway Labels and Labeling System
   1. Labeling system shall consist of a hand-held portable printer
   2. Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.
   3. Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.
   4. Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.
   5. All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.
   6. Identification
      a. All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.
      b. Conduits shall be labeled with the word “communications” and the conduit’s origination room number and destination room number.
      c. The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.
      d. Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.
      e. The Contractor shall label conduit sleeves at each wall and floor penetration.

3.8 FIRESTOPPING

A. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system.

B. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for communications infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.

C. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

D. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.

E. Using a “ring and string” method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.

F. Coordinate firestopping procedures and materials with General Contractor.

G. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.

H. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0’-4”.

I. Provide and install removable, intumescent, firestop bricks for all openings greater than 0’-4” where there are penetrations through walls.

J. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers’ specifications.

K. Provide manufacturer recommended material for rated protection for any given barrier.

L. Laminate and permanently affix adjacent to chases the following information:
   1. Manufacturer of firestop system.
   2. Date of installation/repair.
   3. Part and model numbers of system and all components.
   4. Name and phone numbers of local distributor and manufacturer’s corporate headquarters.

M. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.

N. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.

O. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

P. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

Q. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

R. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.

S. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

3.9 TESTING CABLING SYSTEM

A. Upon completion of the installation of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
   1. Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
   2. Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.
   3. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
   4. The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below.
   5. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.

B. Non-Compliant Cabling
   1. Testing that shows some or all pairs of a cable do not comply with specifications, without written approval by the Owner, shall be replaced at Contractor's expense (including respective connectors).
   2. With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.
      a. Testing is still required for non-compliant cabling.
      b. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground.
      c. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.

C. Failed Tests
   1. If tests fail, Contractor shall correct as required to produce a legitimate passing test.
   2. Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
   3. If the Contractor is found to have manipulated or falsified any failing test result to show a "PASS" for any reason (without written notice and prior approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.

D. Owner reserves the right to be present during any or all testing.

3.10 WALL MOUNTED EQUIPMENT

A. Install all wall mounted equipment in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Unless noted otherwise, all wall mounted equipment that need to be accessed for operation or maintenance shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices(note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.11 CLEANING

A. The Contractor will clean all surfaces of equipment and devices prior to final acceptance by Owner.

3.12 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.13 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:
   1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
   2. All devices, equipment, equipment cabinets and enclosure shall be cleaned and in operating condition.
   3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
   4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
   5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

3.14 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes grounding and bonding products, design requirements and installation for communications systems.

B. Related Sections
1. Section 27 02 00 - Basic Materials and Methods for Communications Systems
2. Section 27 05 28 - Pathways for Communications Systems
3. Section 27 11 00 - Communications Room Fittings
4. Section 27 15 00 - Communications Horizontal Cabling
5. Section 27 13 00 - Communications Backbone Cabling
6. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications referenced in Section 27 02 00 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
1. Refer to Section 27 02 00.

D. Codes and Standards
1. Refer to Section 27 02 00.

1.3 SYSTEM REQUIREMENTS

A. General
1. All conductor wire, busbars and conduit shall be UL listed.
2. The communications ground system shall be independent from all power grounding except for the connection to the building's electrical service main grounding electrode system.
3. Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.

B. Telecommunications Main Grounding Busbar (TMGB) and Bonding Conductor for Telecommunications (BCT)
1. The main ground source feed for the Telecommunications Main Grounding Busbar (TMGB) in the MC (MDF) shall be an independent feed from the building's electrical service main grounding electrode system, known as the Bonding Conductor for Telecommunications (BCT).
2. The BCT shall be a stranded copper ground wire from the building ground system to the TMGB in the MC (MDF) sized at a minimum #4/0 unless otherwise sized by the Electrical Engineer of Record.
3. The BCT connections shall be low emission exothermic welds at the connecting ends.

C. Telecommunication Bonding Backbone (TBB) and Telecommunications Grounding Busbar (TGB)
1. The Telecommunication Bonding Backbone (TBB) originates at the TMGB and shall be extended from the TMGB within the MC (MDF) throughout the building along the same route as the

telecommunications backbone pathways, to the Telecommunications Grounding Busbar(s) (TGBs) in each TR (IDF).

2. The minimum TBB conductor size between busbars shall be a stranded copper ground wire one (1) AWG size smaller than the Bonding Conductor for Telecommunications (BCT).

D. Grounding Equalizer (GE)

1. Whenever two or more TBBs are used in a multistory building, the TBBs shall be bonded together with a GE (by low emission exothermic welds) at the top floor and at a minimum of every third floor in between with a copper conductor equal to the gauge of the TBB.

E. TEBC and RBC

1. All cabinets and racks shall be connected by the Telecommunications Equipment Bonding Conductor (TEBC). The TEBC is a stranded copper #4 conductor from the TMGB/TGB extending along each row of racks within the room. Bond each rack with a Rack Bonding Conductor (RBC). The RBC is a stranded copper #6 conductor connected to the vertical rack bonding terminal. All connections shall be irreversible crimp connections. Route conductor so as to minimize the quantity of sweeping bends.

1.4 SUBMITTALS

A. Refer to Section 27 02 00.

1.5 QUALITY ASSURANCE

A. Refer to Section 27 02 00.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 02 00.

B. The Contractor shall ship on manufacturer`s standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Manufacturers

1. Houston Wire and Cable Company
2. Okonite Company
3. General Cable
4. Pirelli Cable Corporation
5. Triangle Wire and Cable
6. Owner Approved Alternate

C. Electrical Service Entrance Bonding Conductor and Connector Manufacturers

1. Copperweld
2. Thomas & Betts
3. Blackburn
4. Owner Approved Alternate

D. Exothermic Connector Manufacturers

1. Erico Products (Cadweld)
2. Continental Industries (thermOweld)
3. Harger
4. Owner Approved Alternate

E. Crimp Connector Manufacturers
   1. Thomas & Betts
   2. FCI Burndy Electrical
   3. O-Z/Gedney
   4. Owner Approved Alternate

F. Telecommunication Grounding Busbars
   1. Chatsworth
   2. Panduit
   3. Leviton
   4. Owner Approved Alternate

G. Bonding Straps
   1. Chatsworth
   2. Harger
   3. Brundy
   4. Owner Approved Alternate

H. C-Type Compression Taps
   1. Brundy
   2. Harger
   3. Owner Approved Alternate

I. Antioxidant Joint Compound
   1. Chatsworth
   2. Owner Approved Alternate

J. Labeling
   1. Refer to Section 27 02 00.

K. Firestopping
   1. Refer to Section 27 02 00.

2.2 MATERIALS

A. Communications Grounding Conductors: Copper American Wire Gauge (AWG) wire of the following sizes:
   1. Bonding Conductor for Telecommunications (BCT): #4/0 (unless otherwise sized by the Electrical Engineer of Record)
   2. Telecommunication Bonding Backbone (TBB): #3/0 (unless otherwise sized by the Electrical Engineer of Record)
   3. Grounding Equalizer (GE): equal AWG as the TBB (unless otherwise sized by the Electrical Engineer of Record)
   4. Telecommunications Equipment Bonding Conductor (TEBC): #4
   5. Rack Bonding Conductor (RBC): #6

B. Grounding Connectors
   1. Connectors shall be a copper alloy material and two-hole, double-crimp compression lug type at the connecting ends.

C. Telecommunications Main Ground Busbar (TMGB)
   1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
   2. Sized for the immediate requirements and allow for 25% growth.
   3. The minimum dimensions shall be 0’-¼” thick X 0’-4” wide X 1’-8” long.
   4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
   5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.

D. Telecommunications Ground Busbar (TGB)
   1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
   2. Sized for the immediate requirements and allow for 25% growth.
   3. The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 0'-10" long.
   4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
   5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression type copper lugs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. Copper and copper alloy connections should be cleaned prior to connection.

3.3 INSTALLATION

A. Refer to Section 27 02 00.

B. The Contractor shall install the work in accordance with the specifications, drawings, manufacturer's instructions and approved submittal data.

C. All work shall be supervised and reviewed by the Contractor's on-site RCDD.

D. Installation plans and Requests For Information (RFIs) shall be reviewed by the Contractor's RCDD.

E. General
   1. Bonding and grounding procedures and components shall comply with ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications".
   2. Bonding should be accomplished such that the bonding system is integrated and compliant with NEC specifications.
   3. Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded.
   4. Bonding connections should be made by using compression copper lugs. However, for parts of the ground electrode system that are subject to corrosion, must carry high currents reliably, or for locations that require minimum maintenance, connections are made with low emission exothermic welding (see NEC Article 250).
   5. Make connections to dry surfaces only.
   6. Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection.
   7. Burnish clean a 0'-1" X 0'-1" area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt conductor and connector to burnished and compounded area. Ensure proper conductivity.
   8. Route bonding conductor(s) the shortest distance between bonding contact points.
   9. The ground-wire connecting ends shall have a minimum amount of insulation removed at the ground lug.
   10. Do not connect ground wire in power cable assemblies to the telecommunications ground system.
   11. All grounding and bonding conductors shall be copper and may be insulated. If bare-bonding conductors are used, isolate bonding conductors and prevent contact.
   12. Antioxidant material shall be installed to separate dissimilar metals and prevent corrosion.
   13. If multiple systems are involved (lightning protection systems, communications, radio and TV, CATV, etc.), those systems shall be bonded together to minimize potential differences between the systems, per NEC 250.94.

F. Telecommunication Bonding Conductors
   1. Each telecommunications grounding and bonding conductor shall be labeled at each end detailing the function and room number of its opposite end. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic and include the following text, “TELECOMMUNICATIONS GROUND - DO NOT REMOVE. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER”.
   2. Furnish and install all required bonding material, hardware, and utilize tools manufactured for this purpose.
   3. The connections of the BCT, TBB, GE, TEBC, and RBC shall be made using low emission exothermic welding or hydraulically crimped with a double crimp connector. Two-hole grounding lugs are preferred for connection to the grounding bus bars.
      a. All low emission exothermic welding shall be by Division 26.
      b. Coordinate with the building services personnel in occupied spaces to prevent the smoke from the exothermic weld process from potentially setting off smoke/fire alarms.
   4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in a ferrous metallic conduit that exceeds 1m (3ft) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6AWG conductor, minimum.
   5. The bonding conductors should be installed without splices.
      a. Where splices are necessary, the number of splices should be minimized, be accessible, and be located within the telecommunications spaces.
      b. Joined segments of a bonding conductor shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.

G. Equipment Cabinets and Racks
   1. The busbar shall be installed at the base and back of each cabinet/rack for floor fed cabinets/racks.
   2. The busbar shall be installed at the top and back of each cabinet/rack for top fed cabinets/racks.
   3. Each cabinet and rack shall be provided with a minimum # 6 AWG ground wire.
   4. Do not loop from cabinet/rack to cabinet/rack.
   5. Each cabinet or rack bay against the wall shall be bottom/side ground fed from the wall.
      a. Wall ground feeds/raceways to racks shall not be exposed on the walls.
      b. Exception: Some cabinet or rack bays will require the ground to be fed from the ceiling raceway.
   6. All ground raceways within each cabinet/rack or cabinet base and adjacent-ganged cabinet base shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.

H. Cable Runway, Cable Raceway and Support System Grounding
   1. The Contractor shall provide communications cable tray and cable runway systems with a communications dedicated ground from the TGB.
   2. All cable tray needs to be electrically continuous per NEC 250.96.
      a. Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current plausibly to be imposed on them.
      b. Any nonconductive paint, enamel, or similar coating shall be removed at the threads, contact points, and contact surfaces.
      c. Grounding or bonding conductors shall be connected by fittings designed for that purpose to ensure adequate bonding.
   3. The Contractor shall provide and install a #6 AWG ground wire to bond one end of each cable tray/runway system to the TGB.
   4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to the nearest TGB with grounding bushings or ground clamps.

I. Shielded Backbone Cabling

1. The Contractor shall terminate and bond the shield to the nearest TGB or TMGB at both ends, following manufacturer's guidelines.

3.4 FIELD QUALITY CONTROL

A. Testing
   1. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc.
   2. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
   3. If stray currents, shorts, etc., are detected, eliminate or correct as required.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Hangers and Supports, including open-top supports (cable hooks) for communications systems.
2. Conduits and Pull Boxes for communications systems.
3. Cable Tray and Cable Runway with associated accessories and fittings for communications systems.

B. Related Sections
1. Section 27 02 00 - Basic Materials and Methods for Communications Systems
2. Section 27 05 26 - Grounding and Bonding for Communications Systems
3. Section 27 11 00 - Communications Room Fittings
4. Section 27 15 00 - Communications Horizontal Cabling
5. Section 27 13 00 - Communications Backbone Cabling
6. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications referenced in Section 27 02 00 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer’s instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
1. Refer to Section 27 02 00.

D. Codes and Standards
1. Refer to Section 27 02 00.

1.3 SUBMITTALS

A. Refer to Section 27 02 00.

1.4 QUALITY ASSURANCE

A. Refer to Section 27 02 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 02 00.

B. Conduit Storage
1. Package conduits in bundles maximum 10’-0” long, with conduit and coupling thread protectors for indoor/outdoor storage.
2. Package fittings in manufacturer`s standard quantities and packaging suitable for indoor storage.
3. Protect coating on plastic-coated rigid conduit, fittings, and bodies from damage during shipment and storage.
4. Store conduit above ground on horizontal racks to prevent corrosion and entrance of debris.

5. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Protect plastic conduit and inner duct from sunlight. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Hooks
1. Cooper B-Line, Inc.
2. Erico
3. Caddy
4. Owner approved alternate

C. Basket Type Cable Tray (for use in work areas)
1. Cooper B-Line, Inc.
2. Chatsworth (CPI)
3. Owner approved alternate

D. Wire Basket Cable Tray Cutting Tool
1. Cooper B-Line, Inc.
2. Chatsworth (CPI)
3. Owner approved alternate

E. Polyethylene Cable Support System
1. Erico
2. Owner approved alternate

F. Innerduct
1. Carlon Riser Guard Flexible Raceway (corrugated innerduct)
2. Owner approved alternate

G. Measured pull tape (pull tape printed with sequential footage markings)
1. Fibertek
2. Condux International
3. Owner approved alternate

H. Labeling
1. Refer to Section 27 02 00.

I. Firestopping
1. Refer to Section 27 02 00.

2.2 CABLE HOOKS

A. Cable hooks shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

B. Features
1. Cable hooks shall have a flat bottom and provide a minimum of 0’-1.625” cable-bearing surface.
2. Cable hooks shall have 90° radius edges to prevent damage while installing cables.
3. Cable hooks shall be designed so that the mounting hardware is recessed to prevent cable damage.
4. Cable hooks for non-corrosive areas shall be pre-galvanized steel. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish.
5. Cable hooks for corrosive areas shall be stainless steel.

6. Cable hooks shall have a stainless steel cable latch retainer to provide containment of cables within the hook.
7. The retainer shall be removable and reusable.

C. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

D. Load cable hooks in accordance with manufacturer requirements and recommendations.

E. Provide capacity for 25% growth, add additional hooks as needed.

2.3 PULL BOXES, JUNCTION BOXES, AND GUTTERS

A. All junction boxes, gutters and pull boxes shall be UL listed and comply with NEC requirements.

B. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
1. 16-gauge steel or heavier
2. Seams shall be continuously welded and grounded smooth
3. External screws and clamps
4. External mounting feet (where applicable)
5. Oil-resistant gasket and adhesive
6. ANSI 61 gray polyester powder coating inside and out over phosphatized surface

C. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.

D. All junction boxes, gutters and pull boxes shall be securely installed.

2.4 CONDUITS

A. All conduits shall be UL listed and comply with NEC requirements.

B. Conduit Fittings
1. All fittings shall be compression or threaded.
2. Fittings shall provide a secure connection for pulling communications cables.
3. Setscrew fittings are not permitted.
4. Conduit “condulets” are not permitted.

C. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.

D. Innerduct:
1. All fiber shall be installed in innerduct unless fiber cabling is armored.
2. Shall be constructed of non-metallic material.

E. Only manufacturer’s fittings, transition adapters, terminators and fixed bends shall be used.

F. Measured Pull Tape
1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
2. Minimum average tensile strength shall be 1130 lbs. for 0’-1.5” and smaller conduits and innerduct.
3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0’-1.5”.

G. Fill and Bend Radius
1. Conduit fill shall comply with NEC requirements.
2. The minimum bend radius is 6 X the conduit inside diameter (ID) for 0’-2” conduit or less.
3. The minimum bend radius is 10 X the conduit ID for a conduit greater than 0’-2”.

4. There shall be no more than two 90° bends (180° total) between conduit pull boxes.
5. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
6. Do not use pull boxes for direction changes unless specifically designated otherwise in the drawings.
7. Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.

H. Routing
1. Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
2. There shall be no continuous conduit sections longer than 100'-0" for premises conduits. For runs that total more than 100'-0", insert junction or pull boxes so that no continuous run between pull boxes is greater than 100'-0".

I. Penetrations
1. All conduit penetrations shall comply with all applicable fire codes.
2. All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.

2.5 CABLE TRAY

A. Cable tray systems are defined to include, but are not limited to, straight sections of cable trays, bends, tees, elbows, reducers, crosses, wyes, vertical bends, up/down tees, cable support fittings, drop-outs, supports and accessories.

B. Install all tray types utilizing manufacturer recommended installation instructions and applicable standards.

C. Load cable tray and cable runway in accordance with manufacturer requirements and applicable standards.

D. Cable Tray Materials
1. Aluminum
2. Pre-galvanized Steel
3. Hot-dip Galvanized Steel
4. Stainless Steel
5. Yellow Zinc Dichromate
6. Pre-Galvanized Zinc
7. Electro-Galvanized Zinc

E. Cable Tray Systems
1. Wire basket (mesh) of types and sizes indicated on the drawings; with connector assemblies, clamp assemblies, connector plates, splice plates, cable drop outs, bonding accessories, and splice bars. Construct units with rounded edges and smooth surfaces.
2. Continuous mesh polyethylene cable-support system: with connector assemblies and appropriate support components. All parts shall be UL-listed. Plastic (non-metallic) parts shall have a zero detectable halogen content as substantiated by an independent test laboratory.
3. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 0`-9" on center. Spacing in radius fittings shall be 0'-9" as measured at the center of the tray`s width. Rungs shall have a minimum cable-bearing surface of 0'-.875" with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
4. Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails.
5. Solid bottom trough type trays shall consist of two longitudinal members welded to the side rails.

F. Cable trays shall have sufficient depth and width so as not to exceed a maximum 50% fill ratio, including 25% capacity for anticipated growth.

G. All straight sections shall be supplied in minimum 8'-0" lengths, except where shorter lengths are permitted to facilitate tray assembly lengths.

2.6 HANGERS AND SUPPORT

A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 lbs with a safety factor of 3.

B. Steel support brackets shall have a removable galvanized steel retaining strap.

C. Steel support brackets shall accept 0’-3/8” (10mm) threaded rod for attachment to building structure or sub structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. Verify system is properly sized for cables before installation.

C. Verify that the manufacturer recommended loads are not exceeded.

D. Verify general routing and coordinate locations with other trades before installation. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to ensure non-interference from other trade installations.

3.3 INSTALLATION

A. Refer to Section 27 02 00.

B. Cable Hooks
1. Provide cable hook (j-hook) cable support system for horizontal and/or riser cabling in accessible ceiling space. Assemblies shall be complete with mounting hardware.
2. Provide threaded rod for supporting hangers when hanging from floor deck and deck members.
3. Follow manufacturers fill capacities.
4. Locate cable hooks on 4’ to 5’ centers to adequately support and distribute the cable’s weight.
5. Suspended cables shall be installed with at least 0’-3” of clear vertical space above the ceiling tiles and support channels.
6. For larger quantities of cables, provide special supports that are specifically designed to support the required cable weight and volume.
7. Do not support pathways or cables with the ceiling suspension system or use electrical, plumbing, or other pipes for support.
8. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported.
9. Secure and support exposed horizontal cable at intervals not exceeding 5’-0” and not less than 1’-4” (16”) from cabinets, pack pole, boxes, fittings, outlets, racks, frames, and terminals.
10. Cable sag between vertical supports for horizontal pathway shall not exceed 0’-6”. Provide at least 0’-3” cable sag between supports.
11. Painted J-hooks shall meet or exceed NEC requirements for the environment in which the product is installed.

C. Conduit and Pull Boxes

1. The Contractor shall route the conduit in approximate locations unless drawing is dimensioned for precise placement.
2. Conduit cuts shall be square. Ream ends of burrs, and remove metal shavings and cutting lubricants before conduit is connected to the conduit system.
3. For conduit embedded in concrete, coat threaded connections in conduits with colloidal rust and corrosion inhibitor and sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured.
4. Cap unused conduits with watertight caps
5. Make conduit connections with appropriate fittings and tighten securely.
6. Use appropriate tools to install PVC coated conduit; avoid damage to exterior coating.
7. Install liquid-tight flexible metal conduit where exposed to weather, water, or other liquids.
8. Use IMC, PVC conduit, or rigid galvanized steel conduit in underground installations.
9. The Contractor shall provide fabric innerduct in all underground conduits, as indicated on the drawings.
    a. The Contractor shall use pre-lubricated, woven polyester, low friction, and high abrasion resistant fabric.
    b. The Contractor shall be trained for proper installation technique by the innerduct manufacturer. The Contractor shall coordinate with the owner to demonstrate that pull ropes in each inner duct cell move freely from end to end.

D. Cable Tray and Cable Runway
1. Cut wire basket tray members square with approved cable tray cutting tool as to not leave sharp edges at cut point. Remove burrs and smooth the ends before the cut is connected to wire-mesh tray system.

2. Ensure that standard splices are designed to have less than 1 milliohm (0.0001 Ω) of resistance between connections and provide bonding between sections. Painted wire mesh tray requires the outer mask of the non-conductive surface be removed at each end of the tray prior to installing the splice to provide continuity between painted tray sections.
3. Threaded rod (minimum 0'-½" diameter) or equivalent and slotted channel shall be used for hanging cable tray between floor deck and deck members

E. Fiber Support:
1. Support vertical fiber optic cable with basket weave wire/cable grips. Support fiber riser with single weave support grip with a single offset eye.
2. Mount/attach pulling eye to a wall or ceiling deck secured hook to support/provide strain relief to riser cable. Provide a minimum 3'-0" loop of fiber prior to entering fire stopped floor sleeve.
3. Where required coil up slack fiber cable into pull box and secure with single weave support grip.

F. Clearances
1. A minimum of 1'-0" access headroom shall be provided above a cable tray. Ensure that other building components do not restrict access to the cable trays from the sides.
2. Power outlets shall not be installed in or mounted to cable tray or cable runway.
3. Provide 3'-0" of unencumbered space for every 10'-0" segment of tray.
4. Cable tray clearances
    a. Motors or transformers: 4'-0"
    b. Power cables and conduit: 1'-0"
    c. Fluorescent lighting: 0'-5"
    d. Halide lights: 1'-0"
    e. Above the ceiling tiles: 0'-3"
    f. Access above and on one side of the cable tray: 1'-0"

3.4 FIELD QUALITY CONTROL

A. Test system to ensure electrical continuity of bonding and grounding connections.

B. Ensure compliance with specified maximum ground resistance.

C. Refer to NFPA 70B Chapter 18 for testing and test methods.

3.5 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

B. Wipe clean all cable trays and apply appropriate manufacturer’s paint to areas that have been scratched.

END OF SECTION

SECTION 27 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes underground communications duct banks, hand-holes and maintenance holes

B. Related Sections
1. Section 26 02 00 - Electrical (including related sub-sections)
2. Section 27 02 00 - Basic Materials and Methods for Communications Systems
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 05 28 - Pathways for Communications Systems
5. Section 27 11 00 - Communications Room Fittings
6. Section 27 13 00 - Communications Backbone Cabling

1.2 REFERENCES

A. Refer to section 27 02 00.

B. Conflicts
1. Refer to section 27 02 00.

C. Codes and Standards (Most recent editions or as required in contract)
1. National Electrical Manufacturers Association (NEMA)
   a. RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical metallic Tubing
   b. TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
   c. TC3 PVC Fittings for Use with Rigid PVC conduit and tubing
2. Underwriters Laboratories (UL)
   a. UL 651 - Schedule 40 and 80 Rigid PVC conduit
   b. UL 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit
3. ANSI/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces
4. ANSI/TIA-758-A Customer-owned Outside Plant Telecommunications Standard.
5. BICSI Telecommunications Distribution Methods Manual (TDMM)
6. Standard for Riser Application for Optical Fiber Raceway
7. BICSI Customer Owned Outside Plant (CO-OSP) Design Manual
8. Local, county, state and federal regulations and codes in effect as of date of installation
9. Equipment of foreign manufacture must meet U.S. codes and standards.
   a. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.
10. IEEE C2, National Electrical Safety Code (NESC).

D. Related Documents
1. Refer to section 27 02 00.

1.3 SUBMITTALS

A. Refer to section 27 02 00.

1.4 QUALITY ASSURANCE

A. Refer to section 27 02 00, and IEEE C2.

B. Follow Annex B of National Electrical Code (NEC)

C. Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped.
   1. Store nonmetallic ducts with supports to prevent bending, warping, and deforming

B. The contractor shall endeavor to make the site ready for installation of manholes when delivered so that they can be placed off of the truck into final position.
   1. When this is not possible, store precast concrete and other factory-fabricate underground utility structures as Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

D. Clearly mark containers "For Communications Duct Banks Only".

E. Refer also to section 27 02 00.

1.6 WARRANTY

A. Refer to IEEE C2.

B. Refer also to section 27 02 00.

1.7 MAINTENANCE

A. Refer to IEEE C2.

B. Refer also to section 27 02 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ducts
   1. Use owner approved solution

B. Hand Holes
   1. Christy Concrete Products
   2. Cretex Concrete Products West, Inc.; Riverton Division
   3. Oldcastle Precast Group
   4. Oldcastle Precast Inc/; Utility Vault Division
   5. Utility Concrete Products, LLC
   6. Owner Approved equivalent

C. Maintenance (Man) Holes
   1. Christy Concrete Products

2. Cretex Concrete Products West, Inc.; Riverton Division
3. Oldcastle Precast Group
4. Oldcastle Precast Inc/; Utility Vault Division
5. Utility Concrete Products, LLC
6. Owner Approved equivalent

2.2 MATERIALS

A. Continuous Tape for Underground Conduit
   1. The Contractor shall use orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), three inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 0’-1” high.

B. Labeling
   1. Refer to section 27 02 00.

C. Firestopping
   1. Refer to section 27 02 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Where necessary, Contractor shall provide all excavation, boring, trenching, backfill and restoration of grounds for all OSP pathways.
   1. In addition, Contractor shall include all labor, materials, and equipment.

B. The owner of the property has the option to obtain a testing laboratory to ensure proper soil compaction.

C. All work shall comply with all city, county and State Codes, NEC, EIA/TIA, OSHA, and BICSI TDMM requirements, codes and standards.

D. The above referenced codes and standards are to be considered as a minimum requirement.
   1. If the plans or specifications call for material and/or methods of construction higher than the standard, the plans or specification shall govern.

E. All holes, trenches and/or any other excavation shall be covered, fenced, and/or taped off to make the area safe at all times.
   1. Conform to general Contractor requirements.

F. The Contractor will visit the job site prior to submitting a proposal to determine existing conditions.
   1. Contractor shall evaluate the site for materials, and any other information that may affect the work to be performed.

G. The Contractor shall locate and protect all existing conduits.
   1. Should damage occur notify the appropriate utility.
   2. Damage costs are the responsibility of the Contractor.

H. The Contractor shall CALL BEFORE YOU DIG, One Call Directory Telephone Numbers (Texas: 1-800-245-4545, 1-800-344-8377) to locate any existing conduits (Power, Gas, Telephone, and other utilities) prior to start of work.

I. Any proposed re-routing of all trenches/pole lines shall be reviewed and approved by the owner/consultant.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. The Contractor shall verify materials are on-site in proper condition and of sufficient quantity.

C. The Contractor shall verify proper excavation depth (minimum 4’-0” below finished grade), width, route and support of work.
   1. Verify proper location of hand-holes and maintenance holes (minimum every 350’-0”).
   2. Communications facilities must be placed in separate hand-holes and maintenance holes from electrical facilities.

D. Trenches greater than or equal to 5’-0” deep shall:
   1. Be shored to prevent cave-in.
   2. Have 2’-0” clearance from the dirt pile.

E. Directional boring is a suitable option when trenching is impractical or impossible.
   1. Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages.
   2. Although directional boring machines are manufactured with electrical strike sensing capabilities, which can warn the operator of any contact with a high voltage source, accidents may still occur.
   3. Operators of directional boring machines require special protection due to the potential for exposure to high voltage.
      a. Therefore, operators must always have a ground mat grid underfoot as insulation protection.
      b. In addition, operators must wear insulating boots and gloves, along with hard hats and safety glasses.

F. Minimum separation between electrical and communications underground cable (measured from conduit sidewall:
   1. Concrete: 0’-3”
   2. Masonry: 0’-4”
   3. Well-tamped earth: 1’-0”

G. Before encasement, the Contractor shall:
   1. Prove and verify all ducts are free of debris and properly installed in support and spacer system.
   2. Verify the system is properly fitted together and hold-down hardware is properly installed.
   3. Verify ducts are capped at both ends

3.3 INSTALLATION

A. Refer to section 27 02 00.

B. Hand Holes
   1. Unless otherwise shown, Hand-holes shall be at least 4’-0” X 4’-0” and shall be constructed of 0’-2” thick cement covered with 0’-3/8” steel plate.
   2. The hand-hole or maintenance hole shall rest on a 0’-4” blanket of sand, and 0’-4” around the sidewalls shall be filled with sand.
   3. Each hand-hole or maintenance hole which contains a pedestal shall have four bollards installed 1’-6” (18”) diagonally from each corner, with a cross member welded at 2’-6” (30”) connecting the four corners.
      a. These barriers will be constructed of 0’-4” ridged conduit filled with concrete, driven 4’-0” in the ground and extending 3’-0” above the protective cover.
   4. All Hand-holes shall have a hasp and locking plate installed so they can be locked with padlock.

C. Maintenance (Man) Holes
   1. Precast concrete maintenance hole components shall be in accordance with ASTM C478/C478M.

2. Maintenance hole components shall be designed for H-20 highway wheel loading and specific site conditions.
3. Maintenance hole bases may be either precast or cast-in-place, as appropriate for the application, with a formed recess shaped to match the first precast shaft section.
   a. The maintenance hole base shall extend 0'-10" below the bottom of the lowest pipe and 0'-6" above the top of the largest pipe.
4. Maintenance hole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.
5. Precast maintenance holes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C923/C923M.
   a. Connections to existing maintenance holes shall utilize a boot-type connector per ASTM C923/C923M installed in a cored opening.
   b. Cast-in-place bases shall incorporate a ring-type seal on the pipe to be imbedded in the concrete.

D. Concrete and Reinforcing Steel for Encasement
   1. Furnish products following Division 03, except strengths as follows:
      a. Compressive Strength: 2,500 psi at 28 days, class A
      b. Flexural Strength: 500 psi at 28 days
      c. Dye concrete encasement "orange" to identify communications conduit

E. The Contractor shall install conduit in excavations following drawings.
   1. If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).

F. The Contractor shall install watertight penetrations through foundation, hand-hole and maintenance-hole walls.
   1. Wherever a hand-hole is used to simply pass through, the conduit entrances and exits will be situated at opposite ends of the hand-hole instead of 90° angles.

G. The Contractor shall assemble duct banks with non-magnetic saddles, spacers and separators.
   1. Position separators for 0'-2" minimum concrete separation between outer surfaces of adjacent ducts, and:
      a. Make uniform required bends with a minimum 2'-0" radius for conduits less than 0'-3" diameter, and a minimum 4'-0" radius for conduits 0'-3" and larger.
      b. Maintain vertical or horizontal separations of 1'-0" of well-packed topsoil from any electrical service conduit run parallel to communications conduits.

H. Install concrete encasement fully surrounding reinforcing steel and ducts

I. Unless otherwise noted on the drawings, reinforce with longitudinal #5 steel bars placed at each corner and along each face at maximum parallel spacing of 1'-0" on center, and #5 tie-bars transversely placed at 1'-0" on center maximum longitudinal.
   1. Maintain maximum clearance of 0'-2" from bars to edge of forms and ducts.

J. For duct banks that are being installed for future use, extend rebar well past end of concrete for future tie-in to future concrete pour to ensure that both sections are firmly tied together to prevent slippage between the two pours.

K. Add orange colorants at mixing site at the rate of 10 lbs per cubic yard for voice and data cable.

L. Place concrete with minimum 0'-2" cover surrounding ducts and reinforcement.

M. Maintain ducts in proper place during concrete placement.

N. For duct banks that are being installed for future use, all conduits shall be extended minimum of 1’-0” past the end of the concrete and capped.

O. Transition from nonmetallic to metallic conduit where duct banks enter structures or turn upward for continuation above grade
   1. Where ducts enter structures such as hand-holes, maintenance holes, pull boxes, or buildings, terminate ducts in proper end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits.
   2. Ducts shall be sealed to prevent water and debris from entering the building.

P. Extend below grade conduits to 0’-4” above the finished floor inside a building.
   1. Cover or temporarily seal open conduit ends to prevent water and other foreign matter from entering conduit.

Q. Tag conduits entering pull boxes with stamped stainless steel tags following cable and conduit schedule.

R. Backfill after concrete cures 24 hours.

S. The Contractor shall pull a 1’-0” long mandrel (0’-¼” smaller than duct diameter) through ducts.
   1. Pull a rag swab or sponge through to remove debris, until it shows clean.

T. Where fiber optic cables will be used and/or where indicated in the drawings, innerduct shall be provided.

U. The Contractor shall provide a metered pull tape in all underground conduits and innerduct:
   1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
   2. Minimum average tensile strength shall be 1,130 lbs for 0’-1.5” and smaller conduits and innerduct.
   3. Minimum average tensile strength shall be 1,800 lbs for conduits larger than 0’-1.5”.

3.4 CLEANING

A. Refer to section 27 02 00.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes basic communications and equipment room design requirements and fittings including:
   1. Equipment cabinets, racks, frames and enclosures
   2. Cable management and ladder racks
   3. Telecommunications service entrance pathways
   4. Rack mounted power protection and power strips

B. Related Sections
   1. Section 27 02 00 - Basic Materials and Methods for Communications Systems
   2. Section 27 05 26 - Grounding and Bonding for Communications Systems
   3. Section 27 05 28 - Pathways for Communications Systems
   4. Section 27 15 00 - Communications Horizontal Cabling
   5. Section 27 13 00 - Communications Backbone Cabling
   6. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated

C. Conflicts
   1. Refer to section 27 02 00.

D. Codes and Standards (Most recent editions or as required in contract)
   1. Refer to section 27 02 00.

1.3 COMMUNICATIONS ROOMS

A. Communications rooms must be dedicated to designated equipment and services:
   1. Space shall not be used for storage of equipment not related to designated equipment and services.
   2. Hazardous or corrosive materials shall not be stored in the space.
   3. Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.
      a. Foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases shall not be installed or pass through communication rooms.
      b. With the exception of fire sprinklers, all water pipes shall be routed around communications room.

B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.

C. Walls shall be covered with 0'-3/4" X 4'-0" X 8'-0" AC-grade plywood backboard 1'-0" AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment.

1. Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 0'-1", are spaced not greater than 1'-6" (18") apart in each stud, and with screws 0'-0" from the top and bottom of plywood.
2. Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint.
3. If applicable fire-treatment verification stamps on plywood shall be left unpainted to be readable.

D. Communications room walls shall extend from floor slab to ceiling deck, with no drop ceilings installed.

E. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.

F. Cable ladder rack should be used to distribute cables within rooms, complete with cable bend limiters (drop outs).

G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.

H. Communications rooms shall have only one lockable entrance door, a minimum of 3'-0" wide and 7'-0" high, that opens towards the outside of the room, and does not open into another room.
1. Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.
2. Doors should have no windows or door seals.
3. Communications rooms should have no exterior identifying markings.

I. Mechanical
1. Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.
2. Provide ventilation in the communications rooms to dissipate heat generated by active devices.
3. Temperature and Humidity requirements:
   a. Maintain communication rooms at an average of 60°F to 70°F, with a relative non-condensing humidity of 30% to 50%.
   b. The temperature range should be maintained within ± 9°

J. Plumbing
1. If "wet" fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.
2. Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.
3. Drainage troughs are also recommended for leakage protection.

K. Electrical
1. One manufacturer's product is recommended for each type of installation. The mixing of different manufacturer products for one item is not acceptable.
2. No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.
3. The Contractor shall install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.
4. The Contractor shall provide uniform illumination of at least 50 foot-candles (fc) 3'-0" AFF for communications rooms located a minimum of 8'-6" AFF.
   a. Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 1'-7" (19") standing racks.
   b. Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks
1. 1'-7" (19") X 7'-0" relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.

a. The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.
b. Racks with active electronics shall have rack mounted power strips.

1.4 SUBMITTALS

A. Refer to section 27 02 00.

1.5 QUALITY ASSURANCE

A. Refer to section 27 02 00.

B. Product Standards
1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to section 27 02 00.

B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.7 PROJECT/SITE CONDITIONS

A. Refer to section 27 02 00.

1.8 WARRANTY

A. Refer to section 27 02 00.

B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer's warranty process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Press box Network Enclosure
1. Hubbell RE4 ReBox Remote enclosure
2. Owner approved alternate

B. Labeling
1. Refer to section 27 02 00.

C. Firestopping
1. Refer to section 27 02 00.

2.2 ACCESSORIES

A. Rack-mounted Uninterruptible Power Supply (OFOI)
1. APC SMT3000RM2UC.

B. Rack-mounted Power Strips (OFOI)
   1. Chatsworth P-11D0A5 120V 20A One Per enclosure

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to section 27 02 00.

B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 INSTALLATION

A. Refer to section 27 02 00.

3.4 FIELD QUALITY CONTROL

A. Refer to section 27 02 00.

3.5 CLEANING

A. Refer to section 27 02 00.

3.6 ACCEPTANCE

A. Refer to section 27 02 00.

END OF SECTION

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the backbone cabling portion of a structured cabling system including:
   1. Copper backbone cabling
   2. Fiber backbone cabling
   3. Splicing
   4. Termination and patch cables

B. Provide all backbone cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in Telecommunications rooms.

C. Provide a New Indoor/outdoor rated 12-Strand fiber from nearest IDF room to New Pressbox network enclosure.

D. Related Sections
   1. Section 26 02 00 - Electrical (including related sub-sections)
   2. Section 27 02 00 - Basic Materials and Methods for Communications Systems
   3. Section 27 05 26 - Grounding and Bonding for Communications Systems
   4. Section 27 05 28 - Pathways for Communications Systems
   5. Section 27 05 43 - Underground Ducts and Raceways for Communications Systems
   6. Section 27 11 00 - Communications Room Fittings
   7. Section 27 15 00 - Communications Horizontal Cabling

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Refer to section 27 02 00.

D. Codes and Standards (Most recent editions or as required in contract)
   1. ANSI/TIA-568-C: Commercial Building Telecommunications Wiring Standard
   2. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
   3. ANSI/TIA-606-A: Administration Standard for Commercial Telecommunications Infrastructure
   4. ANSI/NECA/BICSI-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
   5. TIA/EIA-758-A: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
   6. National Electrical Code (NEC), based upon year approval by local codes or AHJ
   7. BICSI Telecommunications Distribution Methods Manual (TDMM)
   8. Local, county, state and federal regulations and codes in effect as of date of purchase
   9. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.3 SUBMITTALS

A. Refer to section 27 02 00.

B. Cable Pulling Plan
   1. The contractor shall submit a cable pulling plan prior to installation.
   2. Submittal requirements:
      a. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
      b. Indicate contents of each conduit.
      c. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
      d. Include detail and schedule showing the construction sequence of communications rooms.
      e. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the engineer.

C. Splice Plan
   1. The contractor shall submit shop drawings indicating the intended cable splice points, mounting method and equipment list prior to installation

D. Cable Testing Plan
   1. Refer to Section 27 02 00.

E. Cable Testing Reports
   1. Refer to Section 27 02 00.

1.4 QUALITY ASSURANCE

A. Refer to section 27 02 00.

B. Cable splicing personnel shall have a minimum of five years splicing experience and shall have completed a minimum of five major splicing projects.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to section 27 02 00.

B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

C. Fiber cables shall be shipped on reels in lengths as specified with a minimum overage of 10%:
   1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
   2. Two meters of cable at both ends of the cable shall be accessible for testing.
      a. All fiber shall be tested on the reel for continuity and distance compliance before installation.
   3. Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture.
      a. Labels shall be water resistant and the writing on the labels shall be indelible.

1.6 PROJECT/SITE CONDITIONS

A. Refer to section 27 02 00.

1.7 WARRANTY

A. Refer to section 27 02 00.

1.8 MAINTENANCE AND SUPPORT

A. Refer to section 27 02 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE COPPER CABLE MANUFACTURERS

2.2 ACCEPTABLE FIBER CABLE MANUFACTURERS

A. OSP (Outside Plant) (indoor/outdoor OS2 Singlemode)
   1. CommScope # 760037192 P-012-OD-8W-FSUBK
   2. Owner approved alternate

2.3 ACCEPTABLE COMPONENT MANUFACTURERS

A. Fiber Connectors (LC)
   1. CommScope
   2. Owner approved alternate

B. Fiber Duplex Patch Cables (Type SM and MM)
   1. CommScope
   2. Owner approved alternate

C. Fiber adapter panels (6-port)
   1. CommScope
   2. Owner approved alternate

D. Fiber Termination Shelf (Rack-Mounted)
   1. Berk-tek
   2. CommScope
   3. Owner approved alternate

E. Fiber Distribution Cabinet (Wall Mounted)
   1. CommScope
   2. Owner approved alternate

F. Building Entrance Terminals - 110in/110out - complete with 5 pin fast acting solid state protection modules for all terminated cable pairs.
   1. Circa
   2. Portasystems
   3. Emerson
   4. Owner approved alternate

G. Wall and/or Rack-mounted 110 Terminations Blocks .
   1. Panduit
   2. Leviton
   3. Ortronics
   4. Owner approved alternate

H. Labeling
   1. Refer to section 27 02 00.

I. Firestopping
   1. Refer to section 27 02 00.

2.4 FIBER BACKBONE CABLING

A. Fiber General Requirements

1. Fiber shall be certified to meet all parts of TIA-455 and comply with TIA-492, ANSI/ICEA S-83-596 and ANSI/ICEA S-83-640 and the NEC.
2. Fibers shall have D-LUX coating or approved equivalent to ensure color retention, minimize micro bending losses and improve handling. The coating shall be mechanically strippable.
3. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP (optical fiber non-conductive plenum) in accordance with the NEC.
    a. Plenum Fiber rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket.
        1) Each group of fibers shall have a color-coded Low Smoke PVC buffer.
        2) The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded low smoke tube.
    b. Within the premises, all fiber shall be placed in plenum rated innerduct the entire length of the cable for protection. Use manufacturer plenum rated couplings for all connections.
4. Riser cable shall meet UL 1666 and be marked OFNR (optical fiber nonconductive riser) in accordance with the NEC.
    a. Non-plenum, riser rated cable consisting of multiple fibers, shall have an orange, Polyvinyl Chloride (PVC) outer jacket.
5. OSP (Outside Plant) Fiber
    a. Stranded loose tube dielectric fiber cable shall be utilized for underground conduit, direct buried, or aerial applications.
    b. Underground cable, including cable installed in conduits or duct banks, shall contain an additional moisture barrier in the form of a flooding compound.
    c. All OSP fiber strength members shall be dielectric without any metallic elements.
6. Fiber conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the following color codes:
    a. Fiber/Binder No. 1 - blue
    b. Fiber/Binder No. 2 - orange
    c. Fiber/Binder No. 3 - green
    d. Fiber/Binder No. 4 - brown
    e. Fiber/Binder No. 5 - slate
    f. Fiber/Binder No. 6 - white
    g. Fiber/Binder No. 7 - red
    h. Fiber/Binder No. 8 - black
    i. Fiber/Binder No. 9 - yellow
    j. Fiber/Binder No. 10 - violet
    k. Fiber/Binder No. 11 - rose
    l. Fiber/Binder No. 12 - aqua
7. Cable Minimum Bending Radius:
    a. During Installation: 20X cable diameter
    b. After Installation: 10X cable diameter
8. Operating temperature range: -76°F to 185°F (-60°C to 85°C)

B. Multi-mode Fiber Requirements
1. Fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.
2. 50/125 µm ± 2.5 µm core (OM 4)
3. Core non-circularity: = 5%
4. 125 µm ± 1 µm cladding diameter
5. Cladding non-circularity: =1%
6. Colored fiber diameter: 254 µm ± 7 µm
7. Buffering diameter: 890 mm ± 50 mm
8. Minimum tensile strength: 100,000 psi
9. Maximum Attenuation: 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm
10. Minimum Bandwidth: 2000 MHz per km with laser launch at 850 nm ensured by differential mode delay at 850 nm" in TIA-492AAAC and 500 MHz at 1300 nm.
11. Additional component and transmission requirements for a 50/125 µm fiber cable capable of supporting 10 Gb/s serial transmission up to 984'-0" (300m) using 850 nm nominal wavelength lasers. These cables are suitable for use in accordance with ANSI/TIA-568-B.1.

C. Single Mode Fiber Requirements
1. Fibers shall have dual wavelength capability, transmitting at 1310 and 1550 nm ranges.

2. 8.3 µm core
3. 125 µm ± 1 µm cladding diameter
4. Cladding non-circularity: = 1%
5. Core/cladding concentricity error: = .5 µm
6. Colored fiber diameter: 254 µm ± 7 µm
7. Maximum Attenuation: 1.0 dB/km at 1310 and 1550 nm (inside premises) and 0.5 dB/km at 1310 and 1550 nm (OSP)
8. Minimum Bandwidth: 20 GHz
9. The mechanical and environmental specifications for OSP fiber cable shall be in accordance with ANSI/ICEA S-87-640. OSP fiber cables shall be of a water-block construction and meet the requirements for compound flow and water penetration as established by ANSI/ICEA S-87-640. Outdoor cable shall have minimum pull strength of 2670 N (600 lbf).

2.5 COPPER BACKBONE CABLING

A. Copper Cable Requirements
   1. 100 Ω balanced twisted-pair
   2. Plenum-rated cabling: Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked CMP (communications multipurpose plenum) in accordance with the NEC.
      a. Plenum cable shall consist of #24-AWG solid copper conductors insulated with color-coded FEP
   3. Non-plenum riser-rated cabling shall meet UL 1666 and be marked CMR (communications multipurpose riser) in accordance with the NEC, and shall consist of 24 AWG copper conductors insulated with color-coded PVC copper cables.
   4. ASP-filled multi-pair copper cables shall be utilized for underground conduit or direct buried applications.
      a. All OSP copper cable shall be transitioned to inside cable within 50’-0” of building entry.
      b. The metallic portion of the cables, if present, must be bonded to the building ground upon entry.
   5. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

B. Coaxial Cable Requirements
   1. All cable must be plenum-rated 0.500 hard line or RG-11
   2. All cable shall be shielded, with a copper clad aluminum center conductor; expandable polyethylene dielectric; continuous aluminum outer conductor, and a flame retardant jacket.
   3. All cable shall be tested and marked to comply with the NEC requirements for (CATVR) riser rating.

2.6 COPPER PATCH CABLES

A. Refer to Section 27 15 00.

2.7 FIBER PATCH CABLES

A. Verify exact quantities and lengths with Owner prior to purchase

B. Provide the appropriately-rated (matched to the installed cable plant) Modular Patch Cords for the appropriate location and equipment.

C. Multi-mode patch cables shall be a buffered, graded-index fiber with a 50 µm core and a 125 micron cladding

D. Single Mode patch cables shall be a stepped-index 8.3 µm core with a 125 µm cladding.

E. Duplex SC connectors shall meet the following specifications:
   1. Made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.
   2. Patch cords shall be in original packaging when presented to the Owner.

F. Aramid yarn and a jacket of flame-retardant PVC shall cover the fiber cladding.

G. Multi-mode patch cables additional requirements:
   1. Mated Connector Loss: μ = 0.3 dB, σ = 0.2 dB
   2. Connection Repeatability: 0.20 dB maximum changes per 100 reconnects

H. Single Mode patch cable additional requirements:
   1. Return Loss: -50 dB maximum
   2. Mated Connector Loss: μ = 0.35 dB, σ = 0.2 dB
   3. Connection Repeatability: 0.20 dB maximum changes per 200 re-connects.

I. The Multi-mode connector (visible portion) and adapter/outlet shall be identified by the color beige.

J. The Single Mode connector (visible portion) and adapter/outlet shall be identified by the color blue.

2.8 LABELING

A. Refer to Section 27 15 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

B. Verify the following before proceeding:
   1. Conduits, cable trays and pull boxes are properly installed following section 270528
   2. Backboards in communications rooms are properly installed following section 271100
   3. Grounding system is properly installed and tested following section 270526
   4. Liquid-carrying pipes are not installed in or above voice and data system communications rooms.
      a. Do not proceed with installation in affected areas until removed.

3.2 PREPARATION

A. Refer to section 27 02 00.

3.3 COPPER INSTALLATION

A. Backbone Cable
   1. The Contractor shall install riser cables according to manufacturer’s instructions for compliance to warranty requirements.

B. OSP Cable
   1. The Contractor shall verify pulling material (pull rope, mule tape, etc.) average breaking strength based on cable type and size, pulling distance and pathway, and other pertinent factors.

C. Copper Cable and Connectors
   1. The Contractor shall install connectors according to manufacturer’s instructions for compliance to warranty requirements.

3.4 TERMINATION FOR COPPER BACKBONE

A. Copper
   1. 110-type Wiring Blocks using C5 clips, Insulation Displacement Connector Systems, with proper patch cord
      a. Compatible with all voice and data circuits
      b. Underwriter`s Laboratories (UL) listed
   2. Protector Panels shall be provided for all outside plant installed copper circuits. The protectors shall provide pair-for-pair protection and be mounted on a 0’-3/4” fire-rated wallboard.

3.5 FIBER INSTALLATION

A. Fiber Cable Installation
   1. Fiber cable shall be installed in innerduct from near end termination point to far end termination point.
      a. Only UL-approved plenum-rated innerduct shall be installed in all plenum areas.
      b. Metallic conduit may be used in lieu of innerduct in plenum-rated ceilings if it is bonded and grounded correctly.
   2. Only technicians certified by the product manufacturer shall perform terminations.
      a. Terminations shall be made in a controlled environment.
      b. Cables may be assembled off-site, although testing must be completed with the cable in its final installed condition.
      c. Test optical fiber on the reel for distance and continuity verification before installation.
   3. At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags.
      a. These tags shall be yellow or orange in color, and shall contain the warning "CAUTION FIBER OPTIC CABLE".
      b. The text shall be permanent, black, block characters, and at least 0’-.1875” high.
      c. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5’-0”.
      d. Any section of exposed cable that is less than 5’-0” in length shall have at least one warning tag affixed to it.

B. Fiber Distribution Center
   1. Contractor shall provide sufficient spare adapter plates to fill the appropriate-sized FDC.

3.6 FIBER TERMINATION AND SPLICING

A. Interconnect Units and Distribution Shelves
   1. Modular in design and used in fiber interconnection, cross-connection, and splicing applications
   2. 1’-7” (19”) rack-mountable
   3. Accept 12-strand, 24-strand, 48-strand or 72-strand terminations
   4. Owner approved industry standard connector

B. Splicing and closures
   1. Fiber splice modules shall be utilized for all OSP terminations.
   2. The link shall consist of:
      a. Fiber cable
      b. Splice
      c. Splice tray holder/closure
      d. Fiber panel/coupler
      e. Pre-manufactured fiber pigtail with pre-polished fiber connector
      f. Fiber jumper to connect the pigtail-coupled link to the appropriate electronic switch

C. Fiber Fusion Splice
   1. Fusion splices shall be mounted in protective trays within the closure.
   2. Fusion splices shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/TIA-455-34, Method a (factory testing) or ANSI/TIA-455-59 (field testing).
      a. Fiber splices shall have a minimum return loss of 20 dB for Multi-mode
      b. Fiber splices shall have a minimum return loss of 26 dB for Single Mode
         1) Minimum Single Mode return loss for broadband analog video (CATV) applications is 55 dB.

3.7 INSTALLATION REQUIREMENTS

A. All installation shall be done in conformance with ANSI/TIA-568-B standards, BICSI methods, and industry standard installation guidelines.
   1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.

2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

B. The Contractor shall provide service loops for cables terminating in the communications rooms.
1. A 10'-0" service loop shall be provided and secured in a neat and standards-compliant manner above the equipment racks or cable trays unless specified otherwise.
2. This allows for future changes or expansion without installing new cables.

C. Documentation
1. All cable inventory data documentation shall be submitted in format coordinated with and approved by owner so that data can be incorporated into existing databases.
2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.

3.8 FIELD QUALITY CONTROL

A. Refer to section 27 02 00.

3.9 COPPER POST-INSTALLATION TESTING

A. Contractor shall test each pair or strand of every cable prior to acceptance.

B. Refer to Sections 27 02 00 and 27 15 00.

C. Copper Test Documentation
1. Refer to Section 27 15 00.

D. Copper testing requirements
1. Refer to Section 27 15 00.
2. Copper backbone shall exceed ANSI/TIA-568-B.2 Backbone Cabling requirements and meet the manufacturer's specifications for the installed product.
3. OSP cabling test equipment shall be capable of making frequency sweeps at an impedance of 135 Ω at the following frequencies (kHz): 20, 30, 50, 69, 90, 110, 138, 276, 400, 600, 800, 1000, and 1100.
   a. A far-end device shall be used for all frequency measurements.
   b. The loss at 138 kHz shall not exceed 46 dB.
   c. The test set shall have the ability to store 100 tests and be able to upload to a PC.
   d. The test set shall be able to measure resistance between the following conductors: tip to ring, tip to ground, and ring to ground.
   e. All measurements shall be greater than 999 Ω.

E. Copper Test Equipment
1. Refer to Section 27 02 00.

3.10 FIBER POST-INSTALLATION TESTING

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete and proper test measurements of the installed fiber cabling.

B. Contractor shall have successfully attended a fiber testing training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof.

C. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing.

1. Any testing performed on incomplete systems shall be redone on completion of the work.

D. Dust caps shall be placed on fiber endfaces or adapters for each optical fiber link after all testing is complete on the fiber link.

E. Pre-test Submittals
   1. Manufacturers catalog sheets and specifications for the fiber cable field-test instruments including
      a. OLTS (Optical Loss Test Set)
      b. OTDR (Optical Time Domain Reflectometer)
      c. End-face inspection capture device
   2. A schedule (list) of all fiber cables to be tested
   3. Fiber testing training program certificate
   4. Sample test reports

F. Fiber testing standards
   1. The Contractor shall meet or exceed the following standards and guidelines:
      a. ANSI/TIA-568-C.0 Optical Fiber Transmission/Test Requirements, and Annex E: Optical Fiber Field Test Guidelines (Tier 2)
         1) Tier 2 testing is a higher level of testing that provides qualitative measures of the installed condition and performance of the cabling system
      b. ANSI/TIA-568-B.3 Optical Fiber Cabling Components Standard
      c. TIA/TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
   2. Multi-mode requirements
      a. ANSI/TIA-526-14-A, Method B
      b. ANSI/TIA-455-50B
   3. Single Mode requirements
      a. ANSI/TIA-526-7, Method A.1: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7
   4. The cable installers shall have a copy of these references in their possession and be familiar with the contents

G. In order to conform to the overall project event schedule, the contractor shall survey and coordinate the optical fiber testing with other applicable trades.

H. In addition to the test regiment detailed in this document, the contractor shall notify the Owner of any additional tests that are deemed necessary to guarantee a fully functional system.
   1. The contractor shall carry out and record any additional measurement results at no additional charge.

I. The contractor shall provide all test measurement results two (2) weeks prior to substantial completion in spreadsheet format and native file format from the test instrument.
   1. Software shall also be provided to view the native results.

J. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
   1. A visible fault locator (VFL) normally uses a Class 2 or 3 light source and should not be directly viewed.
   2. Safe usage of the tool requires indirect viewing of the light source by pointing the end of the fiber at an adjacent surface (or introducing another surface in front of a fixed mounted connector) until the presence of light is determined.

K. Link attenuation measurement and allowance calculation
   1. The measured link attenuation shall be less than the link attenuation allowance. The link attenuation allowance is calculated as:
      a. Link Attenuation Allowance (dB) = Cable Attenuation Allowance (dB) + Connector Insertion Loss Allowance (dB) + Splice Insertion Loss Allowance (dB)
         1) Connector Insertion Loss Allowance (dB) = Number of Connector Pairs X 0.4dB
         2) Splice Insertion Loss Allowance (dB) = Number of Splices X 0.15dB

3) Cable Attenuation Allowance (dB) = Maximum Cable Attenuation Coefficient (dB/km) X Length (km)

L. Fiber Testing Requirements
1. All installed fiber links shall be field-tested and pass the following tests:
   a. OLTS (Optical Loss Test Set) length and dual wavelength attenuation
   b. OTDR (Optical Time Domain Reflectometer) traces and event tables
   c. Image captures of connector end-faces
2. OLTS (Optical Loss Test Set)
   a. The length and attenuation of each installed fiber link shall be measured and documented.
   b. System loss measurements requirements:
      1) 850 and 1300 nanometers for Multi-mode
      2) 1310 and 1550 nanometers for Single Mode
   c. Reflective events (connections) shall not exceed 0.75 dB.
   d. Non-reflective events (splices) shall not exceed 0.3 dB.
   e. The acceptable link attenuation for Multi-mode horizontal fiber is based on the maximum distance of 295'-0".
   f. A horizontal link in a network with a consolidation point may be tested using a fixed upper limit for attenuation of 2.75 dB.
   g. Optical sources shall be turned on for a minimum of 5 minutes prior to referencing.
   h. Fiber links shall be measured and reported for attenuation in each direction and attenuation bi-directionally (averaged in both directions)
   i. Polarity shall be verified for duplex connector systems
   j. Mandrels
      1) Mandrels shall be used when testing attenuation of Multi-mode fiber cabling
      2) Where mandrels are used, secure the mandrel to the light source by some means such as a cable tie or tape.
      3) Care should be taken to ensure that the fiber jacket is not deformed or damaged when using a cable tie or tape.
      4) The light source shall be referenced to the meter a minimum of twice daily (i.e., in the morning and noon).
3. OTDR (Optical Time Domain Reflectometer)
   a. An OTDR trace shall be taken of each fiber link in one direction to ensure uniformity of cable attenuation and connector insertion loss
   b. Testing shall consist of a bi-directional end to end OTDR trace performed per TIA 455-61
   c. Individual connector, splice and fiber insertion loss shall be evaluated using the OTDR trace.
   d. Fibers shall be inspected at 250X for Multi-mode and 400X for Single Mode
4. End-face Image Capture
   a. An image of each fiber optic connector end-face shall be taken, recorded and provided as part of the records.
5. Maximum Attenuation
   a. Single Mode ISP (inside) 1.0 dB/km at 1310 nm and 1550 nm
   b. Single Mode OSP (outside) 0.5 dB/km at 1310 nm and 1550 nm
   c. Multi-mode 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm
6. Test Cords (Jumpers)
   a. Testing of the cabling shall be performed using high-quality test cords of the same fiber type and core size as the cabling under test. Use a single patch cord reference for fiber testing.
      1) OLTS test cords shall be between 3'-3" (1m) and 16'-4" (5m).
      2) OTDR testing shall be approximately 328'-0" (100m) for the launch cable and at least 82'-0" (25m) for the receive cable. . OTDR testing shall be Bidirectional with Pigtails installed.
   b. The test jumper, the adapters, and fiber under test shall be cleaned immediately prior to each fiber being tested.
      1) After cleaning, cleaning solutions shall be given sufficient time to evaporate (approximately 30 seconds) prior to the mating of fiber test jumper to the fiber under test.
7. Test Failure
   a. Any fiber link that fails these requirements shall be diagnosed and corrected.
   b. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link meets performance requirements
8. Acceptable Testers

a. Fluke DTX CableAnalyzer
b. Owner Approved equivalent

M. The Owner or the Owner's representative shall be invited to witness, review or both witness and review field-testing.
1. The Owner or the Owner's representative shall be notified of the testing start date, five (5) business days before testing commences.
2. The Owner or the Owner's representative will select a random sample of 5% of the installed links and test that sample.
a. The measured results obtained from the random sample shall be compared to the data provided by the contractor.
b. If more than 2% of the sample results differ in terms of the pass/fail determination, the contractor under supervision of the Owner or Owner's representative shall repeat 100% of the testing at no cost to the Owner.

N. Test Results
1. The detailed test results documentation data is to be provided in an electronic database for each tested fiber strand and shall contain the following information:
a. Identification of the customer site as specified by the end-user
b. Name of the test limit selected to execute the stored test results
c. Name of the personnel performing the test
d. Date and time the test results were saved
e. The manufacturer, model and serial number of the test instrument.
f. The version of the test software and the version of the test limit database held within the test instrument.
g. Fiber identification number
h. Length for each optical fiber
i. Index of refraction used for length calculation when using a length capable OLTS.
j. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
k. Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
l. Length for each optical fiber as calculated by the OTDR
m. Overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements
n. Circuit IDs reported by the test instrument should match the specified label ID

3.11 CLEANING

A. Refer to section 27 02 00.

3.12 ACCEPTANCE

A. Refer to Section 27 15 00.

END OF SECTION

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section of the horizontal cabling portion of a structured cabling system includes:
   1. UTP Copper cabling
   2. Termination and patch cables
   3. PoE Injectors and PoE Surge Protectors

B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.

C. Related Sections
   1. Section 27 02 00 - Basic Materials and Methods for Communications Systems
   2. Section 27 05 26 - Grounding and Bonding for Communications Systems
   3. Section 27 05 28 - Pathways for Communications Systems
   4. Section 27 11 00 - Communications Room Fittings

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Refer to section 27 02 00.

D. Codes and Standards
   1. Refer to section 27 02 00.

1.3 SUBMITTALS

A. Refer to sections 27 02 00 and 27 13 00.

1.4 QUALITY ASSURANCE

A. Refer to section 27 02 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to sections 27 02 00 and 27 13 00.

B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.6 PROJECT/SITE CONDITIONS

A. Refer to section 27 02 00.

1.7 WARRANTY

A. Refer to section 27 02 00.

1.8 MAINTENANCE AND SUPPORT

A. Refer to section 27 13 00

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Labeling
   1. Refer to section 27 02 00.

B. Firestopping
   1. Refer to section 27 02 00.

2.2 ACCEPTABLE COPPER MANUFACTURERS

A. UTP Plenum Rated Cable Cat6 and Cat6A
   1. Commscope
      a. Cat 6 Blue (Data/Voice) - Commscope Part # CS37P BLU
      b. Cat 6 Green (IP Cameras) - Commscope Part# CS37P GRN
      c. Cat 6 Violet (Access Control) - Commscope Part # CS37P VLT
      d. Cat 6A Yellow (Access Points) - Commscope Part# CS44P-YEL
   2. Owner approved alternates

B. Indoor/Outdoor Category 6 and Cat 6A U/UTP, Plenum, Outdoor Rated (OSP). Only for locations run underslab , to exterior , or to other wet enviroments.
   1. Commscope Cat 6 Indoor/Outdoor Part # CS34P-IO
   2. Commscope Cat 6A Indoor/Outdoor Part # CS44P-IO
   3. Or owner approved equivalents

C. Cat 6 and Cat6A Outlet Components Cat6
   1. Commscope
      a. Data - Commscope SL Series Part# 760237628 USL 600 - Blue. Blue in Color for all data drops in the project.
      b. Voice - Commscope SL Series Part# 760237629 USL 600-A.WHT. White in color for all voice drops in the entire project.
      c. IP Cameras - Commscope SL Series Part# 760237630 USL 600-GRN - Green in color for all IP camera drops in the entire project.
      d. Access Control System - Commscope SL Series Part# 760237637 USL 600-VIO. Violet in color for all drops to Access control system.
      e. Access Points - Commscope SL Series Part# 760241143 USL10G- YEL. Yellow in color for all Access Point drops in the entire project.
   2. Owner approved alternates

D. Patch Panels (24 or 48 port) Cat6 and Cat 6A
   1. Commscope Category 6 24-Port Part # 760180042- UNP-6-DM-1U-24
   2. Commscope Category 6 48-Port Part # 760180059- UNP-6-DM-2U-48
   3. Commscope Category 6A 24-Port Part # 760162800 | UNP-6A-DM-1U-24
   4. Commscope Category 6A 48-Port Part # 760162818 | UNP-6A-DM-2U-48
   5. Contactor shall provide cable support bars at back of all patch panels to provide additional support.
   6. Owner approved alternate

E. Copper Patch Cords Cat6 and Cat 6A - Pre-assembled

1. Commscope
2. Owner approved alternate

F. Faceplate for wall-mount telephones
1. Semtron Part #1FM-0E-AMP-PHONE
2. Owner approved alternate

2.3 ACCESSORIES

A. Security Camera and Exterior Access Point POE Injectors
1. Contractor shall provide Procet Gigabit PoE injector Model No. PT-PSE109GBRO-AH for Exterior Multi Sensor cameras (TYPE 6).
2. Contractor shall provide Microsemi POE Injector Model No. PD-9501GR/AC-US for exterior access point locations shown.
3. PoE injectors are to be installed in MDF/IDF serving the device. Contractor shall install PoE injector in rack mounted shelf. Label each device with device ID.

B. PoE Device Surge Protector
1. Provide Ditek DTK-MRJPOE Power over Ethernet Surge Protector for all exterior cameras and access points.
2. Surge protector modules are to be grounded to building steel where possible. If grounding to building steel is not possible contractor must homerun ground to telecom grounding system.

C. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner.

D. Provide clear plastic lamination serving each communication room.

E. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.4 HORIZONTAL COPPER CABLING

A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:
1. Category 6 UTP cable
2. Catergory 6A UTP Cable

B. Category 6 UTP Cable Requirements
1. 23/24 AWG solid bare copper.
2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum).
3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.
4. Cables shall be marked as UL verified with a minimum of Category 6 rating.
5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz) of analog broadband video.
6. The maximum horizontal cable tested length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295’-0”. It’s contractor’s responsibility to reroute as necessary to bring all cable runs within distance limit without additional cost to the project. Plan ahead and get approval or exception from Owner before pulling the cables that would ne over the distance limit.

7. Cable shall meet or exceed the following electrical characteristics:
8. Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications.

2.5 TERMINATION HARDWARE

A. Patch panels
   1. Patch panels shall be rated to match installed cable plant
   2. The wiring block shall accommodate #23 AWG cable conductors.
   3. All modular cross connect panels shall be UL-listed.

B. Work Area Outlet Cat6 and Cat 6A
   1. Universal eight-position jack pin/pair assignments
   2. Jack Color:
      a. Data: Blue
      b. Voice:White
      c. IP Cameras : Green
      d. Access Control : Violet
      e. Access Points: Yellow
      f. or approved alternates

C. Work Area Outlet Faceplates:
   1. 4-Port Single Gang Stainless Steel Semtron Part # 1FM-(4)0E-AMP-LAB
   2. Or owner approved alternate

2.6 PATCH CABLES

A. Workstation Patch Cables:
   1. Contractor shall provide (1) 10' Category 6 Patch cable for each data drop in the entire project and (1) 10' Category 6A patch cable for each Access Point drop, in the entire project.Contractor shall provide (1) Category 6 Outdoor rated (OSP) Patch cable of required length to each exterior IP camera in the project. Patch cables are to be color coded.All patch cables are to be pre-assembled by the manufactue
      a. Data Drops: Commscope Uniprise Part # UC1BBB2-0ZF010- Blue in Color
      b. Voice Drops: Commscope Uniprise Part # UC1BBB2-08F010- White in Color
      c. IP Camera Drops: Commscope Uniprise Part # UC1BBB2-0MF010 -Green in Color
      d. Access Control System: Commscope Uniprise Part # UC1BBB2-0LF010 - Violet in Color
      e. Access Points -Commscope Uniprise Part # UC1AAA2-09F010- Yellow in Color
      f. Exterior IP Cameras - Commscope Part # CO15542 - CO15542-01F0** - OSP Black in Color .(**) Shall be replaced with numeric value representing the required length. Contractor shall field verify required length.

B. Network Rack Patch Cables (MDF/IDF):
   1. Contractor shall provide (1) 6' Category 6 patch cable for each data drop in the project. Provide (1) 6' Category 6A for each Access Point drop in the entire project. All patch cables are to be pre-assembled by the manufactuer. Provide patch cords to owner representative. TBISD is to patch into Network Equipment.
      a. Data Drops: Commscope Uniprise Part # UC1BBB2-0ZF016- Blue in Color
      b. Voice Drops: Commscope Uniprise Part # UC1BBB2-08F006- White in Color
      c. IP Camera Drops: Commscope Uniprise Part # UC1BBB2-0MF006- Green in Color
      d. Access Control System Drops: Commscope Uniprise Part # UC1BBB2-0LF006- Violet in Color
      e. Access Point Drops - Commscope Uniprise Part # UC1AAA2 -09F006- Yellow in Color
   2. Contractor shall verify exact quantities and lengths with Owner prior to purchase
   3. Coordinate with Owner on the active equipment layout prior to purchase to ensure correct sizing of patch cords from patch panels to switching equipment.
   4. Place each size/length patch cord in a separate container, and mark the containers that hold the patch cords with the length of patch cords contained within.

5. All cords shall conform to the requirements of ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program.
6. Cords shall be equipped with an eight-pin modular connector on each end, wired straight through and shall be of appropriate length for application.
7. All rated patch cords shall be round, and consist of #23 AWG copper, stranded conductors, tightly twisted into individual pairs.
8. Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.

2.7 IDENTIFICATION (LABELING) SYSTEM

A. Refer to sections 27 02 00 and 27 13 00.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 PREPARATION

A. Refer to section 27 02 00.

B. The Contractor shall check pathways, raceways, and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation prior to installation.

3.3 INSTALLATION REQUIREMENTS

A. Refer to section 27 02 00.

B. All installation shall be done in conformance with ANSI/TIA-568-C standards, BICSI methods, industry standards and manufacturer`s installation guidelines.
   1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.
   2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
   3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.
   1. Pull cables in smooth and regular motions using methods that prevent cable kinking.
   2. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
   3. If necessary, use approved cable pulling lubricant
   4. Use fish tape, cable, rope, basket weave wire/cable grips, and other tools that will ensure no damage to the media or raceway.
   5. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.
   6. Do not bend cable greater than a bend radius of 0’-1”.

D. Provide a 10’-0” service loop at the communications room and shall provide a 3’-0” service loop above the access ceiling or cable trays unless specified otherwise.
   1. All service loops shall be a minimum of 1’-6” (18”) in diameter and be accessible for maintenance.
   2. Provide all camera and access pont field location with minimum 10' service loop.

E. Coordinate loop placement and orientation with the technology consultant.
   1. This allows for future changes or expansion without installing new cables.

F. Install cables in continuous “home run” lengths from work station outlet to specified patch panel.
   1. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the workstation outlet without written Owner permission.

G. All cable must be handled with care during installation so as not to change performance specifications.
   1. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable.
   2. There shall never be more than 0’-1/2” of unsheathed cable at either the wiring closet or the workstation termination locations.

H. All cabling and associated hardware shall be placed so as to make efficient use of available space.
   1. All cabling and associated hardware shall be placed so as not to impair equipment`s efficient use of their full capacity.

3.4 CABLING METHODS

A. The Contractor shall provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system.
   1. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used.
   2. Use UL or ETL listed plenum rated cable in all spaces.
   3. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.

B. Conceal raceway and cabling except in unfinished spaces as is practical.

C. Exposed Cable
   1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.
   2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist.
      a. Owner must approve all exceptions.

D. The Contractor shall utilize conduits/cable tray as indicated on the drawings.

E. All cabling placed above drop ceilings must be supported by cable tray, J-hooks, caddy bags or conduit.
   1. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported.
      a. Attaching cable to pipes or other mechanical items is not permitted.
      b. Cabling shall not be attached to ceiling grid wires.
   2. Multiple cables are to be dressed every 5’-0” to 7’-0”.
      a. Maximum cable sag between cable hooks is 3”-6”.

F. The Contractor shall route data and voice cables separately in a neat and orderly fashion.
   1. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Cable ties shall be rated for the environment.

G. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes.

H. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks’ contacts.
   1. Envelope will be removed on final trim out after other trades have completed their finish work.
   2. It shall be the Contractor’s responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.

a. Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are on the floor.
b. Cable pulling force shall not exceed 25 lbs of pulling tension or cable manufacturer's recommended pulling tensions.
c. Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.

I. Communications room cables shall be combed and dressed in a manner as to prevent twists, "braiding" and crossed cables in the cable bundle from the communication room entrance to the termination point at the rear of the patch panel.
1. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.
a. Use Velcro wraps instead of cables ties for all bundling in the communications rooms.
b. Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the communications room.

3.5 CABLING SEPARATION

A. Comply with TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

B. Maintain a minimum spacing of 1'-6" (18") from electrical feeders and/or branch circuit wiring including, but not limited to, light fixtures, sources of heat and EMI sources.

C. Maintain a minimum spacing of 1'-0" from auxiliary systems cabling.

D. Maintain a 1'-0" separation where cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems.
1. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

E. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10'-0" is recommended.

3.6 CABLING TERMINATION

A. Terminate cables in consistent consecutive order.

B. Terminate cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.

C. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

D. Provide a 10'-0" service loop for horizontal cables at each rack in communications rooms.
1. Locate loop at ceiling deck or on bottom of cable runway in minimum 1'-6" (18") diameter.

E. Provide a 3' service loop for horizontal cables at work area outlets. Locate service loop above or below data/voice outlet were vertical cable run transitions to horizontal run.

F. Maintain twists in cable pairs to within 0'-1/2" of termination.

G. Building Systems Cabling (BAS, FA, elevator line, etc)
1. Coordinate exact placement and connectivity requirements with applicable trade prior to installation.
2. Group all building systems cables in one group.

3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.

H. Limit cable-bending radius to 20X the cable diameter during installation, and 15X the cable diameter after installation.

I. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.
   1. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

3.7 TERMINATION HARDWARE

A. Station Hardware
   1. Flush mount jacks shall be mounted in a faceplate with back box.
   2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
   3. 8P8C Jack Pin Assignments for work area outlets shall match the T-568B wiring scheme.

B. Patch panels
   1. Copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels.
   2. All Modular jack panels shall match the T-568B wiring scheme.

C. Work Area Outlet
   1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA-568-C compliant for the specified transmission requirements

D. Work Area Outlet Faceplates:
   1. Furnish and install blank plates in all unused ports.

3.8 SPECIAL CIRCUITS

A. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits, including cables to wireless access point locations, security, elevators, fire alarms, etc.

B. Wireless Access Points
   1. Install two (2) cable(s) from dedicated wireless patch panel(s) in communications room to outlets having 8P8C connectors within a BISCUIT box.
   2. Enclosures shall be NEMA rated for the environment to which they are exposed.
   3. 30’-0” of cable slack shall be coiled and hung on a “J”-hook at the enclosure location.

3.9 IDENTIFICATION AND LABELING

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

B. Labelling scheme shall meet Owner’s IT cabling standard and industry standards and best practices. Submit labelling scheme for approval before work to start.

C. Fiber termination hardware (designation strip) shall have a 0’-3/4” x 0’-1/4” thermal transfer printable label with a permanent acrylic adhesive

D. All labels shall be permanent and shall not fade, peel, or deteriorate due to environment or time.

E. The Contractor shall provide a copy of the finalized plan in writing to the Owner representative and DBR for review and authorization to proceed.

1. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.

F. Labeling requirements:
   1. Label cable terminations on designation strips
   2. Label all cable at each terminating point.
   3. Label each port of the work area outlet.
   4. Cable identification numbers shall not be duplicated.
   5. Label patch panels in the communications rooms to match those on the corresponding voice and data outlets.
      a. The font shall be at least 0'-1/8" in height.
   6. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate labeling of grid with Owner and Architect prior to application of labels.
   7. Label each distribution rack, block and other terminating equipment unit and field within that unit within 0'-4" from the block or patch panel termination. Keep labels in a neat and orderly lineup.
   8. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms.
      a. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
   9. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

G. Location and termination field description
   1. Room location
   2. Rack-mount or Wall mount
   3. Termination field type
      a. Specific patch panel ports versus a separate dedicated patch panel

H. Unique identifiers
   1. Segregation and position on equipment rack
   2. Port color-coding
   3. Unique labeling

I. Documentation
   1. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
      a. All labels shall correspond to as-built drawings and to final test reports.
   2. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.
   3. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
   4. Complete cross connect documentation is required.

3.10 FIELD QUALITY CONTROL

A. Refer to section 27 02 00.

3.11 POST-INSTALLATION TESTING

A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)

B. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

C. Standards Compliance and Test Requirements:
   1. Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.

D. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.
   1. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.
   2. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.
   3. Length, propagation delay, and delay skew relative to the relevant limit.
      a. Length, propagation delay, and delay skew shall be tested relative to the relevant limit.
      b. Test shall also include mutual capacitance and characteristic impedance.
         1) Any individual test that fails the relevant performance specification shall be marked as a ‘FAIL”.

E. Cable Test Documentation:
   1. Cable test documentation shall be submitted in hard copy and electronic formats.
      a. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results.
      b. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report.
      c. Certificate shall reference traceable circuit numbers that match the electronic record.
   2. Each test record shall contain the cable ID as follows:
      a. “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.
   3. Test results saved within the field-test instrument shall be transferred into an accessible database utility that allows for the maintenance, inspection and archiving of the test records.
      a. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”.
      b. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
   4. Test reports shall include the following information for each cabling element:
      a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
      b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
      c. Cable manufacturer, cable model number/type, and NVP
      d. Tester make & model, serial number, hardware version, and software version.
      e. Cable ID and project name
      f. Auto-test specification used
      g. Overall pass/fail indication
      h. Date of test

F. Cable Test Equipment
   1. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
   2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
   3. Testing equipment shall be UL-verified to meet Level III accuracy.
      a. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
   4. Testing equipment shall be within the calibration period recommended by the manufacturer.
   5. Testing equipment shall have the latest software and firmware installed.
   6. Testing equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.
   7. Test adapter cables shall be approved by the manufacturer of the test equipment.
      a. Adapter cables from other sources are not acceptable.
      b. Adapter cables must be replaced after 1000 tests to ensure accuracy.
   8. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
   9. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

10. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
11. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
12. Test equipment must include a library of cable types, sorted by major manufacturer.
13. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
    a. Test equipment must store at least 1000 auto tests in internal memory.
14. Test equipment must include DSP technology for support of advanced measurements.
15. Test equipment must make swept frequency measurements in compliance with TIA standards.
16. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector.
17. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
18. Acceptable testers:
    a. Fluke DTX CableAnalyzer
    b. Owner approved equivalent

3.12 CLEANING

A. Refer to section 27 02 00.

3.13 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable.
    1. These circuits must be repaired to meet "PASS".

END OF SECTION

SECTION 27 41 00

INTERCOMMUNICATIONS SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete school communications system.
   1. A complete system includes items such as wiring, speakers, handsets, control consoles, and main distribution equipment.
   2. Integrate all components to provide a complete and functioning system.
   3. Provide all components required to enable district wide notifications

B. Pressbox intercommunication system is to be an extension of the existing Schools Dukane CH1000 life safety communications platform. Contractor is to provide all cabling hardware and accessories required for the integration. Pressbox shall be programmed as an independent zone and added to page all protocol.

C. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the Owner.

D. Integrate the communications system with the following systems:
   1. Bell System.
   2. Telephone System.
   3. Access control system lock down sequence.
   4. Fire alarm system.

E. Return air plenum cable may be used as an option at the contractor's discretion. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.

1.2 QUALITY ASSURANCE

A. Provide the system by a company that has been designing and supplying similar systems for a period of 3 years. Provide, upon request by Owner or Architect/Engineer names and addresses of similar installations.

B. Provide central processing control console wiring connections by factory engineers or authorized factory trained personnel.

C. Installing contractor shall have qualified staff members present on campus on first day of school to ensure all systems are fully operational.

1.3 WARRANTY

A. Warranty equipment for a period of 1 year, from date of substantial completion.

B. Correct defects in material or workmanship with a minimum loss of operating time at no cost to Owner.

C. On site service.

1.4 SUBMITTAL

A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
   1. Control panel wiring and interconnection schematics.

2. Complete point-to-point wiring diagrams
3. Riser diagrams.
4. Complete floor plan drawings locating all system devices.Shop drawing submittals shall include wiring pathways including wire types, counts, and required conduit pathways. Shop drawings must be newly prepared by the installing contractor. Submitting marked up copy of engineering drawings shall not be accepted.
5. Factory data sheets on each piece of equipment proposed.
6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
7. Complete system bill of material.
8. Line by line specification review stating compliance or deviation.

B. All submittal data will be in bound form with contractor's name, supplier's name, and project name adequately identified.

C. Minimum size drawings: 11" x 17".

1.5 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the communication system with all other trades.

B. Coordinate locations of wall mounted (recessed) speakers with architectural prior to begining work.

1.6 REFERENCES

A. National Electrical Code.

B. UL

C. Communication systems connected to a telephone utility company shall comply with the Federal Communications Commission rules Section 68 and the corresponding UL listing.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carehawk Safety Communication System CH-1000 (No Substitution)

B. Atlas/Soundolier – Speakers and Attenuators (or approved equivalents)

C. Quam- Speakers and Attenuators (or approved equivalents)

2.2 CENTRAL CONTROL EQUIPMENT

A. The central equipment shall be mounted in a 19" equipment rack . Installed in buildings MDF room. Exact location to be coordinated with the owner before beginning work, The central equipment shall consist of but not be limited to:
1. The equipment housing.
2. A power supply to provide operating DC power for the circuitry contained within the central equipment housing and all administrative control stations (ACSs) shall be provided.
3. A central microprocessor unit containing all solid-state memory and components necessary to provide the features specified herein.
4. Zone circuit boards as required to meet the system requirements for remote stations and/or communications linkage.
5. The provision for terminating the cabling from up to 8 remote stations and 4 administrative control stations (ACSs) shall be provided.

6. The provisions to automatically activate a selectable program source between class changes.

2.3 EXTERNAL PAGING AMPLIFIER

A. External paging amplifiers shall be provided as required to meet the load requirements of the system when activated in the all-page mode. The system shall be equipped with equipment required for (one) program channel.

B. Program/paging amplifiers shall have the following:
1. Power output shall be capable of providing sufficient power for the speakers required to the project and include an additional 25% capacity.
2. Maximum .5% harmonic distortion from 20-20KHz.
3. Frequency response of 20Hz to 20KHz +/-1 dB.
4. 90 dB signal to noise ratio at 20Hz to 20 KHz.
5. 1V RMS input sensitivity at 1 KHz.
6. Master volume control.

2.4 PROGRAM SOURCES (PSE) EXISTING

2.5 EMERGENCY TONE GENERATOR

A. Provide tone generator kit. It shall incorporate a multi-tone generator with priority relay to override any paging or program function of the system.

B. The tone generator shall be activated for an external contact closure provided by the fire alarm or emergency push button.

2.6 EQUIPMENT RACK

A. Expansions modules required shall be housed in Audio Video system rack in press box

B. Telephone Type 66 blocks shall be mounted inside lockable, hinged panel with 3/4" painted plywood backboard where required.

C. The program sources shall be remotely located from the control equipment. The rack shall be a matte black finish, tabletop rack located as directed by the Owner/Architect.

2.7 SPEAKERS

A. Ceiling speakers:
1. General Purpose Speaker: 8" speaker with 5 oz. magnet complete with line matching transformer. Program rating shall be 5 watts continuous. The speaker shall be a Quam System 12. 25/70V transformers shall have primary taps of 0.25, 0.5, 1, 2 and 5 watts. Tap speaker at 0.25 watt. White finish unless indicated otherwise.
2. Indoor wall mounted speakers Quam C5/BU/SW or approved equivalent. Provide recessed mount ES8 and all required accessories or approved equivalent at each location.
3. Classroom, office, conference, telephone, teacher lounge, workroom speakers: 8 ohm speaker with 5 oz. magnet, complete with line matching transformer. Program rating shall be 4 watts continuous. The speaker shall be a Quam System 12/VC, with integral volume control. 25/70V transformers shall have primary taps of 0.25, 0.5,1, 2, 5 watts; tap speaker at 0.5 watt.

B. Wall mounted volume control: Soundolier AT-1O-PA or Quam QC-10P qual recessed autotransformer volume control. Volume control shall have public address (PA) emergency override of volume control.

C. Interior/Exterior Wall- Recessed Vandal- Resistant Paging Horn:

1. Provide square recessed backbox, with acoustic foam lining and conduit stub-up to nearby cabling pathway above accessible ceiling or bottom of structure. Coordinate backbox depths with other trades.
2. Provide 16 W compression-type re-entrant horn loudspeaker with vandal-resistant square stainless steel baffle and integral transformer. Baffel finish to be White unless noted otherwise.
3. Basis-of-design product: Subject to requirements, provide ATLAS APF-15T or comparable products by manufacturers listed below.

D. Exterior Canopy Surface Mounted Vandal-Resistant Speaker:
1. Provide square surface-mount backbox with conduit connections and matching square vandal-resistant baffle with security torx fasteners. Finish color to be White unless noted otherwise.
2. Provide 8" diameter moisture-resistant loudspeaker with 5w integral transformer.
3. Basis-of-design product: Subject to requirements provide ATLAS APF-15T or comparable products by manufacturers listed below.

E. Surface mount speaker/horn: Soundolier AP-15TC or Quam H16 surface mount wide-angle loudspeaker with multitap line matching transformer with armored cable adaptor

F. Remote Source Output Volue Control: Rack mounted in remote source rack. Provide line level volume control of output of eat remote source device. Label each volume control for each output device.

2.8 ADMINISTRATIVE CONTROL STATION (ACS)

A. Administrative phones shall be installed in all locations indicated on the drawings. The administrative phone shall be wired with a single Cat 6 cable and be hot swappable. The administrative phone must have alphanumerical display built in. Administrative phones with optional mounted displays are not acceptable. The system must be able to have a capacity of 32 total administrative phones as a minimum. You must be able to be able to perform programming of the system from the administrative phone without a computer when required.

B. The administrative control station (ACS) shall be the control center for communications, paging, and signaling functions for the system. The ACS shall contain control panel with buttons for functional control and user programming.
1. For voice paging, the ACS shall be equipped with a handset, keypad, speaker, microphone, and a TALK button.
2. It shall be possible to manually activate and sound the time event signal to any of the 8 time zones from the ACS.
3. The ACS shall be equipped with a built-in tone generator, which provides for both time signal tone and user accessible tones (single chime, repetitive chime, steady tone, hi-lo, alarm, wail, and warble) for use as manually activated emergency or other signals.
4. All ACSs shall have a dedicated control labeled "ALL PAGE". The operation of this control shall gather all speakers for distribution of tone signaling distress or emergency signals, and emergency voice announcements. This control shall be defeatable as to restrict access into the all-page function only to assigned ACSs.
5. A designated ACS within the system shall have the ability to enter the user accessible functions for data input and programming. A "Security Code" number shall be required to enter this programming mode.
6. Desk mounted handset: (switch Hook): Staff telephone station.

2.9 PROGRAMMING COMPUTER

A. Provide compatible Windows based software and IBM (PC) compatible computer and monitor for programming when such methods are the only ones available for programming the system.

2.10 CO TELEPHONE/PBX INTERFACE

A. Contractor must provide system interface and connection to the Owner's telephone system (Provided by Owner). Provide all equipment and cabling necessary to connect and integrate system to the phone system.

B. Each trunk shall be programmable as either incoming, or outgoing, or both.

C. For incoming trunks, system shall be able to direct calls to a user-defined attendant telephone or provide dial tone. For outgoing trunks, system shall provide access to the trunk by dialing 8, 9, or both. If digit 9 is used to access an outgoing trunk, the system shall be able to automatically dial a second 9.

D. Each trunk shall be loop start.

E. CO telephone/pbx interface for remote paging from an outside telephone / pbx extension .Intercom contractor must coordinate telephone interface with Owner's telephone system vendor/installer

PART 3 - EXECUTION

3.1 PAGING SYSTEM DESCRIPTION

A. The paging system shall consist of a central equipment cabinet, microprocessor control unit, power supply, zone modules, administrative control stations (ACSs), amplifiers, and station loudspeaker assemblies. Provide all associated material hardware, wiring, and options as described herein to provide a complete working system, which shall meet the specified requirements.

B. The Public Address System shall consist of the Central Control Unit, Administrative Consoles, PC-Based Graphic User-Interface (GUI) with visual representation of the school, separate web-based programming editor, rack equipment and all other necessary devices that are required to create a complete and operational system such as Speakers, Horns, Amplifiers, and Visual Message Devices, etc. All Public Address main equipment including card cages and all cards, power amplifiers, program sources, etc., shall be rack mounted in the MDF room. All system programming of Public Address and Master Clock features shall be accomplished by an Administrative Console (located as shown in drawings) area or over the LAN/WAN or internet by a browser-based software programming tool. The browser-based programming tool shall be separate from graphical user interface and shall not be accepted as a substitution of graphical user interface. It shall not be necessary to attend to the main equipment in the Headend for normal day-to-day operation of the system.

C. The system shall be a 25-Volt two-way paging system providing paging zones as indicated and determined by the Owner. The system shall be of modular design utilizing plug-in circuit cards to enable quick on-site replacement or addition of components for system expansion and modification. The system headend equipment shall be rack-mounted in the MDF where shown on the drawings with side panels and stationary platform base. Provide shelves, doors, blank panels, AC power distribution, etc. as required to support all equipment and fill empty rack space. System shall be comprised of all solid-state electronics, utilizing a microprocessor- based central processor unit, power supplies, audio interface cards, control cards, input/output cards, telephone interface cards, transformers, paging amplifiers, etc., as required for a complete system, to include equipment and installation to interface with the Owner's VoIP telephone system. The interface must comply with loop-start central office (CO) trunk standards in North America as defined by Bellcore and/or industry-standard 2500 analog station ports.

D. The system must include a Graphical User Interface (GUI) software application that allows for the operation of the System from a Windows®-based PC. Provide networked PC, (coordinate location with Owner), keyboard, mouse, and 21" LCD Monitor. PC shall exceed manufacturer recommended specifications. This software package shall utilize an easy-to-use graphical user interface (GUI), quick graphical access to paging, and program distribution. The software shall also allow easy activation of class change schedules. Emergency operations shall be simplified through this software application by allowing stored audio files and alphanumeric messages for message displays to be activated from the GUI. The GUI shall allow common

operations such as daily announcements to become automated (removed), removing multi-step console set ups. (removed) The means for originating voice communications to selected locations must be separate from GUI application and must be provided through the system Administrative Console, Telephone Handset or Microphone. The software must allow the creation of a Custom Operating Screen(s) based on the floor plans of the school facilities. Icons representing Intercom Stations, and Paging, Monitoring and Audio Program Zones shall be incorporated onto the floor plans. The Software GUI shall provide:

1. Simple Routine Call Processing
2. Emergency Functions
3. Paging
4. Audio Program Distribution
5. Enabling and Disabling of Schedules and Bell Scheduling
6. Customizable Page Elements
7. Customizable Operating Screen
8. Element Library for Emergency Event Icons

E. The GUI must provide an efficient and reliable method of notifying the occupants of a facility of critical situations. A variety of emergency tone signals that reside within the Intercom/Paging System shall be activated by clicking on pre-programmed buttons on the PC GUI screen, initiating the transmission of tone signals to speakers, and alphanumeric messages to Message Displays/Digital Clocks. A 'lockdown' icon shall be designed as per Owner direction, with owner selecting the appropriate tone.

F. The system shall provide a server for network connectivity from authorized PC's to remotely control or program the CH1000 systems. The server shall provide remote system diagnostics and access to activity log files on the CH1000 system. It also provides support for the GUI program and integrates the functionality of an AP1-B Administrative Consoles into the framework of a PC. Audio files that are used for daily as well as emergency announcements and music files can be stored in the server for retrieval by the GUI interface and Assistant . WAV and MP3 files can be stored on the server and called up with assistant for play on any event programmed from the bell schedules and played in the appropriate time zones throughout the school. The server also provides for the synchronization of the CH1000 to a master time keeping source. This can be a time source within the facility or an external time server via the Internet.

G. Connection to a local building digital PBX or VoIP telephone system (phone system by Owner), allowing any telephone handset that is part of the telephone system to page and conduct hands-free, open-voice communication with any speaker in the system; the Control Console; GUI or any other classroom telephone. The Connection to the local phone system shall not diminish or restrict any of the capabilities of local telephone system. Public Address System interfaces shall allow any programmed telephone to perform but not be limited to the following intercommunication system functions: all-call; zone call; intercom call to classroom speakers, distribute class change signals, etc.

H. Distribution of general announcements over School loudspeakers using a microphone, Control Console, GUI, or telephone handset, on an All-Call basis, pre-selected zone basis, or multiple-zone basis to any paging zone. Speaker assignments to any zones shall be programmable from the Web Editor.

I. Selection and monitoring of individual program sources (Microphone, AM/FM Tuner, Tape or CD) and distribution by the Control Console.

J. Control Console programming of administrative microphone for control and distribution of public announcements, to eliminate the need to go to the central electronics for microphone set up. Keying the microphone shall automatically mute all other audio programs at a lower priority in the system, including Local Audio Systems (emergency pages only). Microphone shall transmit to all rooms or specific speaker zones as programmed in the system software.Coordinate exact programing with owner.

K. The capability of multiple open-voice intercom paths. Intercom paths shall be global.

L. Automatic gain-control of intercom speech to assure constant speech level.

M. A minimum of two channels for intercom communications or audio program distribution. The System shall be user-programmable to allocate, upon demand, either of the two channels for intercom or audio program.

N. The ability to monitor the school building either on or off the premises from a single telephone.

O. Audio program distribution to eight different areas of the building selected by the Control Console and Assistant . Inputs shall be provided for five (5) low-impedance microphones, tuner, tape player and auxiliary source. Program material shall include audio programs from standard AM/FM tuner, Media player, or auxiliary source. Control Console and Visual Console shall have the ability to monitor program sources being distributed. Coordinate location of antenna(e) with architect. Locate and install for optimal performance.

P. Audio Source equipment shall have the ability to be located remotely from the main system control electronics, and shall have the ability to distribute two channels of audio simultaneously if so desired. School shall be equipped with (1) rack-mounted AM/FM tuner, (1) rack-mounted Media player.

Q. The system shall provide the facilities for the paging or sounding emergency signals or time event signals to selected groups or all remote speakers.

R. The system shall provide facilities for the control and distribution of the program channel to individual zones, selected zone groups, or all zones, as well as paging communications and class change signals.

S. The system shall include the facilities of a built-in master clock and programmer capable of correcting appropriate secondary clock displays and controlling events based on user programmed time schedule programs.

T. Provide remote control of program distribution. Distribution of the program source shall be possible from any administrative control station (ACS).

U. Zone system as follows:
1. All instructional areas shall be a zone.
2. All speakers in corridors shall be zone area designation.
3. All outside horns shall be one zone.
4. Cafeteria(s), Auditorium(s), Multipurpose Area(s), and Assembly Areas(s) shall each be a zone.

V. Provide Principal's microphone as directed by Owner / Architect.

W. Zone system as follows:
1. All speakers in corridors shall be zone area designation. (ie. All speakers in the 100 series roos, all speakers in corridors in the 200 series rooms, etc., etc.)
2. Restrooms Toilets, Electrical rooms, Mechanical rooms., telephone closets, data closets, janitor’s room, and storage rooms shall be zones with the nearest corridor zone.
3. All outside horns shall be one zone
4. Each individual room such as and not limited to classrooms, cafeteria, kitchen, office, conference room and gymnasium shall be an individual zone.

3.2 PAGING SYSTEM FUNCTIONS

A. The system shall have 8 user assignable zones for zoned audio paging. Coordinate with Architect and Owner the exact zoning layout prior to construction.

B. The system shall allow for user definable pre-selective access to "zone" and "all-page" functions. This feature will prevent unauthorized paging from designated ACSs.

C. The system shall provide facilities so that the user has access for sounding selected tones available from the tone generator from any ACS on either all-page or by zone basis for use as emergency or other alarm signals.

D. Provisions shall be provided inherent to the system, to allow for the use of a priority override inputs (telephone extension). This circuit, when activated by an external source, shall gather all speakers for distribution of the

signal information provided by the external source. This priority override input shall preempt other functions currently under way in the system. Upon conclusion of the priority override function, all pre-empted functions shall be automatically restored.

E. The system shall have the capability to operate with external paging amplifiers to increase the audio output available for paging. Adequate audio amplification shall be provided as required.

F. The system shall be equipped with control point outputs for activating outboard devices such as priority override relays on remote sound systems. These control point outputs shall be activated when the system is placed in the all-page mode.

G. The system shall be equipped with RS-232 ports to allow for the following:
1. Diagnostics via a standard computer terminal.
2. Modem interface to allow remote factory engineering assistance. Systems not providing a port of access to the system shall not be acceptable.

H. System must allow simultaneous operation of both diagnostic and functional routines (paging, zone page, time events, etc.).

I. The system shall have the ability to perform scan functions from the administrative control stations for:
1. Edit and review master clock time programs.

J. System shall allow for Principal's microphone to page pre-selected zones and pre-empt other functions (except priority override) currently underway in the system. Upon conclusion of the use of the Principal's microphone, all pre-empted functions shall be automatically restored.

3.3 INSTALLATION

A. General: Install new communication system components in accordance with the manufacturer's instructions.
1. Terminate all field wiring on telephone punch blocks mounted in an enclosure as specified.
2. Provide 4-pair Category 6 cable from paging system to telephone system.
3. Label cables and wiring logically, legibly, and permanently for ease of identification, using adhesive strip type labels.
4. Provide four pair category 6 cable from communications system to a location designated by Owner. Provide raceway, as required, for connection of Principal's computer to clock/bell system.
5. Cable shall not lay on ceiling grid or ceiling tile.

B. Speaker Installation:
1. Install new speakers types as indicated on the drawings.
2. Speakers in high ambient noise areas (cafetorium, gymnasiums, etc.) Shall be tapped as required to overcome the ambient noise generated by the public.
3. Coordinate exact location of exterior speakers with Owner/Architect. Paint speaker baffle to match exterior color as directed by Architect.

C. Conduit and Cables
1. Install conduit, fittings and boxes as specified in Division 26.
2. Single system cables may be grouped together in a common conduit of adequate capacity to facilitate the ease of installation and prevent conductor or insulation damage.
a. In no case shall the conduit fill exceed 50% capacity.
1) Do not group conductors or cables of different systems in a common conduit.
3. Cable:
a. Install cables as recommended by the system manufacturer. Conductor quantities specified are minimum required. Conductors to be installed shall be coordinated with the system equipment supplier.
b. Cables installed on exposed surfaces, in inaccessible locations, or underground shall be installed in conduit.
c. Cables installed above accessible, ceiling spaces may be installed without conduit. All cables not installed in conduit shall be plenum rated.

4. Cables not installed in conduit shall be grouped and bundled. Cable shall be bundled on a maximum of 2'-6" on center and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
5. Cables installed in hollow wall spaces shall be installed in conduit to an accessible location.
6. Tag each circuit at each end and at each terminal with a separate tag indicating the area served.

3.4 INSTRUCTIONS

A. Provide four hours instruction to the operating/maintenance personnel.

3.5 TESTING AND ACCEPTANCE

A. General
1. After completion of installation and start-up procedures, commence a verification and testing sequence leading to final acceptance.
2. Submit for approval, a sample of the form on which the test will be reported.
   a. Identify project.
   b. Provide a list of all system devices, arrange in numerical order of point addresses.
      1) 1) Show descriptor and location of each.
   c. Signatures of participants and observers.
   d. Results.
   e. Description of adjustment or corrections of defective components.
   f. Date.
3. Provide schedule of tests. Estimate dates of significant events.
   a. All testing shall be performed in the presences of the Owner / Engineer.
4. Test, calibrate and adjust each device in the system.
5. Verify operation of all specified functions.
6. Provide documentation of all tests and verifications as specified.

3.6 ZONE DESIGNATION

A. Final zone designations shall be based on actual zone graphics. (Do not use Architectural drawing zone designations).

3.7 GROUNDING OF EQUIPMENT

A. Racks and cabinets shall be grounded to the metallic structure of the building or to the building system power ground in accordance with NEC section 250. Securely bond equipment to the ground system through a minimum 6 gauge green insulated conductor.

B. Electronic systems shall be grounded to the building system ground, with a maximum resistance of 0.1 ohm. Systems ground shall be building steel, or other approved ground of the building power systems ground.

3.8 ANTENNA

A. Provide the Antenna as specified. Secure antenna to structure using 2-inch rigid galvanized steel conduit penetration through roof. Secure conduit to structure. Provide weatherheads on top of conduit for antenna cables.

3.9 MASTER CLOCK

A. Provide all final connections as required for integration with communications system.

3.10 SERVICE AND MAINTENANCE

A. The Contractor shall provide a one-year warranty of the installed system against defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner during normal working hours. The warranty period shall begin on the date of acceptance by the Owner/Architect.

B. The Contractor shall, at the Owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

C. The installing contractor shall submit evidence that he maintains in his service department the following items:
   1. Master Station Module
   2. System Control Card

END OF SECTION

SECTION 27 41 16

INTEGRATED AUDIO-VIDEO SYSTEM AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This document covers the general requirements for the installation of audio-video (AV) systems.

B. Contractor shall provide and install all AV-Cabling in the project.

C. Contractor shall install local sound reinforcement system in new pressbox.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections
1. Section 27 02 00 - Basic Materials and Methods for Communications Systems
2. Section 27 05 28 - Pathways for Communications Systems
3. Section 27 05 26 - Grounding and Bonding for Communications Systems
4. Section 27 15 00 - Communications Horizontal Cabling

1.3 CODES

A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.

B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
1. NFPA 70, National Electrical Code.
2. NFPA 101, Code for Safety to Life from Fire in Buildings and Structures.
3. FCC Rules, Part 76.
4. UL 50, Enclosures for Electrical Equipment.
5. All applicable parts will be FCC Class B approved.
6. All equipment, cable, devices, and accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
7. Americans with Disabilities Act.
8. Texas Accessibility Standards.
9. International Building Codes (IBC).
10. State and Local Building Codes with Amendments.
11. All requirements of the local Authority Having Jurisdiction (AHJ).

1.4 REGULATIONS

A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.

1.5 SUBMITTALS

A. General
1. Refer to Division 1 and section 27 02 00.
2. Submit in quantities, format and timetable as required by General Conditions.

B. Product Data Binders
   1. Minimum number of Sets: four (4) or one (1) electronic copy on CD.
   2. Timetable
      a. Submit within thirty (30) days after award of contract.
      b. Submit simultaneously with Shop Drawings.
      c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
      d. Review and approval of Product Data is required before equipment purchase and installation.
      e. Bind product data sheets together either in GBC or 3-ring type binders.

C. Shop Drawings
   1. Minimum Number of Sets: four (4) or one (1) electronic copy on CD.
   2. Timetable
      a. Submit within thirty (30) days after award of contract.
      b. Submit simultaneously with Product Data Binders.
      c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
   3. Description:
      a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
      b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
      c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.
      d. Number and title each drawing in logical manner as a set.
      e. Include cover sheet with listing of all drawings included in bound set.
      f. Ensure that labeling on Shop Drawings match labeling on equipment.
      g. Minimum Scale:
         1) Floor Plans: 1/8 inch = 1 foot.
         2) Rack Elevations: 1-½ inch = 1 foot.
         3) Plate/Panel Details: 6 inches = 1 foot.
         4) Loudspeaker Details: 1 inch = 1 foot.
      h. Include as a minimum:
         1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
         2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
         3) Plate details showing size, material, finish, connectors, engraving, etc.
         4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:
            a) Itemization of items reviewed by the Structural Engineer.
            b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
            c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
         5) Rack elevations.
         6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
         7) Electrical power wiring diagram. Include circuit, switching, and control details.

8) Wiring diagram of grounding and shielding scheme.
9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
10) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals
1. Minimum number of Sets: four (4).
2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
3. Format and Minimum Information below:
a. Section 1 - System Operation.
1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.
b. Section 2 - System Documentation.
1) Simplified system one-line schematic diagram showing changes made during construction.
2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
4) All Shop Drawings corrected to reflect as-built conditions.
5) Other data and drawings required during construction.
6) Initial Tests and Adjustments data.
7) Final Tests and Adjustments data.
8) CD-ROM discs including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
c. Section 3 - Manufacturer's Documentation.
1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
2) Manufacturer's Product Data.
3) Operating instructions.
4) Installation instructions.
5) Service information.
6) Schematic diagrams.
7) Replacement parts list.
d. Section 4 - Maintenance Information.
1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
3) Troubleshooting information complete with instructions for procedures during equipment failure.
e. Section 5 - Warranty Information
1) System warranty letter.
4. Provide three (3) sets on CD-R disc that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.
5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.
6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

E. Samples.
1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.
2. Product Tests
   a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
   b. Obtain written approval of tested products before incorporating into system.

1.6 QUALITY ASSURANCE

A. AV Contractor Qualifications.
1. Be established AV System Contractor, regularly engaged in furnishing and installing AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.
2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.
3. Be Authorized Dealer for all major lines of equipment listed in Part 2 (Biamp, Chief, Crestron, JBL, Middle Atlantic, Shure, etc.) Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale. Project Manager shall also have either an AVIXA CTS-I or CTS-D certification.

PART 2 - PRODUCTS

2.1 GUIDELINES

A. Infrastructure Products - All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.

B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer's published specifications. Verify performance.

C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Quantities - All quantities are indicated on AV drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.

F. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

G. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.

H. Security Screws - Use Bryce Security Penta-Plus button-head screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers (not provided by Bryce) to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do no use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.

I. AV Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.

J. AV Screens - For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor, and include additional black drop as appropriate considering screen size and mounting height.

K. AV Racks:
   1. Provide blank faceplate in any area marked BLANK in drawings.
   2. Provide shelf for mounting of any device for which rack mount kit is not available.
   3. PanelcraftersProvide one (1) Panelcrafters DBR-XXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.

L. Wireless Microphones - Coordinate frequency selection with other radio-frequency sources in the area and with manufacturer's recommendations.

M. Control System Programming:
   1. Program each panel to provide simple, intuitive control of all basic AV functions including:
      a. program and speech volume levels
      b. video source and destination routing
      c. screen control
      d. video projector lift control (where applicable)
      e. AV system power
      f. media player transport functions
      g. video conferencing CODEC controls including call initiation (where applicable)
      h. video conferencing PTZ camera control (where applicable)
      i. combine/uncombine settings for all combinations of controlled rooms
      j. local lighting and blackout shade controls (where applicable)
   2. Utilize AVIXA's "Dashboard for Controls" concept and Crestron's SMART GRAPHICS for touch panel layout unless directed otherwise by Owner.
   3. Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.
   4. Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
   5. Staff member certified by control system manufacturer shall program control system.

6. After programming is approved, all control system code and programming, including touch panel code and graphics, will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
7. Provide follow up meeting with Owner after 6 months of operation to make updates as requested to control programming.

N. Audio System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.

O. AV Design Bid & Substitutions:
1. System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
2. Bid AV system with products specified in Base Bid section below unless noted otherwise from Owner.
3. No substitutions will be allowed without prior approval from Owner specific to proposed manufacturer and model numbers.
4. Equipment listed in Part 2 is based on performance criteria to meet Owner design requirements.
5. All requested substitutions need to meet or exceed performance of devices listed in Part 2. For each request provide manufacturer's published specifications to verify performance and explain functional and cost impact.
6. Evaluation and approval of substitution requests will be performed by Owner.

2.2 ROOM DESCRIPTIONS

A. Press Box
1. An audio system shall be provided for program audio and speech reinforcement.
2. The system shall include wireless microphones, wired microphone & auxillary inputs, media player with bluetooth connectivity, audio DSP, audio amplifier, wall mounted loudspeakers, monitor loudspeaker, and an assistive listening system.
3. System control shall be provided by a table top control panel for source selection, mixing, and volume control.
4. An equipment rack shall house all the headend AV components.

2.3 AV PRODUCTS - ACTIVE EQUIPMENT

A. The following are major products for this project.
1. Pressbox Speakers
   a. Community R.25-94Z
   b. Or Owner Approved Equivalent
2. Amplifier
   a. Crown DCI 2/600
   b. Or owner Approved equal
3. Digital Signal Processor
   a. BSS Blu-100
   b. Or owner approved equal
4. Wireless Microphone
   a. Shure QLXD24/SM58 system
   b. Shure QLXD14/85 system
   c. Shure SBC800-US charging dock with Rechargeable Lithium Batteries SB900B
   d. Or owner approved equal
5. CD Media Player
   a. Denon DN-700CB
   b. Or owner approved equal
6. Control Panel
   a. **BSS EC-8BV-US**
   b. Locate on countertop in FSR DSKB-2G or equal

c. Or owner approved equal

7. Network Switch
   a. Netgear GS305PPV3
   b. Or owner approved equal
8. Mic/Line Input Plate
   a. RDL D-J3M
   b. Locate on countertop with monitor speaker in FSR DSKB-2G or equal
   c. Or owner approved equal
9. Monitor Speaker
   a. **RDL D-PSP1**
   b. Locate on countertop with input plate in FSR DSKB-2G or equal
   c. Or owner approved equal
10. Assistive Listening System
    a. Listen Technologies
    b. Provide additional receivers to comply with ADA/TAS guidlines
    c. Coordinate with architect for location of notification signage
    d. Or owner approved equal
11. Power Sequencer
    a. Atlas ECS3
    b. Or owner approved equal
12. Equipment Rack
    a. **Middle Atlantic ERK-1025 with front and rear locking doors and Q-FANS.**
       1) Provide one (1) rack
       2) Provide 3RU drawer for wireless microphone transmitters and other accessories.
    b. Or owner approved equal

2.4 CABLES

A. Interconnect Wiring – Provide and install following cable as required for connections in all areas. Meet provisions of N.E.C. Provide plenum rated cable where required.

B. AV Cabling
   1. Low Impedance Loudspeaker Cable
      a. For cable distance <50’: 14-guage 2-conductor West Penn #25226B
      b. For cable distance from 50’ to 100’: 12-guage 2-conductor West Penn #25227B
      c. For cable distance > 100’, consult with manufacturer and engineer before ordering/installation.
      d. Terminate with Neutrik “Speakon” type connectors when available.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Guidelines
   1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
   2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge AV infrastructure system installations.
   3. [if !vml][endif]Provide a complete functioning sound system that’s been fully tested and properly balanced, configured, and equalized. Be of maximum assistance to the Owner during the warranty period of the system, to the degree that maximum Owner satisfaction is assured.
   4. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to ensure that constant polarity is maintained. Balanced audio connectors shall be wired as follows.

Wire	Connector	Signal

Black	Pin #3 or Ring	Low or Negative
Red or White	Pin #2 or Tip	High or Positive
Bare	Pin #1 or Shield	Ground

5. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the outputs of the various equipment items in the system
6. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.[if !vml][endif]
7. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.
8. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
9. All solder joints and terminations shall be made with resin-core silver solder. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature unregulated irons shall be used on the job site.
10. Each mechanical connector shall be attached using the proper size controlled- duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site.
11. Label all wires in racks and console as to destination and purpose with permanent labels. Clearly and permanently label all controls and connections at the front and back of the rack, with permanent labels. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.
12. Documents at Job Site - Keep following documents at job site during entire construction period:
    a. Complete Specifications and Drawings.
    b. Approved Shop Drawings.
    c. Approved Product Data.
    d. Progress Set of Project Record Documents.
13. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
14. Locate wireless microphone system and hearing assist system antennas at or above ceiling or at bar joist height in areas without ceilings. Coordinate exact location with Owner to provide adequate coverage in the area served by the system. Adjust antenna location for best possible reception/transmission in area of coverage.
15. Provide adequate protective vandal guards for all devices located in areas subject to damage from activities or vandalization, such as school gym, sports field, school cafeteria.
16. Provide hearing assist transmitter(s) and receivers for each sound reinforcement system. The quantity of hearing assist receivers for each system shall be equal to a minimum of four (4) percent of the total seating capacity, but in no case less than ten (10) receivers for the area of coverage of each local sound reinforcement system.
17. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
18. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
19. Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.
20. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling
   1. Equipment Labels - AV Contractor shall provide engraved lamicoid labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
      a. Line 1: Generic name of device, such as MIXER AMPLIFIER.
      b. Line 2: Schematic designation of device, such as AV-MSW-1.
   2. Control Labels - AV Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
   3. Terminal Strip Labels - AV Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
   4. Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.
   5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
   6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

C. Power and Grounding
   1. Power Coordination - Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to AV systems. Before installation, verify load requirements for systems as accepted.
   2. Bus Bars - Install 1-inch by 1/4-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 26) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

D. Equipment Racks
   1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.

E. Wiring
   1. Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.
   2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.
   3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.
   4. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length 3/4-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from

rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.

5. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
6. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
7. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.
8. Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.
9. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.2 FIRESTOPPING

A. Refer to section 27 02 00.

3.3 STORAGE AND HANDLING

A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.

B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.

C. Schedule delivery to minimize delays in the project.

D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.4 WARRANTY

A. Refer to Division 1.

B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:

1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.
4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
6. Extended Manufacturer’s Warranties - Identify products with manufacturer’s warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.

C. Extended Warranty - Provide cost to extend complete AV system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.5 INITIAL TESTS

A. Purpose - These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).

B. Testing Standards - Perform testing in accordance with ANSI standards.

C. Inspection - Verify prior to beginning actual tests and adjustments on systems:
1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
2. Cables dressed, routed, and labeled, connected with proper polarity.
3. Insulation and shrink tubing in place.
4. Dust, debris, solder splatter, etc. removed.
5. Proper frequency settings (or modules) at crossovers and controllers.
6. All equalizer bands and tone controls set for flat frequency response.
7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.

D. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, AV Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). AV Contractor to document measurements.

E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.

F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.6 FINAL TESTS AND ADJUSTMENTS

A. Purpose - These tests are to be witnessed by AV Consultant to determine if system is complete and functioning as designed and specified. Also, AV Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.

B. Timetable - Coordinate with Owner, General Contractor, and AV Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.

C. System and Site Conditions - AV Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant’s arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon AV Consultant’s arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or AV Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.

D. Test Labor - Provide technician familiar with this project’s AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs,

and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.

E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.

F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, AV Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

H. Installer shall perform thorough preliminary testing of the AV Systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications. Perform preliminary programming and setup of digital signal processors as necessary to conduct these tests.

I. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately eight (8) hours will be required for this work

J. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.

K. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.

L. Prior to requesting systems testing, verify the following:
   1. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published.
   2. All specified equipment, including loose equipment, is on the job site for proper accounting.
   3. All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit in PDF format prior to final tests.
   4. All video systems and associated control systems have been tested and are in perfect working order.
   5. All equipment controls shall be labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control on the front and in the rear of the racks as to its function with write-on tape. Supply printer labels or markers suitable for permanently indicating knob settings after equalization is performed.
   6. Operation manuals for every equipment item furnished are on hand at the job site.
   7. Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing. Installer shall provide a calibrated RTA and microphone, and pink noise generator at time of testing.

M. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.

N. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

3.7 SOUND SYSTEM PERFORMANCE

A. After equalization and testing, the sound system shall meet or exceed the following specifications:
   1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.

2. Minimum SPL with band-limited pink noise input to the system in the targeted space shall be 95 dB before audible distortion occurs.
3. Seat-to-seat variation in SPL at 4kHz octave band pink noise shall be within a tolerance of plus or minus 3dB SPL.
4. Acoustic response of the system shall be plus or minus 1.5dB along a line which is flat from 50 Hz to 4000 Hz and which rolls off at 1dB per octave to 16kHz.

B. The following tests and adjustments shall be performed by the Contractor. All equipment required supplied by the Contractor Follow EIA standard RS-160 and RS-219 in performing the tests. Make all necessary corrections to bring systems into specification compliance. Record the results of these tests in project record drawings. Submit written results of tests to Architect and Engineer prior to scheduled equalization and final inspection date.
1. Measure and record impedance of each speaker line at frequency of 1,000 Hz, with loudspeakers connected to their respective lines.
2. Measure and record overall system hum and noise level of each input channel with controls set so that -50 dBm microphone input or +4 dBm input would drive the system to full amplifier output. Terminate inputs with resistor (150 to 600 ohms) and disconnect power to noise generator for this test.
3. Adjust the gain of each active device to provide both optimum signal - to noise ratio, and at least 10 dB headroom at each active device. Observe the output of each active device with an oscilloscope of 5 MHZ band width, and verify visually that the signal required for full amplifier output is free of overload, clipping, parasitics, and radio frequency components. Adjust gain structure of all active components and record the input and output signal levels of all active components and record the input and output signal levels of all active components in both dBm and volts, during normal program levels.
4. Measure and record system electrical frequency response for each input channel through power amplifier. Required is flat response with permissible deviation of +/-1 dB within the range of 30 Hz to 16 kHz.
5. Check system to assure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output Detect unwanted signals on Oscilloscope at termination.
6. Check phasing of loudspeakers by applying constant power per octave (pink) noise to system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next. Apply sine wave sweet signal to each loudspeaker system sweeping from 50 Hz to 5,000 Hz and at a level of 10 Db below full amplifier output, and listen for rattle or objectionable noises Correct if apparent.
7. Achieve uniform distribution of sound from each loudspeaker (with bleachers in their extended position in gymnasium where applicable). Drive system with broadband, constant power per octave (pink) noise, and measure the SPL using a sound level meter incorporating an octave-band filter centered at 4 kHz. Adjust noise level until the meter readings are between 75 and 80 dB. Use a sound level meter filter that meets ANSI S1 4-1971 Type 2 and ANSI S1 11-1971 standards set for slow meter damping. Take all readings at seated ear height. Adjust speaker as necessary to achieve +/-3 dB over entire area covered by this system.

3.8 FINAL ACCEPTANCE BY OWNER

A. Certificate - Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.

B. General Adjustments - Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.

C. Input/Output Jack Demonstration - Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.

D. Inventory - Inventory all installed and portable equipment for correct quantities.

E. Functional Demonstration - Demonstrate operation of each function of each major piece of equipment.

F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.

G. Final Equipment Settings - Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.

H. Security Inspection - Inspect equipment for security from tampering (covers, shaft-locks, etc.).

I. Review of Labels - Review installed labels on cables, equipment, controls, and terminal strips.

3.9 OWNER TRAINING

A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.10 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. hould Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION

SECTION 31 00 00

SITE EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Operations required for the excavation of materials on site.

1. Operations required for the excavation of borrow material from approved sources.
2. Compaction of natural subgrades.
3. Placement and compaction of embankments to grade.
4. Finish grading.
5. Disposal of excess or unsuitable materials.
6. Other required operations.
7. Earthwork must conform with dimensions and typical sections shown, and within lines and grades established on the Drawings.

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

1.2 EXISTING UTILITIES

A. The plans show the approximate location of all known underground utility lines and structures. Where pipes, ducts and other structures are encountered in the excavation but are not shown on the plans, immediately notify the Owner's Representative.

1.3 CLASSIFICATIONS

A. Top Soil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes grasses and other vegetation.

B. Subgrade: Consists of that portion of the surface on which a compacted embankment or pavement is constructed.

C. Compacted Embankment: Earth fill placed and compacted between subgrade and underside of pavement and fill areas adjacent to paving.

D. Borrow: Material taken from approved sources to make up any deficit of excavated material. The borrow shall have a measured plasticity index of between 7 and 20, and shall be free of organic matter and excess silt.

E. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.

F. Stripping of Ground Surface: All vegetation, all decayed vegetable matter, rubbish and other unsuitable material within the areas to be graded not removed by clearing shall be stripped or otherwise removed to ground level before grading or other earthwork is started. In no case will such material be allowed to remain in or on the areas to be graded.

G. Excavation: After all necessary stripping has been done, excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings.

H. Compaction: Compaction of soil materials shall be measured as a percentage of Standard Proctor

density as determined by the AASHTO Standard T 99 procedure.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish, operate and maintain such equipment as is necessary to produce uniform layers, section and smoothness of grade for compaction and drainage.

B. Tamping Rollers:

1. Use tamping rollers with one or more cylindrical drums. Each cylinder must be at least 48 inches long and 40 inches in diameter.
2. The minimum weight per linear foot of drum length must be 1500 pounds weighted and 1000 pounds empty.
3. For tamping rollers with multiple cylinders, each cylinder must rotate independently and the cylinders must be pivoted on the main frame so that the units can adapt to irregularities in the ground surface.
4. Provide approximately 2.7 tamping feet per square foot of drum surface on each cylinder. Stagger the feet uniformly over the cylinder surface. Each foot should have a face area between 5 and 7 square inches and a clear projection from the cylinder surface of 7 to 9 inches. Equip each unit with a device for cleaning the feet as the cylinders rotate.
5. Use a crawler tractor with sufficient power to pull the tamping roller at a speed of approximately 3.0 miles per hour.

C. Rubber Tire Rollers:

1. Use rubber tire rollers having two axles and not less than a total of nine wheels with pneumatic tires.
2. Mount the wheels so that the rear tires will not follow in the tracks of the forward tires and so the unit will give uniform compaction over the entire width of coverage.
3. Mount the axles in a rigid frame with a loading platform or body suitable for being ballasted to a specified gross weight between 10 and 50 tons loading. The Owner's Representative will specify the tire inflation and gross weight.
4. If the roller is not self propelled, the towing equipment must also have pneumatic tires.

D. Use tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.

E. Scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment and other equipment must be suitable for construction of fills.

2.2 EARTH FILL

A. Obtain embankment fill from required excavation or, if excavated material is not sufficient, from Borrow areas approved by the Owner's Representative.

B. Use the best material available from excavation or borrow. Suitability of fill material is subject to the approval of the Owner's Representative.

C. Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.

D. Embankment material must have a plasticity index between 7 and 20 inclusive.

PART 3 EXECUTION

3.1 REMOVAL OF TOPSOIL

A. Remove topsoil within the limits of the construction areas as shown on the Drawings.

B. Stockpile the topsoil for future distribution. Protect stockpiled topsoil from other excavated materials.

3.2 EXCAVATION

A. As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction of embankments or pavement. Remove materials within the indicated limits and dispose of as directed.

B. Maintain grades during excavation for complete drainage. When required, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the Work.

C. If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in approved areas for later use.

D. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.

E. Uniformly dress cut and fill slopes to slope, cross section and alignment, as shown.

3.3 SUBGRADE UNDER PAVEMENTS

A. After excavation is made to subgrade lines under proposed pavements, remove and replace soft or undesirable material with select material as specified for embankments. Stabilize and compact the subgrade as stated in the sections on stabilization of pavement subgrade.

3.4 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS

A. After excavation is made to lines under proposed embankments, remove soft or undesirable material to a depth determined by the Owner's Representative. Break down sides or holes or depressions to flatten the slopes.

B. Fill each depression with the appropriate soil for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.

C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly loosen the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.

D. Compact the surface of the embankment subgrade as specified in the following paragraphs.

E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner's Representative suspect such a deficiency, the material must be thoroughly broken and recompacted before proceeding with construction.

3.5 PLACING EMBANKMENT FILL

A. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Representative.

B. During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material.

C. After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction must not exceed 8 inches unless otherwise directed. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.

D. If the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.

E. Stabilize and compact the top 6 inches of embankment fills under pavement sections as specified in the section on stabilization of pavement subgrade.

3.6 MOISTURE CONTROL

A. Developing the maximum density obtainable with the natural moisture of the embankment material is preferred. However, the moisture content must be 1 to 3 percentage points wet of optimum, as determined by AASHTO Test Method T 99.

B. If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

3.7 COMPACTION

A. Compact each layer of embankment with suitable rollers as necessary to secure at least 95% of the standard Proctor density, within the specified range of the moisture content, according to AASHTO Test Method T 99.

3.8 DISTRIBUTION OF TOPSOIL

A. Preparation:

1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels set 10 inches apart.
2. Shape all areas designated for grading, including cut and fill areas, to receive a minimum of 6 inches of topsoil.
3. In areas that require only blading and dressing, the adequacy of existing topsoil will be determined by the Owner's Representative.

B. Placement:

1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.
2. Distribute topsoil uniformly and spread evenly to an average thickness of 6 inches. Do no compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.

3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.

C. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement. Replace topsoil.

3.9 MATERIAL DISPOSAL

A. Remove excess excavated material and excess topsoil from the area before substantial

completion. Stockpile materials separately in designated areas. Excess soil, topsoil and strippings shall become property of the Contractor and shall be removed from the site.

B. Dispose of waste material without causing expense or damage to the Owner.

END OF SECTION 31 00 00

SECTION 31 06 20.15

CEMENT STABILIZED SAND

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cement stabilized sand.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).

B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM C 150 - Specification for Portland Cement.

H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.

I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.

J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.

N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

1.5 Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications. DESIGN REQUIREMENTS

A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per ton of dry sand.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C 150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Division 2 and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
2. Deleterious materials:
   a. Clay lumps, ASTM C 142 - less than 0.5 percent.
   b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
   c. Organic impurities, ASTM C 40, color no darker than standard color.
3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.

C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

A. Add required amount of water and mix thoroughly in pugmill-type mixer.

B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

A. Determine target cement content of material as follows:

1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
2. Complete molding of samples within 4 hours after addition of water.
3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
4. Perform cement content tests on each sample.
5. Perform moisture content tests on each sample.
6. Plot average 48-hour strength vs. cement content.
7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).

B. Test raw sand for following properties at point of entry into pug-mill:

1. Gradation
2. Plasticity index

3. Organic impurities
4. Clay lumps and friable particles
5. Lightweight pieces
6. Moisture content
7. Classification

C. Present data obtained in format similar to that provided in sample data form attached to this Section.

D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula: f'c% 1/2 standard deviation

PART 3 EXECUTION

3.1 PLACING

A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is +3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Division 1.

B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabililized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.

D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.

H. Reporting: Test reports shall contain, as a minimum, the following information:

1. Supplier and plant number
2. Time material was batched
3. Time material was sampled
4. Test age (exact hours)

5. Average 48-hour strength
6. Average 7-day strength
7. Specification section number
8. Indication of compliance / non-compliance
9. Mixture identification 3
10. Truck and ticket numbers
11. The time of molding
12. Moisture content at time of molding
13. Required strength
14. Test method designations
15. Compressive strength data as required by ASTM D 1633
16. Supplier mixture identification
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:

1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula: Credit per Cubic Yard = $30.00 x 2 (100 psi - Actual psi) 100

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to Owner.

END OF SECTION 31 06 20.15

SECTION 31 06 20.17

UTILITY BACKFILL MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material Classifications.

B. Utility Backfill Materials:

1. Concrete sand
2. Gem sand
3. Pea gravel
4. Crushed stone
5. Crushed concrete
6. Bank run sand
7. Select backfill
8. Random backfill

C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

A. Unsuitable Material:

1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
4. Materials contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material:

1. Materials meeting specification requirements.
2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within embedment zone

extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

J. Refer to Division 33 for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregate.

B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.

E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.

H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.

L. TxDOT Tex-460-A - Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.

D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.

E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.6 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.

B. Verification tests of backfill materials may be performed by Owner in accordance with Division 1.

PART 2 PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
   a. Plasticity index: non-plastic.
   b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
   a. Plasticity index: non-plastic to 4.
   b. Gradations:
      1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
      2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
      3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
   a. Plasticity index: greater than 7.
   b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
4. Class IVA: Lean clays (CL).
   a. Plasticity Indexes:
      1) Plasticity index: greater than 7, and above A line.
      2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
   b. Liquid limit: less than 50.
   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
   d. Inorganic.
5. Class IVB: Fat clays (CH)
   a. Plasticity index: above A line.
   b. Liquid limit: 50 or greater.
   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
   d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Division 31.

B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner's Representative, provided that physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:

1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner's Representative.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.

7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15"	15" – 8"	< 8"
1"	95 – 100	100	--
¾"	60 – 90	90 – 100	100
½"	25 – 60	--	90 – 100
3/8"	--	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 – 15
No. 8	--	0 – 5	0 – 5

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Division 31 to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Division 31.

K. Cement Stabilized Sand: Conform to requirements of Division 31.

L. Concrete Backfill: Conform to Class B concrete as specified in Division 32.

M. Flexible Base Course Material: Conform to requirements of applicable portions of Division 33.

2.3 MATERIAL TESTING

A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:

1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
2. Plasticity of material passing No. 40 sieve.
3. Los Angeles abrasion wear of material retained on No. 4 sieve.
4. Clay lumps.
5. Lightweight pieces.
6. Organic impurities.

B. Production Testing. Provide reports to Owner's Representative from an independent testing

laboratory that backfill materials to be placed in Work meet applicable specification requirements.

C. Assist Owner's Representative in obtaining material samples for verification testing at source or at production plant.

PART 3 EXECUTION

3.1 SOURCES

A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.

B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner's Representative may obtain samples for verification testing.

C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner's Representative, expense for sampling and testing required to change to different material will be credited to Owner through change order.

D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.

E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.

B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

A. Quality Control

1. The Owner's Representative may sample and test backfill at:
   a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
   b. On-site stockpiles.
   c. Materials placed in Work.
2. The Owner's Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.

B. Production Verification Testing: Owner's testing laboratory will provide verification testing on backfill materials, as directed by Owner’s Representative. Samples may be taken at source or at production plant, as applicable.

END OF SECTION 31 06 20.17

SECTION 31 22 00

SITE GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of topsoil.

B. Rough grading the site for site structures, building pads, and play fields.

C. Replacement of topsoil and finish grading for planting.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 PROJECT CONDITIONS

A. Protect above- and below-grade utilities thatremain.

B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

C. Protect bench marks survey, control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil - Soil Type : Topsoil excavatedon-site.
   1. Graded.
      a. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
      b. Provide imported topsoil conforming to the requirements of Division 32 as required.
   2. Other Fill Materials: Reference relevant sections of Division 32 and the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

A. Identify required lines, leveler contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect utilities that remain, from damage.

D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or degraded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Division 31 Specifications for filling procedures.

G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL

A. Stockpile excavated topsoil on site.

B. Stockpile excavated subsoil on site.

C. Stockpiles: Use areas designated on site, pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.5 FINISH GRADING

A. Before Finish Grading:
1. Verify building and trench backfilling have been inspected.
2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove/Break-up soil clumps greater than 1” in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).

E. Place topsoil in areas where seeding is indicated.

F. Place topsoil where required to level finish grade.

G. Place topsoil to the following compacted thicknesses:

1. Areas to be Seeded with Grass: 6 inches (150 mm).
2. Areas to be Sodded: 4 inches (100 mm).

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and foreign material while spreading.

J. Near plants spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

L. Lightly compact placed topsoil.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).

3.7 FIELD QUALITY CONTROL

A. See Division 1 and Division 31 for compaction density testing.

3.8 CLEANING AND PROTECTION

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water. Excess topsoil and subsoil to be removed at no additional cost to owner.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 31 22 00

SECTION 31 23 16.14

TRENCH SAFETY SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trench Safety System for the construction of trench excavations.

B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). The Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.

C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Division 1.

B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.

C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.

D. Review of the safety program by the Engineer will only be in regard to compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.5 REGULATORY REQUIREMENTS

A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.

B. The Contractor is responsible for obtaining a copy of OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209.

C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).

D. Reference materials, if developed for a specific project, will be issued with the Bid Documents.

1.6 INDEMNIFICATION

A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.

B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 PRODUCTS – Not Used PART 3

EXECUTION

3.1 INSTALLATION

A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.

B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.

C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.2 INSPECTION

A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.

C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

END OF SECTION 31 23 16.14

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Division 1.

K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from

trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
    a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
    b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
    c. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.

O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.

P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both protective systems and shoring systems as defined in Division 31.

S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.

U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

1.4 REFERENCES

A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.

B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand- Cone Method.

E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.

K. TxDOT Tex-110-E - Particle Size Analysis of Soils.

L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SCHEDULING

A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.6 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit planned typical method of excavation, backfill placement and compaction including:

1. Trench widths.
2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.

C. Submit backfill material sources and product quality information in accordance with requirements of Division 31.

D. Submit trench excavation safety program in accordance with requirements of Division 31. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.

E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner’s Representative.

1.7 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by Owner in accordance with requirements of Division 1 and as specified in this Section.

B. Perform backfill material source qualification testing in accordance with requirements of Division 31.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre- manufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.

B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Division 31.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Division 31.

C. Geotextile (Filter Fabric): Conform to requirements of Division 1.

D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

E. Timber Shoring Left in Place: Untreated oak.

PART 3 EXECUTION

3.1 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

C. Classification of material will be determined by Owner's Representative.

3.2 PREPARATION

A. Establish traffic control to conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.

B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Division 31.

C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Division 2, as applicable.

E. Install and operate necessary dewatering and surface-water control measures to conform to Division 1. Provide stable trench to allow installation in accordance with Specifications.

F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Division 1.

3.3 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.

1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
2. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.

B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.

C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

3.4 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Division 1.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or

abandonment of facilities is indicated on Drawings.

D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to the Owner.

3.5 EXCAVATION

A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

Nominal Pipe Size, Inches	**Minimum Trench Width, Inches**
Less than 18	O.D. + 24
18 to 30	O.D. + 24
36 to 42	O.D. + 36
Greater than 42	O.D. + 48

D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner's Representative and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:

1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re- compact after shield is moved if soil is disturbed.
3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
5. Conform to applicable Government regulations.

H. Voids under or damages to paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports. Contractor is responsible for all cost associated with the repairs.

I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.

J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber- tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company’s line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company’s representative.

K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Owner’s Representative. Provide supports for collar or welds. Discuss with Pipeline Company’s representative and determine methods of supporting collar or weld during excavation and later backfilling operations.
When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.6 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials, which are suitable as defined in this Section and conforming to Division 31. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming to requirements of Division 31.

C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Division 1. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.7 TRENCH FOUNDATION

A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. When wet soil is encountered on trench bottom and dewatering system is not required, overexcavate an additional 6 inches with approval by Owner’s Representative. Place non- woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.

C. Perform over excavation, if directed by Owner's Representative, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Owner's Representative:

1. Even though Contractor has not determined material to be unsuitable, or
2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Division 1.

D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.

B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.

E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.

F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.

H. Place electrical conduit, if used, directly on foundation without bedding.

I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Division 31. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:

1. Class I, II and III Embedment Materials:
   a. Maximum 6 inches compacted lift thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
2. Cement Stabilized Sand (where required for special installations):
   a. Maximum 6 inches compacted thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.

3. Class I Embedment Materials.
   a. Maximum 6-inches compacted lift thickness.
   b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
   c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
4. Class II Embedment and Cement Stabilized Sand.
   a. Maximum 6-inches compacted thickness.
   b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
   c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.

B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand, select fill, or random backfill material as specified in Division 31.

C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand to level 12 inches below the pavement. For sewer pipes under natural ground backfill from 12 inches

above top of pipe to 6” inches below finish grade with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12-inch backfill directly under pavement. Use topsoil for 6-inch backfill directly under natural grade. For backfill materials reference Division 31.

D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.

E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.

F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.

1. Class I, II, III or IV or combination thereof (Random Backfill):
   a. Maximum 9-inches compacted lift thickness.
   b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
   c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner’s Representative.

2. Cement-Stabilized Sand:
   a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
   b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
   c. Moisture content on dry side of optimum determined according to ASTM D 558 but

sufficient for cement hydration.

3. Select Backfill:
   a. Place in maximum 8-inch loose layers.
   b. Compaction by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
   c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698, unless approved by Owner's Representative.

G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.

1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at no additional cost to Owner, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.
2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
4. Moisture content as necessary to achieve density.

H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, INLETS, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on Drawings.

B. Below paved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement.

C. In unpaved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of finish grade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use suitable on-site material and topsoil for the 12-inch backfill directly under natural ground.

3.11 FIELD QUALITY CONTROL.

A. Test for material source qualifications as defined in Division 1.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.

C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner's Representative.

D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.

E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.

1. For open cut construction projects and auger pits: Unless otherwise approved by Owner's Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
2. A minimum of three density tests for each full shift of Work.
3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
7. Recompacted placement will be retested at same frequency as first test series, including verification tests.
8. Identify elevation of test with respect to natural ground or pavement.

F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Division 1.

END OF SECTION 31 23 33

SECTION 31 31 00

SOIL TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Application of soil chemicals for the prevention of termite infestation.

B. Related Sections:
1. Section 07 26 00 - VAPOR RETARDERS

1.2 SUBMITTALS

A. Product Data: For termiticide.
1. Include the current EPA-Registered Label for termiticide products.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Work shall be performed by a licensed, reputable, pest control operator with an established record of at least five years' successful experience in this work.

B. Regulatory Requirements: Application of soil treatment shall meet the requirements of regulatory organizations.
1. Texas Department of Agriculture, Structural Pest Control Service, Austin, TX.
2. Formulate and apply termiticides according to the EPA-Registered Label.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-registered label.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard from, signed by application and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites for a period of 5 years from date of substantial completion. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT SOLUTION

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of Texas Department of Agriculture, Structural Pest Control Service, Austin, TX, in an aqueous solution formulated to prevent termite infestation. Solution shall include synthetic dye to permit visual identification of treated soil. Product/manufacturer; one of the following:
Demon MAX; Syngenta
BaseLine or Dragnet SFR; FMC Corp., Agricultural Products Group

B. Dilute termiticide as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION/PREPARATION

A. Verify the soil surfaces are unfrozen, sufficiently dry to absorb termiticide, ready to receive treatment.

B. Beginning of application means acceptance of soil conditions.

C. Notify Architect and Owner at least 12 hours prior to beginning work.

3.2 APPLICATION

A. Apply termiticide to soil at metered rates, in accordance with manufacturer's instructions or as indicated below if more stringent.

B. Applying Chemicals: Apply the solution not more than 24 hours prior to placing concrete slabs and at such time as there is reasonable assurance that no rain will fall until after the slabs have been placed.
   1. Vertical Barrier:
      a. Establish a vertical barrier in areas around the base of footings, foundation walls, grade beams, plumbing, piers, and backfill soil. Treat both sides of footings, walls, beams, and around all sides of pipes and piers.
      b. Apply at the rate of 4 gallons of emulsion per 10 linear feet per foot of depth from grade to the top of footings or the bottom of beams as each demands.
      c. Applications must be made by rodding and/or trenching in accordance with manufacturer's application instructions.
      d. Cover the treated soil with a thin layer of untreated soil or other suitable barrier such as polyethylene sheeting.
      e. Apply extra treatment to structure penetrations, pipe, ducts, expansion joints and other soil penetrations.
   2. Horizontal Barrier:
      a. Establish a horizontal barrier under concrete slabs on carton forms. Apply emulsion at the rate of 1 gallon per 10 square feet of grade.
      b. Applications shall be made by a low pressure spray.
      c. If concrete slab cannot be poured over the soil the same day it has been treated, cover treated soil immediately after application with polyethylene sheeting (Section 07 26 00 - VAPOR RETARDERS) to prevent disturbance of the termiticide barrier.
         1) This protective vapor retarder shall be removed prior to the placement of void boxes. Vapor retarder will be placed on top of the void boxes.
         2) If slab-on-grade is used, do not remove vapor retarder.

C. Post signs in the areas of application warning workers that soil poisoning has been applied. Signs shall remain in place until areas are covered by other construction.

END OF SECTION

SECTION 31 63 29

DRILLED CONCRETE PIERS

PART 1 - GENERAL

1.1SUMMARY

A. Section Includes: Concrete piers, including drilling, reinforcing, casing, and placing concrete.

B. Related Documents/Sections:
1. Document 00 31 32 - GEOTECHNICAL DATA.
2. Section 01 45 23 - TESTING AND INSPECTION SERVICES.
3. Section 03 20 00 - CONCRETE REINFORCING.
4. Section 03 30 00 - CAST-IN-PLACE CONCRETE.
5. Typical Pier Detail - refer to structural drawings.

1.2 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A252/A252M - Standard Specification for Welded and Seamless Steel Pipe Piles; 2026.

1.3 SUBMITTALS

A. Data Reports: Independent Testing Laboratory shall log each drilled shaft by recording not less than the following information:
1. Identifying mark; use same identifying mark shown on drawings.
2. Date and time excavation started;
3. Shaft diameter as per drawings;
4. Shaft diameter as constructed;
5. Bottom of penetration as per drawings;
6. Bottom of penetration as constructed;
7. Actual elevation at initial point of drilling, i.e. top of ground (in relation to sea level);
8. Estimated bearing elevation at top of penetration as per drawings (in relation to sea level);
9. Actual elevation at top of penetration as constructed (in relation to sea level);
10. Bottom of casing (if casing is used) (in relation to sea level);
11. Comments on water conditions;
12. Date and time excavation completed;
13. Date and time concrete placed;
14. Note: This data report does not reduce or limit the scope of work or the recording of data as required by the testing laboratory services for fulfillment of the contract documents.

B. Complete logs at the end of each day and submit a copy to the Architect for review.

C. Reconciliation of Drilled Piers and Casings: Upon completion of the construction of the drilled piers, the Contractor shall reconcile the actual costs of the drilled piers and casings against the estimated costs, based on the estimated depths and sizes of piers shown on the structural drawings, the percentage of piers estimated to require casing as described in this specification, other pertinent information given in this specification and the Contractor's unit prices stated on the Bid Form, which included Extra and Credit prices for drilled piers and casings.
1. The Contractor shall document the total costs of the combined reconciliations of the drilled pier depths and casing lengths for submission to the Architect in a format identical to that represented by Sample Worksheets "I" and "II" included at the end of this specification section. To obtain Total Dollar Change to Contract, refer to formula on Sample Worksheet "II".
2. Refer to Sample "III", included at the end of this specification section for Glossary of Terms used in Sample Worksheets "I" and "II".

D. Confirmation of contact with Owner's testing company.

E. Confirmation of contact with Owner's geotechnical engineer.

1.4 QUALITY ASSURANCE

A. Tolerances:
1. Center line of the top of the drilled shaft shall be within 3" of the plan location.
2. Drilled shaft shall be plumb to within 1-1/2" the first 10' plus 1% of the depth greater than 10'.

B. Prior to start of shaft drilling, Contractor shall contact Owner's testing laboratory for verification and identification of bearing strata, and required penetration of bearing strata by their geotechnical engineer.

1.5 UNIT PRICES

A. Piers: Bids shall be based on drilling to estimated bearing elevation(s) plus required penetration depth as shown on typical pier detail in the structural drawings. Bids shall state unit prices per foot inclusive of drilling, reinforcing, and concrete for depths greater or less than the estimated depths as shown on typical pier detail. Adjustment of the contract sum shall be based on the total of individual shaft depths greater or less than estimated depths multiplied by their respective applicable unit price. The reconciliation of pier shaft lengths shall be calculated as shown on the "Sample "I" Pier Depth Reconciliation Worksheet" included in this specification section.

B. Casings for Piers: Bids shall include the cost of casings for _____% of the total number of piers in each pier diameter category (e.g. 18", 24", etc.). Contractor shall fill in unit prices on the bid form for casing “extra” costs and “credit” amounts for each category. After taking into account the total linear feet of casing required by the base bid for each category, the Contract sum shall be adjusted to reflect the net increase or decrease in the total linear feet of casing required for each category, multiplied by the applicable unit cost or credit amount. The reconciliation of pier casing lengths shall be calculated as shown on the "Sample "II" Pier Casing Length Reconciliation Worksheet" included in this specification section.

C. Penetrations shall be drilled to depths shown on structural drawings and shall be included in the Contractor's bid. In recognition of the imprecise nature of the drilling process, payment for over-drilling penetrations shall be permitted for up to and including 8" beyond the depth shown on the structural drawings. Payments for overdrilling beyond 8" shall only be considered when recommended by the Independent Testing Laboratory as a result of conditions encountered in the field, on a per-hole basis and when such recommendation has been so noted on the pier log report.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcement shall meet the requirements specified in SECTION 03 20 00 - CONCRETE REINFORCING.

B. Concrete shall meet the requirements specified in SECTION 03 30 00 - CAST-IN-PLACE CONCRETE with the exception of the following slump requirements:
1. 4" to 6" for dry shafts
2. 6" to 8" if casings are used

C. Casing: ASTM A252/A252M, Grade 2 or ASTM A36/A36M.

D. Pier Sleds: Provide "Centraligner" sleds and Hijacker pier bolsters as manufactured by Pieresearch, Arlington, TX (phone 817.265.0980) or equivalent.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Drilling: Drill foundation shafts with a power auger drilling machine designed for the purpose. Locate accurately and drill to the required size and depth. Underream for pier bells. Actual depth required for piers shall be determined by an engineer from the independent testing laboratory at the project site during the pier drilling operation. The pier drilling rig shall have sufficient size and power to penetrate to the required depths.

B. Cleaning: Machine clean the bottoms of shafts of loose material and debris. De-water the shafts. Shafts shall be inspected by the testing laboratory before concrete is placed.

C. Reinforcing Steel:
   1. Form a cage as a structural element to maintain its shape and proportion throughout the placing of concrete and extraction of casing.
   2. Install pier sleds so that reinforcing remains in position without displacement while the concrete is placed. Sled spacing and attachment shall be in accordance with sled manufacturer's recommendations.
   3. Block reinforcing steel up off the bottom at least 3" with pier bolsters and fasten in place without any contact with the sides of the shaft.

D. Placing Concrete: Place concrete in each pier shaft not later than 8-hours after drilling, underreaming and cleaning of the pier hole is completed.
   1. Concrete shall be placed using a clean “tremie”. In no event shall concrete strike the sides of the excavation or the reinforcing cage. Placement by the "Free Fall" method may be implemented only at the direction of the Owner’s on-site testing laboratory.
   2. Vibrate or "rod" only the top 10' of concrete. Do not vibrate concrete of 6" slump or higher.
   3. Do not place concrete in intersecting walls and beams until the pier concrete is no longer plastic.

E. Casing:
   1. If caving soil or flowing water is encountered, use a casing to prevent caving and to exclude water. Casing shall be temporary type, to be withdrawn as the concrete is placed.
   2. If a temporary casing is used, withdraw casing as concrete is placed so that bottom of casing remains below top of concrete throughout placing operation or until top of concrete reaches stable soil free from seepage. Do not rotate casing during withdrawal.
   3. The requirement for casing of piers and the quantity of casing required for each pier, if any, shall be determined by the independent testing laboratory representative at the project site during the pier drilling operation.

3.2 FIELD QUALITY CONTROL

A. Inspection and Evaluation: The Independent Testing Laboratory shall provide full-time inspection at the project site during the drilling of shafts, installation of reinforcing steel, and placing of concrete in pier shafts. Full-time inspection shall include recording and reporting the information required in this specification.

B. The cost of the full-time inspection service shall be borne by the Owner.

C. All costs associated with reinspection, additional inspection or retesting required as a result of non-conforming work shall be borne by the Contractor.

3.3 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:
   1. Release, revoke, alter or enlarge on requirements of contract documents.
   2. Approve or accept any portion of the work.
   3. Perform any duties of the Contractor.

3.4 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work.

B. Furnish copies of product test reports as required.

C. Furnish incidental labor and facilities:
   1. To provide access to work to be tested.
   2. To obtain and handle samples at the Project site.
   3. To facilitate inspections and tests.
   4. For storage and curing of test samples.

D. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. Notify laboratory immediately if there is a change in schedule to alleviate any unnecessary trips by laboratory personnel.

E. Payment for all retesting required because of nonconforming work or materials.

SAMPLE WORKSHEET "I"
PIER DEPTH RECONCILIATION WORKSHEET

PROJECT _____ PAGE ____ OF ____

PIER DIAMETER THIS PAGE _____

	A	MINUS	B	=	C	x	D	=	E
	PIER NO.	ESTIMATED BEARING ELEVATION		ACTUAL BEARING ELEVATION		AMOUNT DEEPER (+) OR SHALLOWER (-) THAN ESTIMATED BEARING		APPLICABLE UNIT PRICE FROM BID FORM (NOTE: EXTRA(+) OR CREDIT (-))	NET EXTRA COST OR CREDIT DUE PER PIER
1									
2									
3									
4									
5									
6									
7									
8									
9									
									TOTAL OF COLUMN "E"

SAMPLE WORKSHEET "II"

PIER CASING LENGTH RECONCILIATION WORKSHEET

PAGE _____ OF _____

PROJECT _____

PIER DIAMETER THIS PAGE _____

	PIER NO.	F MINUS GROUND ELEVATION AT PIER	= ESTIMATED BEARING ELEVATION (A)	G ESTIMATED CASING LENGTH	F MINUS GROUND ELEVATION AT PIER	= * ACTUAL BEARING ELEVATION (B)	ACTUAL CASING LENGTH (H)
1							
2							
3							
				SUM OF FIGURES IN COLUMN "G"			SUM OF FIGURES IN COLUMN "H"
				x SPECIFIED BID BASIS PERCENTAGE FOR CASING TO BE CASED			
				= TOTAL ESTIMATED CASING LENGTH			= TOTAL ACTUAL CASING LENGTH

TOTAL ACTUAL CASING LENGTH - TOTAL ESTIMATED CASING LENGTH x APPLICABLE UNIT PRICE EXTRA(+) OR CREDIT(-) = TOTAL COST OF CASINGS

TOTAL COLUMN "E" ON WORKSHEET "I" + TOTAL COST OF CASINGS ON WORKSHEET "II" = TOTAL DOLLAR CHANGE TO CONTRACT

* IF THE ELEVATION OF THE BOTTOM OF CASING DIFFERS FROM THE ACTUAL BEARING ELEVATION, USE BOTTOM OF CASING ELEVATION WHEN CALCULATING TOTAL ACTUAL CASINGS.

SAMPLE "III"
GLOSSARY OF TERMS USED IN SAMPLE WORKSHEETS "I" AND "II"

COLUMN "A" - ESTIMATED BEARING ELEVATION:

For bidding purposes, it is the estimated elevation shown on the typical pier detail in the structural drawings at which point pier penetration commences.

COLUMN "B" - ACTUAL BEARING ELEVATION:

Actual elevation at which the bearing material is encountered by each pier as determined in the field by the independent testing laboratory.

COLUMN "C" - AMOUNT DEEPER (+) OR SHALLOWER (-) THAN ESTIMATED BEARING ELEVATION:

The amount, in feet, the bearing material was encountered above or below the estimated bearing elevation.

COLUMN "D" - APPLICABLE UNIT PRICE FROM BID FORM, EXTRA (+) OR CREDIT (-):

The applicable Extra and/or Credit unit prices per linear foot including drilling, reinforcing and concrete shown on the successful contractor's Bid Form.

COLUMN "E" - NET EXTRA COST OR CREDIT DUE PER PIER:

Net extra cost or credit due per individual pier (exclusive of casing, if required).

COLUMN "F" - GROUND ELEVATION AT PIER:

The elevation of ground at pier at time pier is drilled.

COLUMN "G" - ESTIMATED CASING LENGTH:

The estimated total linear feet of casing required for bidding purposes.

COLUMN "H" - ACTUAL CASING LENGTH:

The actual total linear feet of casing utilized during drilling.

END OF SECTION

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SECTION 32 11 13.13

LIME-TREATED SUBGRADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Foundation course of lime stabilized natural subgrade material.

1.2 MEASURMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM D698 - Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.

B. ASTM D1140 - Method of Test for Amount of Material in Soils Finer than the No. 200 Sieve.

C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.

D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

G. TxDOT Tex-600-J - Lime Testing Procedure.

H. Geotechnical Engineering Soils Report.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Division 1.

B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.5 TESTS

A. Testing will be performed under provisions of Section - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish

compliance with specifications.

E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to sub grade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 PRODUCTS

2.1 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.2 LIME

A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.

B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.
2. Grade S: Finely-graded quicklime for use in the preparation of slurry for wet placing. Do not use grade S quicklime for dry placing.

D. Lime shall conform to requirements of Item 260 of the 1993 Texas Department of Transportation Standard Specifications.

E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted sub grade is ready to support imposed loads.

B. Verify sub grade lines and grades are correct.

3.2 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Cut material to bottom of sub grade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.
2. Visible indication that cut is to proper depth.

C. Alternatively, scarify or excavate to bottom of stabilized sub grade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

3.3 LIME SLURRY APPLICATION

A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.06C concerning use of quicklime.

B. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

C. Apply so that dry sub grade will contain a minimum lime content of 7 percent by weight of dry sub grade unless otherwise instructed by Testing Laboratory.

3.4 PRELIMINARY MIXING

A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

C. Shape mixed sub grade to final lines and grades.

D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:

1. Seal sub grade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
2. Cure soil-lime material for 1 to 4 days. Keep sub grade moist during cure.

3.5 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.

C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.

D. Shape mixed sub grade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between

application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.6 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

B. Start compaction immediately after final mixing, unless approved by Engineer.

C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:

1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.
2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.

3.7 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Sub grade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep sub grade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from the Engineer.

3.8 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16 foot length.

3.9 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section - Testing Laboratory Services.

B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.

D. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

E. Fill test sections with new compacted lime stabilized sub grade.

3.10 PROTECTION

A. Maintain stabilized sub grade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION 32 11 13.13

SECTION 32 11 16

DRAINAGE STONE BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Drainage stone base material under synthetic grass surfacing.
   2. HDPE Liner.

B. Related Sections:
   1. Section 11 68 00 - PLAY FIELD EQUIPMENT AND STRUCTURES.
   2. Section 32 18 13.10 - SYNTHETIC GRASS SURFACING.

1.2 REFERENCE STANDARDS

A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

B. ASTM D751 - Standard Test Methods for Coated Fabrics; 2019.

C. ASTM D2136 - Standard Test Method for Coated Fabrics—Low-Temperature Bend Test; 2019, with Editorial Revision (2021).

D. ASTM D4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique; 2020.

E. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products; 2007 (Reapproved 2026).

F. ASTM D5884 - Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes; 2015.

G. ASTM D6241 - Standard Test Method for Measuring Static Puncture Strength of Geotextiles and Geosynthetic-Related Products Using a 50?mm Probe; 2022a.

H. ASTM D7003 - Standard Test Method for Strip Tensile Properties of Reinforced Geomembranes; 2021.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: For each type of product:
   1. Include construction details, material descriptions, and accessories for geomembrane liners.

C. Submit test reports from commercial laboratory as outlined herein.

D. Submit reproducible drawing as described under “Record Drawings” Paragraph prior to placement of synthetic turf.

1.4 WARRANTY

A. Manufacture agrees to repair or replace geomembrane line that fails in materials or workmanship within specified warranty period:

1. Failures include, but are not limited to, the following:
   a. Leaks in geomembrane liner.
   b. Defects in seams.
2. Warranty Period: 1 year from date of Substantial Completion

PART 2 - PRODUCTS

2.1 DRAINAGE STONE BASE

A. Drainage stone base shall consist of a 4" coarse utility drainage stone base topped with a 2" layer of crushed limestone finish course. Stone base material used shall be obtained from crushing limestone. Crushed stone used on this project shall conform to the requirements of ASTM C33/C33M - #57, ASTM C33/C33M - #8, and AASHTO. Stone shall conform to the following sieve analysis.

	% Passing	
Sieves	Base Stone	Finish Course
3"	---	---
2"	---	---
1 1/2”	100	---
1"	95-100	---
3/4”	---	---
1/2”	25-60	100
3/8”	---	85-100
1/4”	25-65	---
#4	0-10	10-30
#8	0-5	0-10
#16	---	0-5

B. Drainage stone base system shall have a minimum percolation rate of 30" per hour. Contractor shall provide test results that confirm the base system meets this requirement.

C. Material source must be approved by the Architect.

2.2 HDPE LINER

A. Provide “Titan 20”, a 20-mil liner of woven strips of HDPE (High-Density Polyethylene) encased in low density polyethylene coating as manufactured by Titan Environmental USA and Intertape Polymer Group (IPG) or equivalent.
   1. System has the following performance properties:

TESTED PROPERTY	TEST METHOD	UNIT
Tensile	ASTM D7003	133 lb./in.
Tear Resistance	D5844	60 lbs.
Puncture Resistance	ASTM D4833/D4833M	113 lbs.
Weight	lb./sq.ft.	.05 lb./sq.ft.
Hydrostatic Resistance	ASTM D6241	922 lb.
Low Temperature Flex	ASTM D2136	Md & TD: Pass @ -40 C
CBR Static Puncture	ASTM D6241	922 lbs.
Tongue Tear-Large Scale	ASTM D5884	MD & TD: 60 lbs.
MVTR	ASTM E96/E96M	0.40 g/m² 24 hr
Mullen Burst	ASTM D751	375 psi
Hydraulic Conductivity	(from MVTR)	1.97×10^{-12} cm/s
Carbon Black Content	ASTM D4218	3%

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

A. The subgrade shall be excavated and shaped in conformity with the typical sections shown on drawings. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material and, if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. Subgrade shall be proof rolled to detect any soft spots. The surface of the subgrade shall be shaped with laser guided equipment and shall be finished to line and grade as established and in conformity with the typical section shown on drawings, and any deviation in excess of 0.1 foot in cross section and in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfaction prosecution of the work.

3.2 PLACEMENT OF GEOTEXTILE

A. Prior to placing the drainage stone base, liner shall be spread over the entire subgrade so that none of the stone base comes in contact with the existing soil. Install liner in strict accordance with manufacturer's written instructions and recommendations, including overlapping and 'welding' seams.

3.3 PLACING

A. The base stone and finish course material shall be delivered in approved vehicles of a uniform capacity, and it shall be the charge of the Owner that the required amount of specified material shall be delivered to secure the proper thickness of each course. Material shall be dumped around the perimeter of the field and spread with tracked equipment. Spreading equipment shall always be fully supported by the stone base material. Contractor shall avoid overstressing the soils by utilizing equipment that spreads the base material and only exerts moderate pressure on the subgrade. Rutting at the time of placement is an indication of overstressing the subgrade. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the Owner's Representative. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped with laser guided equipment to conform to typical sections as shown on drawings. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well graded material.

3.4 COMPACTION

A. The stone base shall be sprinkled and compacted with four passes of a steel-wheeled, minimum 20-ton vibratory roller. Any areas of material that do not compact properly will be corrected immediately by scarifying the area affected, reshaping and recompacting.

3.5 FINISH GRADING

A. The drainage stone base shall be fine graded using laser guided equipment. The finish grade shall be within 0.01 foot of proper subgrade elevation.

3.6 RECORD DRAWINGS

A. Upon completion of the stone base grading and compaction the Contractor shall paint a twenty foot (20') grid over the entire field. Grade shots will be taken by a registered public surveyor at each grid line intersection. The grades will be transferred to a reproducible drawing of the football field. The Synthetic Turf Installation Contractor and the Architect must approve the Record Drawings prior to placement of the synthetic turf. The Synthetic Turf Installation Contractor and the Architect must visually observe the painted grid lines to determine if there are any high spots, low spots, undulations, etc., in the stone base. Any irregularities that will affect the accuracy of the yard lines on the field shall be corrected prior to placement of the synthetic turf.

END OF SECTION

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SECTION 32 12 16

ASPHALTIC CONCRETE PAVING REPAIR

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Verify designated areas to be repaired.

B. Removal of unsound asphaltic concrete areas.

C. Tack coating edges and exposed subgrade of excavations.

D. Placing full depth asphaltic concrete.

E. Rolling.

F. Clean up.

1.2 ABBREVIATIONS OF REFERENCE STANDARDS

A. City of Dallas General Specification for Construction, Revised June 7, 1965 (C.D.G.S.).

B. 1972 Standard Specification for Construction of Highways, Streets, and Bridges, Texas Highway Department (T.H.D.).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mineral aggregate, fine aggregates, coarse aggregates and mineral filler - C.D.G.S. M32.2

B. Asphalt Cement - T.H.D. ITEM 300.2(2), AC-20.

C. Tack coat - rapid curing cut back asphalt or emulsified asphalt - C.D.G.S. M32.3.

2.2 MIXTURES

A. Asphaltic Concrete - a uniform mixture of coarse aggregate, fine aggregate, mineral filler and asphalt cement accurately proportioned by weight.

B. Fine graded surface course:
   1. Coarse aggregate portion shall be crushed stone. Pea gravel not acceptable. Asphalt materials shall form 4.0 to 8.0% of mixture by weight.
   2. Gradation:
      a. D.G.S. M32.4 Fine Graded Surface Course Type (D), and Type (B).

PART 3 - EXECUTION

3.1 PREPARATION

A. Jack hammer defined limits of areas in a straight line to minimum depth of 6" or until sound subgrade is obtained. Limits should extend at least on ft. into good pavement outside the damaged area. If sound subgrade is not found within 6", remove unsound subgrade until sound subgrade is found, and replace with suitable material compacted to a stable condition up to within 6" of surface.

B. Tack coat sides and surface of excavation per C.D.G.S. P14.4.

3.2 PLACING

A. Place and compact material in maximum of 4" lifts (courses) in accordance with C.D.G.S. P14.5.

3.3 COMPACTION

A. Use equipment to obtain maximum compaction without damage to surrounding asphalt area.

3.4 CLEAN UP

A. Broom clean areas of Work and remove extraneous material from site.

END OF SECTION

SECTION 32 13 13.25

CONCRETE SIDEWALKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforced concrete sidewalks.

B. Wheelchair ramps.

C. Reinforced slope paving.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.

B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).

H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statues.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit certified testing results and certificates of compliance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Division 32.

B. Reinforcing Steel: Conform to material requirements of Division 32. Use No. 3 reinforcing bars.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Division 31

E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater

than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.

F. Sand Bed: Conform to material requirements for bank run sand of Division 31.

G. Sodding: Conform to material requirements for sodding of Division 31.

H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Division 31. Color shall be Brick Red or as shown on the drawings.

PART 3 EXECUTION

3.1 REPLACEMENT

A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.

B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.2 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Division 31.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Division 31. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.

E. Immediately after subgrade is prepared, begin form work and concrete placement.

3.3 PLACEMENT

A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.

B. Reinforcement:

1. Install reinforcing bars.
2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

C. Expansion Joints: Install expansion joints with load transfer units in accordance with Division

32.

D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

F. Apply coating to wheelchair ramp with contrasting color in accordance with Division 32.

G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

H. Finish edges with tool having 1/4 inch radius.

I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Division 1. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Division 32.

3.4 CURING

A. Conform to requirements of Division 32.

3.5 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Division 1.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. If the Contractor places concrete without notifying the laboratory, the Owner will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.

E. Sampling of fresh concrete shall be in accordance with ASTM C 172.

F. Take slump tests when cylinders are made and when concrete slump appears excessive.

G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.

H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.

I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Owner's Representative. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.6 NONCONFORMING CONCRETE

A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.

B. Replace nonconforming sections at no additional cost to Owner.

3.7 PROTECTION

A. Maintain newly place concrete in good condition until completion of Work.

B. Replace damaged areas.

END OF SECTION 32 13 13.25

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.

B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.

E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 PRODUCTS

2.1 BOARD EXPANSION JOINT MATERIAL

A. Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.2 PREFORMED EXPANSION JOINT MATERIAL

A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.3 JOINT SEALING COMPOUND

A. Provide joint sealant as indicated on the drawings.

2.4 LOAD TRANSMISSION DEVICES

A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.5 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner's Representative.

PART 3 EXECUTION

3.1 PLACEMENT

A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling, or cracks.

3.2 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.3 EXPANSION JOINTS

A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart or as shown on the drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.4 CONTRACTION JOINTS

A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.5 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.6 SAWED JOINTS

A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular

cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.7 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.8 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 40 feet.

3.9 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.

B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Owner's Representative. Use concrete grooving machine or power- operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.

END OF SECTION 32 13 73

SECTION 32 18 13.10

SYNTHETIC GRASS SURFACING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Section Includes: Furnish all labor, materials, tools and equipment necessary to install, in place, all synthetic turf material as indicated on the plans and as specified herein. The installation of all materials shall be performed in strict accordance with the manufacturer's written installation instruction, and in accordance with all approved shop drawings.
   1. Provide extra turf materials to the Owner for future repair and protective purposes.

B. Related Sections
   1. Section 01 23 00 - ALTERNATES.
   2. Section 11 68 00 - PLAY FIELD EQUIPMENT AND STRUCTURES.
   3. Section 32 11 16 - DRAINAGE STONE BASE.

1.2 REFERENCE STANDARDS

A. ASTM D418 - Standard Test Methods for Testing Pile Yarn Floor Covering Construction; 1993 Edition.

B. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings; 2021.

C. ASTM D1907 - Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method; 2018.

D. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).

E. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.

F. ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test); 2021 (Reapproved 2025).

G. ASTM D5793 - Standard Test Method for Binding Sites per Unit Length or Width of Pile Yarn Floor Coverings; 2018.

H. ASTM D5823 - Standard Test Method for Tuft Height of Pile Floor Coverings; 2019 (Reapproved 2024).

I. ASTM D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings; 2020 Edition.

J. ASTM E11 - Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves; 2024.

K. ASTM F355 - Standard Test Method for Impact Attenuation of Playing Surface Systems, Other Protective Sport Systems, and Materials Used for Athletics, Recreation and Play; 2016 Edition, July 1, 2016.

L. ASTM F1936 - Standard Specification for Impact Attenuation of Turf Playing Systems as Measured in the Field; 2019.

1.3 SUBMITTALS

A. Prior to order of materials, the Turf Contractor shall submit the following:
   1. Product Data including Independent Test Lab Results
   2. Installation details
   3. Sample Warranty
   4. Field layout and striping plans
   5. Details on construction, especially any details that may deviate from plans and specifications.

B. Prior to the beginning of installation, the manufacturer/installer of the synthetic turf shall inspect the subbase and supply a Certificate of Subbase Acceptance for the purpose of obtaining manufacturer's warranty for the finished synthetic playing surface.

C. Shop drawings shall be prepared at the scale of the construction documents and contain all pertinent information regarding installation. These drawings shall be submitted to the Architect/Owner for approval prior to the manufacturing and shipment of materials.

D. Submit drawings for:
1. Installation details; edge detail, goal post detail, other inserts and covers, etc.
2. Striping plan; layouts showing any field lines, markings and boundaries, and field logos per project drawings.

E. Samples:
1. Two (2), (6"x12") samples each of each green turf showing backing with perforations.
2. Two (2), (6"x12") samples each of the other colors proposed for use on the field for lines and markings.
3. Two (2), (6"x12") samples each of turf showing method of seam makeup with perforations. One (1) sample to have example of inlaid lines.
4. Two (2), One (1) pound samples of the proposed infill material.

F. Prior to Final Acceptance, the Contractor shall submit to the Owner three (3) copies of Maintenance Manuals, which will include necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and striping.

1.4 QUALITY ASSURANCE

A. Manufacturer/Installer's Experience: The synthetic turf installer/manufacturer shall have the experience of at least ten (10) acceptable installations of full-size football or soccer fields (minimum of 70,000 SF) in the United States within the past five (5) years of tufted, mono-fiber grass-like fabric that are infilled with a layered system of pea gravel and rubber. Provide this listing with the bid. The Turf Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of the specified system.

B. Turf Contractor shall meet the following criteria:
1. Have proper license, in good standing, and have never had a license revoked.
2. Have not had a Surety or Bonding Company finish work on any contract within the last five (5) years.
3. Have not been disqualified or barred from performing work for any public Owner or other contracting entity.

1.5 EXISTING CONDITIONS

A. The Synthetic Turf Contractor will be responsible for any damage to the subbase during installation of the synthetic turf system after the deficiencies (if any) have been corrected as noted on the Certificate of Subbase Acceptability. New football goal posts and/or infield dirt mix backfill within the contiguous turf limits or immediately adjacent thereto are not to be installed by the Owner/Prime Contractor until after the new synthetic turf system has been completed.

1.6 SCHEDULE

A. Turf Contractor shall complete all work on the synthetic turf system in accordance with the published project schedule.

B. The Turf Contractor will require unencumbered use of an area within 30 feet of the synthetic turf area(s) being installed in order to complete his work. Turf Contractor shall also be afforded unencumbered access through the construction site to reach the turf field area being installed.

1.7 SURFACE AREA

A. The Turf Contractor is to verify all existing and new measurements.

1.8 UTILITIES

A. Owner/Prime Contractor will supply necessary water, adequate lighting and electricity for installation.

1.9 WARRANTY

A. Warranty: The Contractor shall submit its Manufacturer's Warranty with (3rd party) verification manufacturing was to standards. The warranty guarantees the usability and playability of the synthetic turf system for its intended uses for an eight (8) year period commencing with the date of Substantial Completion.
   1. The warranty submitted must have the following characteristics:
      a. Must provide coverage for eight (8) years from the date of Substantial Completion.
      b. Must warrant materials and workmanship.
      c. Must verify through a (3rd party) that the materials installed meet or exceed the product specifications.
      d. Must have a provision to either make a cash refund or repair or replace such portions of the installed materials that are no longer serviceable to maintain a serviceable and playable surface.
      e. Must be a manufacturer’s warranty from a single source covering workmanship and all self-manufactured or procured materials.
      f. Warranty shall cover the designated uses enumerated, including, but not limited to:
         1) Athletics/Sports/Practice activities or competitions.
         2) Marching band
         3) Physical exercises
         4) Physical education activities
         5) Pneumatic rubber-tired maintenance and service vehicles
         6) Pedestrian traffic and other similar uses
         7) Ceremonial and Entertainment Events
         8) Wheelchairs.
   2. NOTE: Prior to the final pay application being approved, the warranty documents must be received.

B. Guarantee that throughout the 8-year warranty period, the synthetic turf system shall have a maximum "G" value according to ASTM F1936 and Procedure A, ASTM F355, not to exceed 130G's at any location upon installation and shall not exceed 175G's throughout life of the warranty period. This shall be determined by conducting dynamic cushioning tests at the locations designated in ASTM F1936 and at corners of the soccer penalty boxes at opposite sides of the field. Any increase from 130G's to allowable 175G's maximum shall be at a relative uniform rate not to exceed 15 G's in any single yearly period. Manufacturer will be responsible for testing and documenting the result every year of the warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

A. Approved Manufacturers:
   1. Hellas Matrix 46 with Cushdrain Pad and Ecotherm infill - (46-ounce face weight; 2.25" pile height as measured in the field).
   2. Symmetry AstroTurf 3DM with AstroPad and Brockfill infill - (52-ounce face weight; 2" pile height as measured in the field).
   3. FieldTurf Prestige XM with BrockPad and Coolfill infill - (40-ounce face weight; 2.25" pile height as measured in the field).
   4. Paragon/Shaw Powerblade Pro with NXTPlay Pad and Geofill infill - (43-ounce face weight; 2.25" pile height as measured in the field).

B. Football Field: "Bases of Design"
   1. Provide “Matrix 46 oz Helix” as manufactured Hellas Construction, with Cushdrain Pad and Ecotherm Infill. Material shall be a tufted, mono-fiber grass-like fabric coated with a secondary backing of high grade polyurethane. The fibers shall be tufted to a finished pile height of approximately 54mm. The turf fabric shall be filled with a layered system of silica pea gravel and rubber granules.
   2. Provide colors from full list of manufacturer's available list of colors, to be as selected by Architect, as shown on construction drawings.

3. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure in all climates, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation, and shall have the basic characteristic of flow through-drainage allowing free movement of surface run-off through the turf fabric where such water may flow to the existing subbase and into the field drainage system.
4. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes of all types. The finished surface shall resist abrasion and cutting from normal use.
5. Pile yarn (Polyethylene) shall be a proven athletic caliber yarn designed specifically for outdoor use and stabilized to resist the effect of ultraviolet degradation, heat, foot traffic, water and airborne pollutants. The pile fiber shall possess the following physical characteristics:
6. Infill: Infill material shall be a layered system of pea gravel and rubber in accordance with the manufacturer's recommendations and the Owner's preference.
7. Perimeter and interior edge details, underground storm sewer piping and connections, and goal post foundations required for the system shall be as detailed and recommended by the manufacturer, and as approved by the Owner.
8. Product Characteristics:

	Standard	Property	Specification
1	ASTM D418/ASTM D5848	Pile Weight	46 oz. /Sq. Yd.
2	ASTM D5848	Primary and Secondary Backing Weight	9.2 oz. /Sq. Yd.
3	ASTM D5848	Secondary Coating Weight	26 oz. /Sq. Yd.
4	ASTM D5848	Total Weight	81.2 oz. /Sq. Yd.
5	ASTM D1907	Yarn Denier	4 single monofilament yarn ends in 1,710 denier lime green 4 single monofilament yarn ends in 1,450 denier dark green
6	ASTM D5823	Pile Height	Finished 2 1/4"
7	ASTM D5793	Tufting Gauge	1/2"
8	ASTM D5848	Primary Backing	Tri-layer woven Polypropylene
9	ASTM D5848	Secondary Coating	Polyurethane
10	ASTM D1335	Tuft Bind without Infill	8 lbs. +/-
11	ASTM D5034	Grab Tear (width)	250.1 - 273.1 lbs. Force
12	ASTM D5034	Grab Tear (length)	197.6 - 236.1 lbs. Force
13	ASTM D4491/D4491M	Carpet Permeability	10 - 15 inches/hour
14	ASTM D2859	Flammability (Pill Burn)	Pass
15	ASTM F355	G-max (Impact Attenuation)	<130 at installation <190 over warranty life
16	ASTM E11	Realfill™ Infill	6 -7 lbs +/- per square foot
17		Fabric Width	15'
18		Perforation	3/16" Holes 4" X 4"
19		Yarn	160 microns x 1.6mm (lime green) 170 microns x 1.2 mm (grass green)

All Characteristics listed above nominal +/- 5%

C. Bullpens: **"Tomball Memorial High School Only"**
1. Provide "Matrix Baseball/Softball Helix" as manufactured Hellas Construction. Material shall be a tufted, 8, mono-filament grass-like fabric coated with a secondary backing of high grade polyurethane. The fibers shall be tufted to a finished pile height of approximately 1.75"-2" and have a pile weight of 42 oz./sq. yd.
2. Infill: The turf fabric shall be filled with a layered system of silica pea gravel and rubber granules.
3. Provide colors, to be as selected by Architect, as shown on construction drawings.

4. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure in all climates, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation, and shall have the basic characteristic of flow through-drainage allowing free movement of surface run-off through the turf fabric where such water may flow to the existing subbase and into the field drainage system.
5. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes of all types. The finished surface shall resist abrasion and cutting from normal use.
6. Pile yarn (Polyethylene) shall be a proven athletic caliber yarn designed specifically for outdoor use and stabilized to resist the effect of ultraviolet degradation, heat, foot traffic, water and airborne pollutants. The pile fiber shall possess the following physical characteristics:
7. Infill material shall be a layered system of pea gravel and rubber in accordance with the manufacturer's recommendations and the Owner's preference.
8. Perimeter and interior edge details, underground storm sewer piping and connections, and goal post foundations required for the system shall be as detailed and recommended by the manufacturer, and as approved by the Owner.
9. Product Characteristics:

	Standard	Property	Specification
1	ASTM D418/ASTM D5848	Pile Weight	Min. 42 oz. /Sq. Yd.
2	ASTM D5848	Primary and Secondary Backing Weight	7.9 oz. /Sq. Yd.
3	ASTM D5848	Secondary Coating Weight	26 oz. /Sq. Yd.
4	ASTM D5848	Total Weight	75.9 - 79.9 oz. /Sq. Yd.
5	ASTM D1907	Yarn Denier	12,400
6	ASTM D5823	Pile Height	Finished 1-3/4 - 2"
7	ASTM D5793	Tufting Gauge	1/2"
8	ASTM D5848	Primary Backing	Tri-layer woven Polypropylene
9	ASTM D5848	Secondary Coating	Polyurethane
10	ASTM D1335	Tuft Bind without Infill	10 lbs. +/-
11	ASTM D5034	Grab Tear (width)	275 - 287.4 lbs. Force
12	ASTM D5034	Grab Tear (length)	300 - 340.9 lbs. Force
13	ASTM D4491/D4491M	Carpet Permeability	40 inches/hour
14	ASTM D2859	Flammability (Pill Burn)	Pass
15	ASTM F355	G-max (Impact Attenuation)	<130 at installation <190 over warranty life
16	ASTM E11	Realfill™ Infill	4 - 5 lbs +/- per square foot
17		Fabric Width	15'
18		Perforation	3/16" Holes 4" X 4"
19		Yarn	180 microns

All Characteristics listed above nominal +/- 5%

PART 3 EXECUTION

3.1 GENERAL

A. The installation shall be performed in full compliance with approved shop drawings.

B. Only factory-trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the synthetic turf manufacturer's installation supervisors shall undertake the placement of the system.

C. The surface to receive the synthetic turf shall be inspected and certified by the turf manufacturer as ready for the installation of the synthetic turf system and must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

3.2 INSTALLATION

A. The subbase and curbs shall be inspected by means of a laser level and plotted on a 10-foot grid. Based upon the Contractor's inspection of the topological survey, the Sitework Contractor shall fine grade the subbase suitably, including properly rolling and compacting the base to achieve a surface planarity within 1/4" in 10 feet (+0, -1/4"). OWNER, ENGINEER OR PRIME CONTRACTOR SHALL NOT APPROVE THE SUBBASE FOR TOLERANCE TO GRADE WITHOUT OBTAINING THE TOPOLOGICAL SURVEY.

B. The Turf Project Superintendent shall thoroughly inspect all materials delivered to the site both for quality and quantity to assure that the entire installation shall have sufficient materials to maintain the schedule and proper mixing ratios.

C. Synthetic turf shall be loose laid across the field and attached to the perimeter edge detail. Recycled plastic lumber nailer board with 6" minimum length nails at perimeter, or manufacturer approved equal approved by architect and owner. Turf shall be of sufficient length to permit full cross-field installation. No head or cross seams will be allowed, except as required for inlaid fabric striping or to accommodate programmed cut-outs.

D. All seams shall be flat, tight, and permanent with no separation or fraying. All seams and markings shall be adhered to a special tape with a two-part, high strength polyurethane adhesive applied per the Turf Supplier's standard procedures for outdoor applications.

E. Infill materials shall be properly applied in numerous thin lifts using special broadcasting equipment to produce a layered system of pea gravel and SBR rubber particles. The turf shall be raked and brushed properly as the mixture is applied. The infill material shall be installed to a depth of about 1.75 inches. The layered system of pea gravel and rubber infill materials can only be applied when the turf fabric is dry.

F. Should the ambient outdoor temperature fall below 45 deg F, the Contractor and Owner will discuss available options and/or stoppage of work.

3.3 FIELD MARKINGS AND DECORATIONS

A. The field will have the lines tufted or inlaid according to NCAA or National Federation standards, as applicable.

B. Line width tolerance is (+) 1/4 inchs. Alignment tolerance on any one line (sideline, goal line, end line, yard line) is (+) 1/2 inch. Any incorrectly installed line shall be immediately removed. If such as line permanently discolors the synthetic turf, that section shall be removed and replaced at the Contractor's expense. All line marking and numbers, etc., shall be per the current University Interscholastic League (U.I.L), NCAA, NFSHSA, and Owner's recommendations and approval.
   1. Football: as shown on the contract drawings and rendering(s). Color shall be white, except where noted. Refer to construction documents for graphics and represented colors required.
      a. Side Lines
      b. End Lines
      c. 5-Yard lines
      d. Goal Lines
      e. Coaches Box
      f. Numbers with Arrows
      g. 1-Yard Hash Marks
      h. Tics
      i. Inbound Hash Marks
      j. Kickoff markings
      k. Center Logo
      l. Endzone Graphics
      m. Endzone Lettering
      n. Dashed Restraining Line
      o. **TOMBALL ISD** In White on Both Sides of the Field
   2. Soccer: as shown on the contract drawings and rendering(s). Final color shall be yellow as a color selected by Owner. Refer to construction documents for graphics and represented colors required.
      a. All Lines and Markings

3.4 CLEANING

A. Protect installed turf from subsequent construction operations.

B. Do not permit traffic over unprotected turf surface.

C. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

D. All usable remnants of new material shall become the property of the Owner.

E. The Contractor shall keep the area clean throughout the project and clear of debris.

F. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

3.5 OTHER MATERIALS AND EQUIPMENT

A. Maintenance Equipment: Provide one (1) Clean Sweep Jr., towed, non-powered Turf Sweeper with hitch, excluding prime mover vehicle. The sweeper attachment shall be of sufficient size to cover a 36” wide minimum swath in a single pass. The sweeper attachment shall be fitted with synthetic bristle brushes as recommended by the synthetic turf manufacturer and shall be used primarily to collect surface debris.
   1. Acceptable product: "SMG TurfCare TCA1400" (or approved equivalent) Synthetic Sweeper/Groomer with 72" tow-behind magnet.

END OF SECTION

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SECTION 32 18 23.39

SYNTHETIC RUNNING TRACK SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. All labor and materials necessary to install track surfacing material over the proposed base.
   2. Submit “Track Surfacing Contractor’s Statement of Qualifications” form attached to the end of this Section.

B. Related Sections:
   1. Section 32 12 16 - ASPHALTIC PAVING
   2. Division 33 - UTILITIES; continuous trench drain

1.2 REFERENCE STANDARDS

A. ASTM D395 - Standard Test Methods for Rubber Property—Compression Set; 2018 (Reapproved 2025).

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

C. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2020).

D. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013 (Reapproved 2018).

E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.3 SUBMITTALS

A. The following information shall be submitted to the Architect for approval.
   1. Standard printed specification of the synthetic track surfacing system for which this bid is submitted.
   2. Installation process and requirements:
      a. Any condition of the concrete and asphalt base that may limit track surface installation or affect the quality of installation.
      b. Weather or climatic conditions that may limit track surfacing installation.
   3. Recommended paint for permanent coloration.
   4. A letter, signed by an authorized representative of the track surfacing material manufacturer that the proposed track surfacing material falls within the allowable limits of hazardous materials identified by the EPA.
   5. A table that identifies the quantity of each of the following track surfacing materials to be used:
      a. Rubber granules.
      b. Binder.
      c. Primer.
   6. Submit written proof that the Track Surfacing Installer has a minimum of five (5) years of experience in successfully installing track surfacing of this type.
   7. A synthetic track surface system sample, 6"x6" in size, of the same synthetic track surfacing system to be installed on this project.

B. The Contractor shall be prepared, at the Owner’s request, to provide any and all tests, laboratory analysis, maintenance information, etc., that may be desired.

C. Codes and Standards:

1. Upon completion of all paint striping, the Contractor shall submit to the Architect a certification of accuracy prepared by a Registered Public Surveyor, that the track striping and layout meets all National Federation of State High School Association and U.I.L. rules and regulations.
2. Codes and standards follow the current guidelines set forth by the International Amateur Athletic Federation (IAAF) and the National Collegiate Athletic Association (NCAA), along with the current material testing guidelines as published by the American Society of Testing and Materials (ASTM).

D. Inspection: The Contractor shall, in the presence of the Architect and Owner, inspect the track and field events surfacing at the end of the first year of the guarantee period and each year thereafter until the end of the five (5) year guarantee period. Any defects in workmanship or materials (at no fault of the Owner) shall be repaired at the expense of the Contractor to the Owner's satisfaction and at no cost to the Owner.

E. Material Storage:
1. Track surfacing materials shall be delivered in sealed containers identified with manufacturer's original labeling.
2. Materials shall be stored in a dry location, protected against damage and freezing temperature.
3. All track surfacing material shall be onsite and available for an inventory by the Owner prior to surfacing.
4. All empty track surfacing material drums and bags must remain onsite until all track surfacing material has been installed and their removal is approved by the Owner. The Owner will use the empty drums and containers for a final inventory of installed materials.

1.4 QUALITY ASSURANCE

A. Installer:
1. The Contractor shall have 7 years' experience of successfully installing base mat running tracks and shall have installed a minimum of 10 complete polyurethane running track surfacing systems.
2. The Contractor shall be able to furnish evidence that they have been in business for a period of not less than 3 years, under the present name, and if required, furnish financial statements for each of the past 3 years.
3. Contractor is to provide a list of completed facilities, minimum 10, which are certified to meet IAAF/NCAA rules & regulations.
4. The track surfacing installation crew members must be full time employees of track surfacing company. No subcontracting of track surfacing will be allowed.
5. Running track surfacing shall be installed only by trained craftsmen, who are full-time employees. No outside installer or distributor shall be allowed to install Hellas sport surfaces unless licensed.
6. The Manufacturer must offer a minimum of four (4) IAAF Certified Track Systems.
7. The manufacturer must have a minimum of 10 years of experience with compound two-part polyurethane for athletic surfaces.

1.5 WARRANTY

A. Guarantee: The Contractor shall provide a written five (5) year guarantee. Guarantee shall cover workmanship, labor and materials and shall guarantee the work to be sound for a period of five (5) years from the date of final acceptance. All surfacing shall be guaranteed to the extent that the surfacing: (1) has been manufactured and applied in accordance with these and the manufacturer's specifications; (2) will hold fast and/or adhere to concrete and asphalt base; (3) will perform as specified in these specifications and the specifications of the product manufacturer in the current product information literature and specification sheets; and (4) will not bubble, blister, fade, crack or wear excessively during the guarantee period.

PART 2 - PRODUCTS

2.1 PRODUCT

A. Basis of Design: Provide EpiQ V300 as manufactured by Hellas Sport Surfaces a Division of Hellas Const., Inc. (phone: 512.250.2910, website: www.hellasconstruction.com). Track consists of a base mat made of recycled rubber granules (SBR) bound with a polyurethane binder and a impermeable layer of a bi-component urethane coating, and a pigmented spray-applied top finish of polyurethane spray-coating and EPDM rubber granules.
1. Provide one of the following Products/Manufacturers:
BSS 200; Beynon Sports Surfaces (Tarkett Sports Company)
epiQ Tracks V300; Hellas Construction (Div. of Hellas Construction)
PTS 3000; Paragon Track Surfaces (Conica)

2.2 MATERIALS

A. Primer: Polyurethane-based primers especially formulated to be compatible with the base and track surfacing materials.

B. Black SBR Granules: The rubber granules for the base mat shall be recycled SBR rubber, processed and chopped to 1-3 mm size, containing less than 4% dust.

C. Polyurethane Binder: Binder for the black rubber mat shall be an MDI-based and or MDI/TDI mixture, mono-component, black-pigmented, polyurethane binding agent. The binding agent shall not have a free TDI monomer level above 0.2%, must be black in color and must be solvent free. The binding agent must be specially formulated for compatibility with SBR crumb rubber.

D. Impermeable Layer: The resin for this application shall be a pigmented, thixotropic, two-component, polyol and isocyanate, moisture cured, urethane compound and shall be squeegee applied.

E. EPDM Granules: The rubber granules for the structural spray wearing coats shall be EPDM peroxide cured, man-made rubber containing a minimum 20% EPDM, with a specific gravity of 1.5+/-0.1, cryogenically processed and chopped 0.5-1.5mm. The EPDM rubber will be the same color as chosen by the Architect for the track surface.

F. Structural Spray Coating: The spray coating shall be 1-C single component moisture cured, pigmented polyurethane, specifically formulated for compatibility with EPDM granules. The coating shall be the color as selected by the Architect.

G. Line Marking Paint: The line marking paint shall be polyurethane-based paint, specifically manufactured to be compatible with polyurethane synthetic surfaces.

H. Physical Properties

Thickness:	1/2" (13mm)
Shore A Hardness (ASTM D2240):	55 +/- 5
Elongation at break (ASTM D412):	+/- 40%
Tensile Strength (ASTM D412):	0.80 N/mm2@ 70F
Compression Set Recovery (ASTM D395):	90% - 95% @ 70F over 24-hour period
Abrasion Resistance (ASTM D-501):	0.25 grams loss after 1000 cycles
Chalking (ASTM D822/D822M):	No change after 1000 hours in weather meter.
Coefficient of Friction: (ASTM D-1984)	Dry 0.70 to 0.75
	Wet 0.60 to 0.65
Resilience (ASTM-D2632):	38% - 42%
Tear Resistance (ASTM D624):	60 to 75 psi

PART 3 - EXECUTION

3.1 EXECUTION

A. Sub-base: The Synthetic Track Surfacing System shall be laid on a sub-base designed and approved by a licensed engineer. The General Contractor shall provide compaction test results of 95% or greater for the installed sub-base and the finished asphalt surface.

B. For NCAA certification the following criteria must be followed. The track surface i.e., asphalt substrate, shall not vary from planned cross slope by more than +/-.1 % with a maximum lateral slope outside to inside of 1% and a maximum slope of .1% in any running direction. The finished asphalt shall not vary under a 10' straight edge more than 1/8”.

C. It shall be the responsibility of the general Contractor to determine if the asphalt substrate meets all design specifications, i.e. cross slopes, planarity and specific project criteria.

D. Upon completion of surface test and correction of any defects, track surface Contractor shall submit to Architect/Owner a signed certificate stating the existing surface is acceptable and satisfactory for the installation of his track surface system.

E. Curing: Before application of the synthetic surface can begin, the asphalt shall be cured for at least 14 - 21 days; and a concrete base a minimum of 28 days.

F. Cleaning: The area to be surfaced shall be clean and free of any loose or foreign particles (dirt, oil, etc.) prior to commencement of the work. The surface is usually cleaned by use of a power blower and/or high-pressure washer.

G. Priming: The primer shall be spray-applied in accordance with the manufacturer's specifications. Only those areas that can be installed the same day should be primed.

H. Base Mat: Mix the black SBR granules and the Binder at a ratio of approximately 5:1 by weight. The exact ratio depends on the dust content of the granules, which should be reduced to a minimum. Mixing time is 2 to 4 minutes, depending on the size of the mixing-batches and the type of mixer used. The blended materials are then spread onto the asphalt or concrete base using a mechanical tandem leveler. The tandem leveler shall have a heated oscillating screed bar to obtain both smoothness and compaction. The heated screed bar normally works at a temperature of 158 to 176 degrees F. The laying procedure shall be bay-to-bay and limiting the length of the passes so as not to have any cold (cured) joints between the bays. At the beginning of each new day's work, the traverse joint from the previous day's work shall be tack coated to ensure a good bond. Small irregularities remaining in the surface after the tandem leveler has passed may be removed using a light polyethylene or Teflon roller.

I. Impermeable Layer: The "A" and "B" components are mixed at the prescribed ratio homogeneously with a suitable mixing device. This may be a strong drilling machine with a mixing paddle, a static mixing machine or an automatic mixer. The mixing process may last approximately 2 to 4 minutes per batch, depending on the employed mixing unit. This coating is squeegee-applied to the base mat, making it impermeable.

J. Structural Spray Wear Coats: After the black rubber and sealer coat have cured, the top layer installation consists of the use of Spray Coating and EPDM granules. The base mat must be dry, clean, and free of dust, oils and greases. The Spray Coating material is mixed with the EPDM granules in a suitable device. Application of the mixture is to be effected by use of a structure-spray-machine. To avoid cloud formations and to achieve total coverage of the base mat, apply two applications of the mixture in alternate directions with approximately 1.5 lbs. per square yard per coat. Resistance to abrasion, track spike damage and atmospheric corrosion; and to achieve the longest possible durability, requires installation of the materials in these quantities.

K. Line Markings: All line and event markings shall be applied by experienced personnel utilizing polyurethane based paint compatible with the synthetic track surfacing. All marking dimensions will be in accordance with the specifications issued by the appropriate sanctioning or governing body such as IAAF, NCAA, NFSHSA, etc.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Galvanized steel chain link fences.

B. Related Sections:
1. Section 03 30 00 - Cast-in-place Concrete.

1.2 REFERENCE STANDARDS

A. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.

D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

E. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).

F. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

1.3 SUBMITTALS

A. General: Submit shop drawings, product data, and manufacturer's installation instructions in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Include plan layout, spacing of components, accessories, fittings, hardware, anchorages, and schedule of components, wiring diagrams for motorized vehicle gates and access controlled personnel gates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide chain link fences and gates as manufactured by one of the following:
Allied Tube & Conduit (Div. of Atkore International, Inc.)
Anchor Fence, Inc.
General Wire & Supply Co.
Master Halco, Inc.
Merchants Metals, Inc. (Div. of Oldcastle Building Products, Inc.)
Southwestern Wire, Inc.

2.2 MATERIALS

A. Steel Fabric: Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for fencing up to 12 feet high. All fencing shall have a knuckled selvage top and bottom. Wire size includes zinc coating. Provide 2-inch mesh, 9-gage (0.148-inch diameter) wire, typical.

B. Galvanized Steel Finish: ASTM A392, Class 1, with not less than 1.2 oz. zinc per sq. ft. of uncoated wire surface.

C. Framing: Strength requirements for posts and rails shall comply with ASTM F1043.

D. Pipe shall be straight, true to section, material, and sizes specified, and shall conform to the following weights per foot:

NPS in inches	Outside Diameter (OD) in inches	Type I Steel	Type II Steel
1-1/4	1.660	2.27	1.84
1-1/2	1.900	2.72	2.28
2	2.375	3.65	3.12
2-1/2	2.875	5.79	4.64
3-1/2	4.000	9.11	6.56

E. Steel Framework, General: Posts, rails, braces, and gate frames.
1. Type I Pipe: Hot-dipped galvanized steel pipe conforming to ASTM F1083, plain ends, standard weight (schedule 40) with not less than 1.8 oz. zinc per sq. ft. of surface area coated.
2. Type II Pipe: Manufactured from steel conforming to ASTM A 569 or A 446, grade D, cold formed, electric welded with minimum yield strength of 50,000 psi and triple coated with minimum 0.9 oz. zinc per sq. ft. after welding, a chromate conversion coating and a clear polymer overcoat. Corrosion protection on inside surfaces shall protect the metal from corrosion when subjected to the salt spray test of ASTM B117 for 300 hours with the end point of 5 percent Red Rust.

F. End, corner, and pull posts: 2.875-inch OD Type I or II steel pipe.

G. Line or intermediate posts: 2.375-inch OD Type I or II steel pipe.

H. Top Rail: Manufacturer's longest lengths, with expansion-type couplings, approximately 6 inches long, for each joint. Provide means for attaching top rail securely to each gate corner, pull, and end post.
1. Galvanized Steel: 1-1/4-inch NPS (1.66-inch OD) Type I or II steel pipe.

I. Tension Wire: ASTM A 824, 0.177-inch-diameter metallic-coated steel marcelled tension wire with finish to match fabric.

J. Tie Wires: 12-gauge (0.106-inch diameter) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating of surface area in accordance with ASTM A641/A641M, Class 3.

K. Post and Line Caps: Provide weathertight closure cap for each post. Provide line post caps with loop to receive tension wire or top rail.

L. Tension or Stretcher Bars: Hot-dip galvanized steel with minimum length 2 inches less than full height of fabric, minimum cross-section of 3/16 inch by 3/4 inch and minimum 1.2 oz. zinc coating per sq. ft. of surface area. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

M. Tension and Brace Bands: Minimum 3/4-inch-wide hot-dip galvanized steel with minimum 1.2 oz. zinc coating per sq. ft. of surface area.
1. Tension and Brace Bands: Minimum 12 gage (0.105 inch) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install fence in compliance with ASTM F567. Do not begin installation and erection before final grading is completed.

B. Setting Posts: Set posts in concrete footing as detailed. Space maximum 10 feet o.c. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

C. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

D. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

E. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 11-gage hog rings of same material and finish as fabric wire, spaced maximum 24 inches o.c.

F. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.

G. Tie Wires: Use U-shaped wire of proper length to secure fabric firmly to posts and rails with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
   1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

H. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.2 GROUNDING

A. Ground all fences and electrical equipment attached to the fences as required by applicable code.

3.3 FIELD QUALITY CONTROL

A. Tolerances: Posts shall be straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched.

B. Provide fencing and gates that are true to line with maximum 1/2 inch deviation from the established centerline between line posts.

C. Repair defects as directed.

3.4 ADJUSTING AND CLEANING:

A. Test each gate operator installed to verify proper operation. Make necessary adjustments to provide proper operation.

B. Verify that all specified accessory items have been furnished and installed.

END OF SECTION

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Galvanized steel chain link fences.

B. Related Sections:
1. Section 03 30 00 - Cast-in-place Concrete.

1.2 REFERENCE STANDARDS

A. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.

D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

E. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).

F. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

1.3 SUBMITTALS

A. General: Submit shop drawings, product data, and manufacturer's installation instructions in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Include plan layout, spacing of components, accessories, fittings, hardware, anchorages, and schedule of components, wiring diagrams for motorized vehicle gates and access controlled personnel gates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide chain link fences and gates as manufactured by one of the following:
Allied Tube & Conduit (Div. of Atkore International, Inc.)
Anchor Fence, Inc.
General Wire & Supply Co.
Master Halco, Inc.
Merchants Metals, Inc. (Div. of Oldcastle Building Products, Inc.)
Southwestern Wire, Inc.

2.2 MATERIALS

A. Steel Fabric: Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for fencing up to 12 feet high. All fencing shall have a knuckled selvage top and bottom. Wire size includes zinc coating. Provide 2-inch mesh, 9-gage (0.148-inch diameter) wire, typical.

B. Galvanized Steel Finish: ASTM A392, Class 1, with not less than 1.2 oz. zinc per sq. ft. of uncoated wire surface.

C. Framing: Strength requirements for posts and rails shall comply with ASTM F1043.

D. Pipe shall be straight, true to section, material, and sizes specified, and shall conform to the following weights per foot:

NPS in inches	Outside Diameter (OD) in inches	Type I Steel	Type II Steel
1-1/4	1.660	2.27	1.84
1-1/2	1.900	2.72	2.28
2	2.375	3.65	3.12
2-1/2	2.875	5.79	4.64
3-1/2	4.000	9.11	6.56

E. Steel Framework, General: Posts, rails, braces, and gate frames.
1. Type I Pipe: Hot-dipped galvanized steel pipe conforming to ASTM F1083, plain ends, standard weight (schedule 40) with not less than 1.8 oz. zinc per sq. ft. of surface area coated.
2. Type II Pipe: Manufactured from steel conforming to ASTM A 569 or A 446, grade D, cold formed, electric welded with minimum yield strength of 50,000 psi and triple coated with minimum 0.9 oz. zinc per sq. ft. after welding, a chromate conversion coating and a clear polymer overcoat. Corrosion protection on inside surfaces shall protect the metal from corrosion when subjected to the salt spray test of ASTM B117 for 300 hours with the end point of 5 percent Red Rust.

F. End, corner, and pull posts: 2.875-inch OD Type I or II steel pipe.

G. Line or intermediate posts: 2.375-inch OD Type I or II steel pipe.

H. Top Rail: Manufacturer's longest lengths, with expansion-type couplings, approximately 6 inches long, for each joint. Provide means for attaching top rail securely to each gate corner, pull, and end post.
1. Galvanized Steel: 1-1/4-inch NPS (1.66-inch OD) Type I or II steel pipe.

I. Tension Wire: ASTM A 824, 0.177-inch-diameter metallic-coated steel marcelled tension wire with finish to match fabric.

J. Tie Wires: 12-gauge (0.106-inch diameter) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating of surface area in accordance with ASTM A641/A641M, Class 3.

K. Post and Line Caps: Provide weathertight closure cap for each post. Provide line post caps with loop to receive tension wire or top rail.

L. Tension or Stretcher Bars: Hot-dip galvanized steel with minimum length 2 inches less than full height of fabric, minimum cross-section of 3/16 inch by 3/4 inch and minimum 1.2 oz. zinc coating per sq. ft. of surface area. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

M. Tension and Brace Bands: Minimum 3/4-inch-wide hot-dip galvanized steel with minimum 1.2 oz. zinc coating per sq. ft. of surface area.
1. Tension and Brace Bands: Minimum 12 gage (0.105 inch) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install fence in compliance with ASTM F567. Do not begin installation and erection before final grading is completed.

B. Setting Posts: Set posts in concrete footing as detailed. Space maximum 10 feet o.c. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

C. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

D. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

E. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 11-gage hog rings of same material and finish as fabric wire, spaced maximum 24 inches o.c.

F. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.

G. Tie Wires: Use U-shaped wire of proper length to secure fabric firmly to posts and rails with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
   1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

H. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.2 GROUNDING

A. Ground all fences and electrical equipment attached to the fences as required by applicable code.

3.3 FIELD QUALITY CONTROL

A. Tolerances: Posts shall be straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched.

B. Provide fencing and gates that are true to line with maximum 1/2 inch deviation from the established centerline between line posts.

C. Repair defects as directed.

3.4 ADJUSTING AND CLEANING:

A. Test each gate operator installed to verify proper operation. Make necessary adjustments to provide proper operation.

B. Verify that all specified accessory items have been furnished and installed.

END OF SECTION

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SECTION 32 31 15

VINYL-CLAD CHAIN LINK FENCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Provide materials, equipment and labor to install vinyl clad chain link fencing and gates.

1.2 REFERENCES

A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

B. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

C. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

D. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2025.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Product Data: Include installation instructions for fence posts, fabric, gates, and accessories.

1.4 QUALITY ASSURANCE

A. Single-source Responsibility: Obtain chain link fences as complete units, including necessary erection accessories, fittings, and fastenings from a single source or manufacturer.

PART 2 - PRODUCTS

2.1 EXAMPLES OF ACCEPTABLE MANUFACTURERS

A. Provide vinyl-clad chain link fences and gates as manufactured by one of the following:
Allied Fence Manufacturing Co.
Ameristar Fence Products
Anchor Fence Div. Master-Halco, Inc.
Merchants Metals

2.2 MATERIALS AND CONSTRUCTION

A. Fabric: ASTM F668 The chain link fabric shall be 8 gauge outside finish with 11 gauge galvanized steel core, vinyl clad both selvages knuckled.
1. Color to be determined by Architect.

B. Top rail: 1-5/8", vinyl clad.
1. Color to be determined by Architect.

C. Terminal and Gate Posts: Terminal and Gate Posts shall be 2-1/2" vinyl covered square tubing weighing 5.10 lbs. per lineal foot; or roll-formed section measuring 3-1/2" having integral fabric loops weighing 5.14 lbs. per lineal foot or alternately TYPE I, 2.875" O.D. steel round posts vinyl covered weighing 5.79 lbs. per lineal foot, or TYPE II, 2.875" O.D. steel round posts vinyl covered weighing 4.64 lbs. per lineal foot. These posts shall not be splice welded in such a manner the weld appears above the grade line.

D. Terminal and Gate Post Fittings: Terminal and gate post fittings including tension bands, brace connections and top rail connections shall be No. 11 gauge, hot-dipped galvanized, cold-rolled carbon steel vinyl covered. No aluminum, cast iron, or pot-metal will be accepted as equals or substitutes. Top rail, brace and truss bands shall be vinyl covered and not less than 3/4" wide, secured by 5/16" diameter vinyl covered carriage bolts. Tension bars shall be vinyl covered and not be less than 3/16" by 3/4" and not less than 2" shorter than the nominal height of the fabric with which they are to be used. One tension bar shall be provided for each end and gate post, and two for each corner and pull post.

E. Gates: Gate width is shown on drawings. Frames shall be constructed of 2" vinyl covered square members weighing 2.72 lbs. per lineal foot or alternately of TYPE I, 1.900" O.D. round steel pipe weighing 2.72 lbs. per lineal foot or TYPE II, 1.900" O.D. round steel pipe vinyl covered weighing 2.281 lbs. per lineal foot. Gate frames shall be welded or alternately shall utilize corner fittings of heavy malleable iron or pressed steel securely riveted to the frame. Fabric matching the fence fabric shall be installed in the fame by means of tension bars and hook bolts. Frames having corner fittings shall be equipped with adjustable truss rods having a diameter of 3/8". Hinges shall be of adequate strength to support the gate and have large bearing surfaces for clamping in position. Under no conditions of use or abuse shall the hinges twist or turn under the action of the gate. Gates shall be capable of being opened and closed quickly and easily by one person. Gates shall be equipped with a positive latching device that will accommodate padlocking. A plunger rod, catch and semi-automatic outer catch shall be installed on drive gates so as to secure gates in an open position. Hinges, latches and catches shall be one of the manufacturer's standard designs as selected and approved by the Architect.

F. Line posts and line post top: 2" vinyl clad.
   1. Color to be determined by Architect.

G. Terminal posts and terminal post top: 2½" vinyl clad.
   1. Color to be determined by Architect.

H. Bottom cable: No. 7 gauge galvanized steel vinyl clad.
   1. Color to be determined by Architect.

I. Ties: 11 gauge aluminum vinyl clad.
   1. Color to be determined by Architect

J. Concrete: Provide concrete consisting of Portland cement, ASTM C150/C150M, aggregates ASTM C33/C33M, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi. Use at least 4 sacks of cement per cu. Yd., 1-inch maximum size aggregate, a maximum 3-inch slump, and 2 to 4 percent entrained air.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install fence in compliance with ASTM F567. Do not begin installation and erection before final grading is completed.

B. Excavation: Drill/hand-excavate with post-hole digger, holes for posts in firm, compacted soil.
   1. Excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than 4 times largest cross-section of post.
   2. Excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

C. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space maximum 10 feet o.c. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Extend concrete footings 2 inches above grade and trowel to a crown to shed water.

D. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

E. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 11-gage hog rings of same material and finish as fabric wire, spaced maximum 24 inches o.c.

F. Fabric: Leave approximately 2 inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

G. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.

H. Tie Wires: Use U-shaped wire of proper length to secure fabric firmly to posts and rails with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
   1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

3.2 PROTECTION AND CLEAN UP

A. Clean Up: Clean up all excess materials and dispose off premises. All excess materials are to become the property of the Contractor and shall be removed from the site at his expense.

END OF SECTION

SECTION 32 91 13.13

TOPSOIL PLACEMENT AND GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:

1. pH value of between 5.5 and 6.5
2. Liquid limit: 50 or less
3. Plasticity index: 20 or less
4. Gradation: maximum of 10 percent passing No. 200 sieve

B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 EXECUTION

3.1 EXAMINATION

A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner's Representative.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.2 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of Division 31.

3.3 PLACEMENT

A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Division 31.

C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.

D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Division 1.

E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

3.4 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION 32 91 13.13

SECTION 33 05 16.16

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 309R - Guide for Consolidation of Concrete.

G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.

H. ACI 315 - Details and Detailing of Concrete Reinforcement.

I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.

K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

S. ASTM C 33 - Standard Specification for Concrete Aggregates.

T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.

X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

Y. ASTM C 150 - Standard Specification for Portland Cement.

Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

EE. ASTM C 494- StandardSpecification for Chemical Admixtures for Concrete.

FF. ASTM C 595- StandardSpecificationfor Blended Hydraulic Cements.

GG. ASTM C 685- StandardSpecification for Concrete Made by Volumetric Batchingand Continuous Mixing.

HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.

JJ. CRSI MSP-1 - Manual of Standard Practice.

KK. CRSI - Placing Reinforcing Bars.

LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MM. NRMCA - Concrete Plant Standards.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit proposed mix design and test data for each type and strength of concrete in Work.

C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Owner's Representative.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.5 HANDLING AND STORAGE

A. Cement: Store cement off of ground in well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cementitious Material:
1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Owner's Representative; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of Na2O + 0.658K20.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.
b. Physical Properties:
1) Material: Polypropylene
2) Length: 1/2 inch or graded
3) Specific Gravity: 0.9l
c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.

1. Fiber: Fibrillated Polypropylene Fiber:
a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
b. Physical Properties:
1) Material: Steel
2) Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
3) Specific Gravity: 7.8
4) Tensile Strength: 40-400 ksi.
5) Young's Modulus: 29,000 ksi Minimum Average Tensile Strength: 50,000 psi Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking

6) Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.2 FORM WORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.3 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.4 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.

Classification:

Class	Type	Minimum Compressive Strength (LBS/Sq.In.)		Miximum W/C Ratio	Air Content (Percent)	Consistency Range in Slump (Inches)
		7-Day	28-Day			
A	Structural	3200	4000	0.45	4 + 1	2 to 4*
B	Pipe Block Fill, Thrust Block	_	1500	---	4 + 1	5 to 7

*When ASTM C 494, Types F or Type G admixture is used to increase workability, this range may be 6 to 9.

B. Measure water and liquid admixtures by volume.

2.5 DESIGN MIX

A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix

designs to Owner's Representative for review.

C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Owner's Representative.

D. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.

E. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.

F. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.6 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops:

1. Thickness: not less than 3/8 inch
2. Acceptable Manufacturers:
   a. Kirkhill Rubber Co., Brea, California
   b. Water Seals, Inc., Chicago, Illinois
   c. Progress Unlimited, Inc., New York, New York
   d. Greenstreak Plastic Products Co., St. Louis, Missouri
   e. Approved equal.

2.7 RESILIENT WATERSTOP

A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch
4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
2. Meets or exceeds requirements of Federal Specification SS-S-210A.
3. Supplied wrapped completely by 2 part protective paper.
4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko- Flex Products, Inc.; or approved equal.

PART 3 EXECUTION

3.1 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back form work with sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by Owner's Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.2 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.3 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Owner's Representative before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing

information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed with shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by Owner's Representative.

3.4 PLACING CONCRETE

A. Give sufficient advance notice to Owner's Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to Owner's Representative's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.5 WATERSTOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed en temperature is 35 degrees waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

3.6 F and rising. Take temperature readings in

A. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.
3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Owner's Representative, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.

B. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

C. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

D. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by Owner's Representative, provide technical assistance by manufacturer's representative in field at no additional cost to City.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.
6. Bentonite Waterstop:
   a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
   b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
   c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.

7. Adhesive Waterstop:
   a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
   b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
   c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
   d. Do not remove protective paper until just before final form work completion. Place concrete immediately. time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.7 CONSTRUCTION JOINTS A.

Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.8 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees
F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Owner's Representative.

B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.9 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.

B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Owner's Representative.

3.10 DEFECTIVE WORK

A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.

B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.

C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Division 1.

B. Unless otherwise directed by Owner's Representative, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.

1. Take concrete samples in accordance with ASTM C 172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C 42.

D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Owner's Representative, at no additional cost to City.

3.13 PROTECTION

A. Protect concrete against damage until final acceptance by City and/or County.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Owner's Representative.

END OF SECTION 33 05 16.16

SECTION 33 06 10.14

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.

B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.

C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and

Fittings Based on Controlled Inside Diameter.

N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.

O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.

P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.

R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.

T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.

C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.

PART 2 PRODUCTS

2.1 MATERIAL

A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.

1. Pipe Material:
   a. DR 18: For restrained joints where shown on Drawings.
   b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.

D. Water Service.

1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

E. Gaskets:

1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

G. Do not use PVC in potentially or known contaminated areas.

H. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

B. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.

C. Provide Polyvinyl Chloride Pipe from approved manufacturers.

D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Owner's Representative.

E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.3 GRAVITY SEWER PIPE

A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

Wall Construction	Manufacturer	ASTM Designation	SDR (Max.)/ Stiffness (Min.)	Diameter Size Range
Solid	J-M Pipe	D3034	SDR 26 / PS 115	6” to 10”
	Certain Teed	D3034	SDR 35 / PS 46	12” & 15”
	Diamond	F679	SDR 35 / PS 46	18” to 27”
	Uponor ETI	AWWA C900	DR 18 / N/A	4” to 12”
	North American	AWWA C909	DR 18 / N/A	4” to 12”
		AWWAC905	DR 18 / N/A	14” to 16”
Truss (Gasketed)	Contech	D2680	N/A / 200 psi	8” to 15”
Profile	Contech A-2000	F949	N/A / 46 psi	12” to 36”
	Contech A-2026	F949	N/A / 115 psi	8” to 10”
	ETI, Ultra-Rib	F794	N/A / 46 psi	8” to 30”
	ETI, Ultra-Corr	F794	N/A / 46 psi	24” to 36”

B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.

C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.

D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.

E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the

flattening test in conjunction with pipe stiffness test.

H. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.

I. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Division 33.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide approved ductile iron fittings as per Division 33, except furnish fittings with one of following approved internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
2. Nominal 40 mils (35 mils minimum) polyurethane
3. Nominal 40 mils (35 mils minimum) ceramic epoxy
4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy

D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Division 33.

E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 EXECUTION

3.1 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

3.2 INSTALLATION

A. Conform to requirements of Division 33, as applicable.

B. Install PVC pipe in accordance with Division 33, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.

C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:

1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
2. Water service pipe 16 inches in diameter and larger 5 feet of cover.

D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.

E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.

F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.

G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.3 PVC RESTRAINED MECHANISM

A. Do not apply lubricant to spline or pipe or coupling spline grooves.

B. Do not use excessive force while inserting the spline through coupling.

C. Insert spline until it is fully seated around circumference of pipe.

D. Field Cutting of Pipe Ends:
1. Perform by workers certified by manufacturer.
2. Use a PVC pipe cutter and provide square ends.
3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION 33 06 10.14

SECTION 33 06 40.10

HDPE SOLID AND PROFILE WALL PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.

B. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.

C. High density polyethylene (HDPE) pipe for storm sewers culverts.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"- 48" diameter.

B. AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.

C. AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.

D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.

E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

F. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.

G. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.

H. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

I. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

K. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

M. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.

N. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and

Drain Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

A. Provide manufacturer's certificate of conformance to Specifications.

B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

C. Owner's Representative reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.

1. Manufacturer's Notification: Should Owner's Representative wish to witness manufacture of specific pipes, manufacturer shall provide Owner's Representative with minimum three weeks notice of when and where production of those specific pipes will take place.
2. Failure to Inspect. Approval of products or tests is not implied by Owner's Representative's decision not to inspect manufacturing, testing, or finished pipes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 PRODUCTS

2.1 **GENERAL**

A. For sanitary sewer pipe provide HDPE pipe as follows:

1. New construction pipe products gravity sanitary sewer direct bury.

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM or AASHTO	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02505	Solid Wall Polyethylene (HDPE)	Chevron Plexco Phillip 66 Quail Poly Pipe	ASTM F-714	DR 17 DR 21	115 46	8” - 10” 12” - 48”
02531	Polyethylene Profile Wall	Spirolite	ASTM F-894	n/a	46	

2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC	SIZE RANGE
02550	Solid Wall Poly	Chevron Plexco Quail Poly Pipe AmeriFlow by NAPCO Ameriflow by KWH	F-714	DR 21	46	8” - 48” 3" - 12” 14” - 63”
02550	Polyethylene Profile Wall	Spirolite	F-894	n/a	46	18”-120”

B. For Storm Sewer and Residential Driveway Culverts provide HDPE as follows:

1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
2. Sure-Lok F477 by Hancor, Inc.

C. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.

D. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.

E. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.

F. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:

1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged conforming to the requirements of ASTM F-477.

G. Jointing:

1. Gaskets:
   a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
   b. Pipes allowed to be installed in potentially contaminated areas,

where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by pipe manufacturer

2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.2 MATERIALS FOR SANITARY SEWER

A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.

B. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.3 MATERIALS FOR STORM SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS

A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.

B. Types: CPP shall meet one or both of following:

1. Type S: Outer corrugated wall with smooth inner liner.
2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.

C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.4 TEST METHODS FOR SANITARY SEWER

A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

C. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.

D. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.5 TEST METHODS FOR STOMR SEWERS AND RESDENTIAL DRIVEWAY CULVERTS

A. Pipe stiffness at 5 percent deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.
following information:

1. Pipe size.
2. Pipe class.
3. Production code.
4. Material designation.

B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

2.6 MARKING

A. Mark each standard and random length of pipe in compliance with these Specifications with

PART 3 EXECUTION

3.1 INSTALLATION

A. Conform to requirements of Division 33.

B. Install pipe in accordance with the manufacturers recommended installation procedures.

C. HDPE pipe is not approved in applications requiring augering of pipe.

D. Bedding and backfill: Conform to requirements of Division 31.

END OF SECTION 33 06 40.10

SECTION 33 13 00.10

HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Field hydrostatic testing of newly installed water pipelines.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Disinfect water system pipelines prior to hydrostatic testing.

B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to Public water distribution system.

C. Water for testing will be charged to Contractor in accordance with applicable Ordinances. Prior to hydrostatic testing, obtain a transient meter from the appropriate governing authority. Contractor shall pay all fees associated with transient meter.

D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.

E. Conduct hydrostatic tests in presence of Owner's Representative.

3.2 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.

C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.

D. Begin test by 9:00 a.m. unless otherwise approved by Owner's Representative. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.

E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.3 ALLOWABLE LEAKAGE FOR WATERLINES

A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.

B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.

C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

3.4 CORRECTION FOR FAILED TESTS

A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

B. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Division 33. Pay for water required for additional disinfection and retesting.

C. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION 33 13 00.10

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.4 QUALITY ASSURANCE

A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

B. Provide manufacturer's certification to Specifications.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations.

B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.

C. Store pipe and fittings on heavy timbers or platforms toavoid contact with ground.

D. Unload pipe, fittings, and appurtenances as close as practical to locationof installation to avoid unnecessary handling.

E. Keep interiors of pipe and fittings free of dirt and foreign matter.

F. Store PVC pipe out of direct sunlight.

PART 2 PRODUCTS

2.1 PIPE

A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.

B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Owner's Representative or otherwise shown on Drawings.

C. Existing pipe that has been removed during construction cannot be reused.

2.2 PIPE MATERIAL SCHEDULE

A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in Division 33 and as shown on the Drawings.

B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials that conforming to requirements specified Division 33 and as shown on the Drawings.

C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

D. Pipe materials other than those listed above shall not be used for storm sewers.

2.3 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill Material: Conform to requirements of Division 31.

B. Topsoil: Conform to requirements of Division 32.

C. Use cement stabilized sand material for bedding and backfill in the pipe zone for all storm sewers.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Division 1.

B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.

C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for repairs or relocations, either temporary or permanent.

D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Division 2.

E. Install and operate dewatering and surface water control measures in accordance with Division 1.

3.2 EXCAVATION

A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use of appropriately sized grade boards which are substantially supported.

C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 6 inches.

3.3 PIPE INSTALLATION

A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.

B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Owner's Representative.

C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.

D. Install pipe with bells of pipe facing upstream of anticipated flow.

E. Form concentric joint with each section of adjoining pipe to prevent offsets.

F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Owner's Representative, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.

G. Keep interior of pipe clean as installation progresses.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.

J. For PVC Pipe:

1. Provide a minimum cover as per manufacturer's requirements from top of pavement to top of pipe, but no less than 2 feet.
2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle connections allowed.
3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Owner's Representative. Field modify pipe per manufacturer's recommendations.
4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.
5. Provide gasketed bell and spigot joints installed per manufacturer's recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

3.4 PIPE INSTALLATION OTHER THAN OPEN CUT

A. Conform to requirements of Division 33 where required.

B. Not allowed for plastic sewer pipe.

3.5 INSTALLATION OF APPURTENANCES

A. Construct manholes to conform to requirements of Division 33. Install frames, grate rings, and covers to conform to requirements of Division 33.

B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars.

C. Install inlets, headwalls, and wingwalls to conform to requirements of Division 33.

D. Rehabilitate existing manholes to conform to requirements of Division 33. Adjust manhole covers and inlets to grade conforming to requirements of Division 33.

E. Dimension for Type C and Type E manholes shall be as shown on Drawings.

3.6 INSPECTION AND TESTING

A. Perform post installation television inspection in accordance with Division 33. Hand held cameras may be used in storm sewers in lieu of requirements Division 33. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.

3.7 BACKFILL AND SITE CLEANUP

A. Backfill trench after pipe installation is inspected and approved by Owner's Representative.

B. Backfill and compact soil in accordance with Division 31.

C. Repair and replace removed or damaged pavement and sidewalks as specified in Division 32.

D. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and seed according to requirements of Division 32 as required.

END OF SECTION 33 41 00

SECTION 33 49 13

STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.

B. Ring grates.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AASHTO -American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges

B. ASTM A 48 -Standard Specification for Gray Iron Castings

C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

D. AWS -D 12.1 Welding Reinforcing Steel.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard City details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 PRODUCTS

2.1 CASTINGS

A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers if indicated on Drawings.

B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter.

D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

2.2 BEARING SURFACES

A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

2.3 SPECIAL FRAMES AND COVERS

A. Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

B. Where shown on Drawing, provide manhole frames and covers with 48 inch diameter clear opening, with inner cover for 22 inch diameter clear opening. Provide approved inner cover with pattern shown on Drawings.

2.4 FINISH

A. Unless otherwise specified, uncoated cast iron.

2.5 FABRICATED RING GRATE

A. Fabricate ring grates from reinforcing steel conforming to ASTM A 615.

B. Conform to welds connecting bars to AWS D 12.1.

2.6 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS

A. Use castings conforming to Division 33 requirements.

B. One piece casting with dimensions to fit frame and cover.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

C. Fabricate ring grates in accordance with City of Houston standard detail, "Ring Grate for Open End of 18 Inch to 72 Inch Stubs to Ditch". Set in mortar in mouth of pipe bell.

D. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

END OF SECTION 33 49 13


VLK