SECTION 28 31 01 – FIRE ALARM AND SMOKE DETECTION SYSTEM WITH VOICE EVACUATION FOR A SCHOOL

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall furnish and install a complete distributed microprocessor based 24VDC, electrically supervised, MULTIPLEX, integrated fire alarm and voice evacuation system as specified herein and indicated on the drawings. The system shall include, but not be limited to, all control equipment, remote transponders, printer, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.

B. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

C. The system shall be wired as a Class B supervised system for all circuits.

1.2 CODES AND STANDARDS

A. The system shall comply with the applicable Codes and Standards as follows:

3. Local & State Building Codes (Including all adopted amendments)
4. Texas Accessibility Standards (TAS)
5. American’s with Disabilities Act (ADA)
6. Requirements of Local Authorities having Jurisdiction

1.3 ACCEPTABLE MANUFACTURERS

A. To establish the type, quality, and features of system required, the equipment specified is that of the Hochiki FireNet Systems.

B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.

C. All references to manufacturer's or supplier's model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY conform to the specifications herein.
D. Equipment of other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer five (5) days prior to bid.

E. Provide one of the following manufacturers:

1. Hochiki FireNet

1.4 GENERAL REQUIREMENTS

A. Contractor Qualifications:

1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
4. The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
5. The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.
6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.5 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

1. Control panel configuration including wiring and interconnection schematics.
2. Complete point to point wiring diagram showing terminal connections to all system devices.
3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type. Floor plans shall be on AutoCAD v.12.
5. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
8. Programming matrix defining all input/output functions and zoning.
9. Power supply and battery calculations.
10. Written certification from the manufacturer stating that the distributor is authorized to sell, service and install the proposed fire alarm system.

B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor’s responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

1.6 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 -PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

A. Alarm Detection

1. When a fire alarm condition is detected via the main fire control panel by any of the system alarm initiating devices, the following functions shall occur:

   a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED’s to a steady state.

   b. A 640 character back-lit LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.

   c. Any remote annunciator LCD display associated with the alarm zone shall be activated as herein specified.

   d. The remote signaling or municipal tie connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner).

   e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.

   f. Alarm tones shall sound throughout the facility. Upon expiration of the alert tone, a
digitized predetermined voice evacuation message shall be automatically transmitted throughout the facility. The system shall have the capability to generate multiple distinct digital messages as determined by event initiated programs.

g. Flash all strobe lights (visual signals) throughout the facility.
h. Recall elevators to ground floor as specified herein, or to the alternate floor if the alarm condition originates on the ground floor.
i. Unlock all electrically locked doors.

2. Elevator lobbies shall be provided with one smoke detector. Upon activation of the lobby smoke detector, all elevators shall be automatically recalled to the ground floor. In the event of a fire on the ground floor, all elevators shall be automatically recalled to the 1st terminus floor above the ground floor served by the respective elevator bank.

3. Activation of the heat detector at the top of each elevator shaft and elevator machine room shall activate a shunt trip.

4. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).

5. In addition, remote annunciators shall be located where indicated. The annunciators shall duplicate the control panel alarm status indicators (for selected system zones/points) and in addition, annunciate any system trouble conditions and operate as herein specified.

2.2 SYSTEM TROUBLE DETECTION

A. When a trouble condition is detected by the CPU, one of the system initiating alarm or SLC circuits, the following functions shall immediately occur:

1. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LED’s to illuminate steady.

2. The 640 character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.

3. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

2.3 ZONING

A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the architect/engineer.

B. The system shall utilize remote amplifier cabinets for distributed voice communications (if needed), notification appliance circuits, and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent smoke detection and control modules.
2.4  FIRE ALARM CONTROL PANEL

A. The fire alarm control panel shall be Notifier series NFS2-3030 or approved equal. The control panel shall be modular in design utilizing DISTRIBUTED solid state MICROPROCESSORS and be capable of future expansion. The microprocessor based CPU shall be completely FIELD PROGRAMMABLE. CPU module shall provide for programmable non-volatile RAM memory utilizing integral lithium based memory IC chips. All circuitry shall be U.L. listed for power-limited application.

B. Central Processing Unit Module (CPU) – The CPU shall contain and execute all custom time control functions or control-by-event programs for specified events. Time control events/programs shall be automatically overridden by priority fire alarm events. All programs shall be held in non-volatile programmable RAM memory and shall not be lost even if both system primary and secondary power failure occurs.

The system shall include a trouble reminder feature to alert operating personnel to the continued presence of system trouble conditions.

C. Display Interface Board (DIA) – The DIA shall provide a 640-character back-lit, super-twist Liquid Crystal Display (LCD). It shall provide Light-Emitting Diodes (LED's) for AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; DISPLAY TROUBLE; and DISABLE.

The DIA shall provide a 25-key membrane keypad with control capability to command all system functions, status readouts, manual control action, and entry of any alphabetic or numeric information. The keypad shall include means to enter multiple five digit passwords to prevent unauthorized manual control or programming.

D. Control Switches

1. Acknowledge/step Switch
2. Signal Silence Switch
3. System Reset Switch
4. System Test Switch
5. Lamp Test

E. Loop Control/Expander Module (LCM/LEM) – The LCM/LEM shall communicate and provide power to all devices on its loop over a single pair of wires. Each signaling line circuit shall provide the capability to support up to 159 smoke detectors and 159 monitor and control modules. The LCM/LEM shall receive digital/ANALOG information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble, and sensitivity conditions. The analog information may be used for automatic test and determination of maintenance requirements. The LCM/LEM module shall individually monitor all "intelligent" detectors for sensitivity variation initiating a trouble condition should detector sensitivity "drift" become excessive. The system control unit shall have the capability to remotely read each detectors sensitivity, and if need be, electronically adjust the detector sensitivity as required for existing conditions within U.L. recommended limits. In addition, the system shall incorporate a "day/night" sensitivity feature.

F. Non-Lock Walk Test – The system shall include a special non-lock "walk test" mode. The walk test mode can be initiated by loop, software zone, or globally as field selected. The following reports shall be capable of being generated:
1. General results of all walk tested devices.
4. Report all devices not tested.

G. Automatic Detector Test – The system shall include a special automatic detector test feature which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any “intelligent” detector or addressable interface device individually from the main control panel. An automatic detector test shall occur automatically fourteen times each twenty-four hour period or be initiated manually from the FACP as desired. Automatic detector test sequencing shall be terminated upon receipt of a true alarm condition.

H. Special System Reports – The system shall have the ability to generate and print, upon command, system and point status reports. Selection of ‘system’ read status provides the operator with global system programming information. Selection of ‘point’ read status provides the operator with selected individual point programming data.

I. Field Programming – The system shall be 100% field programmable without the need for external computers or PROM programmers, and shall NOT require replacement of memory IC's. Systems requiring factory programming/re-programming OR REPLACEMENT OF MEMORY I.C. CHIPS shall not be acceptable. All programs shall be stored in non-volatile RAM memory. Programming shall be accomplished only after entering an appropriate and pre-selected five digit password security code. System programming mode shall not require the system to be taken off-line nor prohibit the system from performing its normal operations and routines. The system shall be capable of revising/changing programmed functions or system expansion at anytime subsequent to initialization as described herein without factory modifications or factory programming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site and the owner permanently furnished with required programming apparatus and software as part of this contract.

J. Event History – The main fire alarm control panel shall have the resident ability to store a minimum of 4000 events as well as a separate 1000 event alarm-only file in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five digit password security code. Systems not employing event history memory storage shall be required to furnish a printer/recorder for recording system events.

K. Power Supply – The power supply shall provide all control panel and peripheral power needs with filtered power as well as regulated 24VDC power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet U.L. and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.

Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
2.5 VOICE COMMUNICATIONS

A. The NOTIFIER DVC voice communications panel shall be modular in design utilizing solid state MICROPROCESSOR circuitry. The voice evacuation system shall integrate with the main fire alarm control panel. Side car voice evacuation systems are not acceptable.

B. Communications Controls: The communications control panel shall incorporate the following controls and indicators:

1. All call
2. General alarm
3. Audio trouble LED
4. AUDIO LEVEL LED
5. Manual tone/MESSAGE select switches with LED indicators
6. Communications zone select switches and select indicators
7. Communications monitor speaker with volume control
8. Dynamic paging microphone

C. Paging

1. The microprocessor based one way paging system shall be provided with a means to selectively activate voice, tones or digitized messages to any or all zones in the system via electronic membrane touch-pad controls. In addition, visual indication by zone will be provided.
2. Each audio/speaker circuit will be totally supervised for opens, shorts or grounds with direct shorts prohibiting selection of the respective zone. All audio circuits shall be POWER LIMITED. Each speaker zone shall be provided with an amber trouble LED for circuit trouble conditions and an active/on LED indicator.
3. Alarm/Paging zones shall be provided as required.

D. Alarm Electronics

1. The voice communications center shall be a microprocessor based, supervised, multi-function, audio generator. The communications generator shall contain:
   a. Independent Voice communications CPU.
   b. Non-volatile RAM memory.
   c. One custom digitized message circuits.
   d. Up to four selectable tone generator/oscillators.
   e. Each sub-circuit of the communications center shall be fully supervised and failure of any tone oscillator or digital message generator shall revert the system to the default standby generator.
2. The system shall be provided with a custom field programmable digitized message.
3. The system shall provide adequate audio amplification. The system shall be capable of amplifier capacity and expansion as required. Each amplifier shall be continuously monitored electronically for proper output level. Each unit shall be equipped with diagnostic indicators. Each amplifier shall provide a minimum of 50 watts of 25 VRMS of power. Each unit shall be equipped with its own individual power/pilot LED, audio input trouble LED, battery input trouble LED, and amplifier trouble/fail LED. Provide amplification for 1/2 watt per speaker plus 25% spare capacity. Electrical Contractor shall provide and install a 120 VAC dedicated circuit to each remote amplifier cabinet (if needed).
2.6 FIELD DEVICES

A. Multi Criteria Smoke and Heat Detector:

1. Intelligent multi criteria acclimating detector shall be provided where shown on the drawings. The intelligent multi criteria Acclimate Plus detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

4. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.

5. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

B. Intelligent Duct Detector – Duct mounted "intelligent" photoelectric smoke detectors shall be provided where shown on the drawings. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type "intelligent" photoelectric smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.

The unit shall consist of a clear molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination. Detectors shall be installed per NFPA 90A, and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

C. Intelligent Thermal Detectors

1. Analog, fixed temperature, thermal detectors shall be provided where indicated on the drawings. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
2. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.

3. The detectors shall provide dual alarm and power/status LED's. Status LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

D. Addressable Manual Stations

1. Manual stations shall be provided where indicated on the drawings. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required. Provide Stopper II cover.

2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type.

E. Monitor Module

1. Addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.

2. The monitor module shall provide address-setting means using rotary decimal switches. No binary coding shall be required.

F. Control Module

1. Notifier model FCM/FRM control/relay modules or approved equal shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B-field selected. The control module may be optionally wired as dry contact (form C) relay.

2. The control module shall provide address-setting means using rotary decimal switches. No binary coding shall be required. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steady when the device is actuated via the fire alarm control panel.

G. Remote LCD Alpha-Numeric Annunciators

1. Provide where indicated on the drawings, a remote LCD alpha-numeric annunciator to announce all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 or RS232 serial output terminal from the main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The illumination source shall extinguish during normal/standby mode to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby.
batteries. The remote LCD annunciator shall include:

a. Integral time-date clock  
b. Time-date select switch  
c. Time-date/contrast adjust  
d. Display/step switch  
e. System reset  
f. System silence  
g. System acknowledge  
h. Integral trouble buzzer  
i. Point enable/disable capability  
j. Full QWERTY keypad for system programming.

2. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.

H. Speakers – Speakers shall be listed under U.L. standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall be System Sensor SP200W Series. Speakers or approved equal shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.

1. Speakers shall be 4” square or round with textured white decorative grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10 feet. Speakers shall be wall or ceiling mounted as located on the drawings.

I. Speakers with Integral Strobe Light

Speakers shall be listed under U.L. standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers/strobe units shall be System Sensor SP2C Series. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points. Speaker/Strobes shall be white. Each speaker/strobe shall be equipped with an integral high intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be wall or ceiling mounted as indicated on the drawings. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 1971. All strobe lights shall be synchronized.

J. High Intensity Visual Signals – Provide System Sensor SC Series strobe lights where shown on the drawings. High intensity visual signals shall be installed where shown on the drawings and as may be required by the Americans with Disabilities Act (Public Law 101-336), Texas Accessibility Standards and NFPA 72, Chapter 6. Strobe lights shall be white.

High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be wall or ceiling mounted as indicated on the drawings. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 1971. All strobe lights shall be synchronized.
K. Sprinkler Waterflow Switch – Sprinkler waterflow switches shall be installed where indicated on the drawings. Each unit shall contain one set of SPDT alarm contacts. Waterflow switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor.

L. Sprinkler Valve Supervisory Switch – Sprinkler valve supervisory switches shall be installed on each valve as indicated on the drawings. Each unit shall contain on set of SPDT contacts. Sprinkler valve supervisory switches shall be provided, installed, and adjusted by the fire protection contractor, and connected by the fire alarm contractor.

M. Auxiliary AHU Relays – Relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. All interface relays shall be connected to a supervised notification appliance circuit.

N. Field Charging Power Supplies – Provide power supplies with battery backup as required. Electrical Contractor shall provide and install a 120 VAC dedicated circuit to each power supply.

O. Air Sampling Detector – Provide an air sampling detector as indicated on the contract drawings and as required to provide proper coverage based on the pipe calculations. Each VESDA detector shall be interfaced to the fire alarm system via four separate points (one trouble and three distinct alarm points). Each VESDA detector shall be provided with its own battery backup system as required by NFPA 72. Fire Alarm Contractor shall provide pipe system calculations using the Xtralis Aspire modelling software. All VESDA air sampling pipe shall be supported every five feet.

P. Printer – A high impact dot matrix printer shall be provided in the fire command center room. The printer shall provide hard copy printout of all changes in status of the system and shall time stamp such printouts with the current time of day and date. The printer shall be wide carriage with 80 characters per line and shall use standard pin feed paper. The printer shall communicate with the control panel using a fully SUPERVISED interface complying with Electrical Industries Association standard RS 232c. Printer shall be capable of operating on parallel or serial outputs. Power to the printer shall be 120VAC 60Hz. The printer shall print all status information including status, zone, device/point, and programmed custom ID messages. Provide a table for the printer.

PART 3 -EXECUTION

3.1 INSTALLATION

A. Wiring:

1. All wiring shall be in accordance with NFPA 72 and the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

2. Limited energy FPLP wire shall be installed provided such wire is U.L. Listed to U.L. TEST 910 for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.

3. All wiring for SLC signaling circuits shall be of the twisted, low capacitance type to guard against outside RF and EMF interference and induced noise.

4. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring)
per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and U.L. requirements.

5. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.

6. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

B. Open Wiring

1. Systems utilizing open wiring techniques with low smoke plenum cable.
2. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.

C. Conduit/Raceway and 120 VAC Power wiring

1. Conduit and raceway system shall be installed in the mechanical, electrical and telephone rooms and as required by NFPA 70.
2. Electrical Contractor shall provide and install all required dedicated 120 VAC power circuits for the fire alarm system including the main fire alarm panel, remote amplifier panels and remote strobe light power supplies.

D. Minimum Wire Sizes Shall Be As Follows:

1. Signaling Line Circuits: 18 AWG Twisted (Low Capacitance)
2. Notification Appliance Circuits: 14 AWG
3. Relay Control Circuits: 18 AWG
4. Speaker Circuits: 16 AWG Twisted/Shielded

E. All wire shall be plenum rated.

3.2 TEST AND REPORTS

A. A state licensed and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system. Instruction shall be 4 hours minimum.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested.
C. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.

E. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA Standard 72, Chapter 7. It is mandatory that the installing contractor shall provide such services and make available these services to the owner upon completion of the project.

3.3 WARRANTY

A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

3.4 FLOOR PLANS

A. Provide a 1/16" = 1'-0" floor plan on each floor showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel. The floor plans shall be framed with a glass cover and located by the fire alarm control panel and by the remote annunciator. Provide a sample for approval.

3.5 SPARE PARTS AND ATTIC STOCK

A. The fire alarm contractor shall include in his bid the cost to provide and install the additional spare parts and attic stock and associated cabling as indicated on the schedule on the contract drawings. All devices on this schedule not used during construction shall be turned over to the owner at the time of job completion.

END OF SECTION
SECTION 31 00 00 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Select fill for slabs-on-grade.
4. Subbase course for concrete walks.

B. Related Sections include the following:

1. Division 01 Section "Construction Facilities and Temporary Controls."
2. Division 03 Section “Cast-in-Place Concrete” for granular course over vapor retarder
3. Division 31 Section "Clearing and Grubbing" for site stripping, grubbing, removing topsoil, and protecting trees to remain
4. Division 31 Section “Structural Excavation and Backfill”
5. Division 31 Section “Excavation and Backfill for Utilities” for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.
6. Division 32 Section “Soil Preparation” for finish grading, including placing and preparing topsoil for lawns and plantings.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.
1. **Additional Excavation:** Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. **Bulk Excavation:** Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.

3. **Unauthorized Excavation:** Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. **Fill:** Soil materials used to raise existing grades.

H. **Structures:** Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. **Subbase Course:** Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. **Subgrade:** Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. **Utilities:** Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 **SUBMITTALS**

A. **Samples:** For the following:

1. 20-lb (9-kg) samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.

B. **Test Reports:** In addition to test reports required under field quality control, submit the following:

1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
2. One optimum moisture-maximum density curve for each soil material.
3. Report of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.

1.5 **QUALITY ASSURANCE**

A. **Codes and Standards:** Perform earthwork complying with requirements of authorities having jurisdiction.

B. **Testing and Inspection Service:** Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
C. Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings."

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:

1. Provide a minimum of 48-hours’ notice to the Owner and receive written notice to proceed before interrupting any utility.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide approved borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Select Fill Materials: Satisfactory soil materials; maximum liquid limit of 40 percent and a plasticity index between 7 and 15. Referred to hereafter as "select fill". Locally available "blow sand" or beach sand is not approved for use under building slabs on grade requiring excavations for beams. Such material may be used as fill within grade beams where grade beams are board formed on each face and the concrete slab is placed separately.

E. Backfill Materials: Satisfactory soil materials and excavated materials from site that are free of vegetation. Stripped excavated material including vegetation is usable only as non-structural backfill against buildings, walks, etc.

F. Subbase and Base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (38-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches (300 mm) on each side of pipe or conduit.

2. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3.8 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. When Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

   1. Unforeseen additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

   2. Do not stockpile material to be reused as topsoil in depths exceeding 8 feet.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

   1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.

   2. Surveying locations of underground utilities for record documents.

   3. Testing, inspecting and approval of underground utilities.

   4. Concrete formwork removal.

   5. Removing trash and debris from excavation.

   6. Removing temporary shoring and bracing, and sheeting.

3.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on rock and other unyielding bearing surfaces and fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
B. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches (450 mm) of footings. Place concrete to elevation level with bottom of footings.

C. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory excavated or borrow soil material.
2. Under walks and pavements, use subbase or base material, or select fill material as detailed.
3. Under steps and ramps, use subbase material.
4. Under footings and foundations, use select fill material.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that is too wet to compact to specified density.
3.15 **COMPACTION**

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry density according to ASTM D 698 (Standard Proctor):
   1. Under walks and pavements, compact the top 12 inches (300 mm) below subgrade and each layer of backfill or fill material at 98 percent maximum dry density with +/- 3% of the optimum moisture content.
   2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

3.16 **GRADING**

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1.2 inch (30 mm).
   2. Walks: Plus or minus 1.2 inch (30 mm).
   3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 **SUBBASE AND BASE COURSES**

A. Under pavements and walks, place subbase course material on prepared subgrades.
   1. Compact subbase courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of ASTM D 4254 relative density.
   2. Shape subbase and base to required crown elevations and cross-slope grades.
   3. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
4. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

C. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until required density is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace soil material to depth as directed by Architect; reshape and re-compact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION
SECTION 31 11 00 – CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removing surface debris and rubbish.
B. Clearing site of plant life and grass.
C. Removing trees and shrubs.
D. Removing root system of trees and shrubs.
E. Fence removal.

1.2 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.
B. Coordinate clearing work with utility companies.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

A. Protect following from damage or displacement:

   1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
   2. Plants other than trees and landscape features designated to remain.
   3. Utilities designated to remain.
   4. Bench marks, monuments, and existing structures designated to remain.

3.3 CLEARING

A. Remove stumps, main root ball, and root system to:

   1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.
   2. Depth of 24 inches below finished surface of required cross section for other areas.
   3. Clear undergrowth and deadwood without disturbing subsoil.
   4. Remove vegetation from top soil scheduled for reuse.
3.4 REMOVAL

A. Remove debris, rubbish, and extracted plant material life from site in accordance with all applicable laws and codes.

B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF DOCUMENT
SECTION 31 22 00 – SITE GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This specification shall govern all work necessary for backfill and grading of the site to complete the project.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

A. Prior to site grading, the site shall be cleared in accordance with Specification Section 31 10 00 (Site Clearing). Unless specified otherwise on drawings, the existing surface shall be loosened by scarifying or plowing to a depth of not less than 6 inches. The loosened material shall be recompacted with fill.

B. Fill shall be uniform as to material, density, and moisture content. Fill shall be free of large clods, large rocks, organic matter, and other objectionable material. No fill, that is placed by dumping in a pile or windrow, shall be incorporated into a layer in that position; all such piles and windrows shall be moved by blading or similar method. All fill shall be placed in layers approximately parallel to the finish grade and in layers not in excess of 6 inches of uncompacted depth, unless indicated otherwise on drawings.

C. The fill shall be compacted to a density which approximates that of natural ground unless indicated otherwise on drawings.

D. The Architect may order test rolling to evaluate the uniformity of compaction. All irregularities, depressions, and soft spots which develop shall be corrected by the Contractor.

E. Excess material from excavation, that is not incorporated into the site as fill, shall be become property of the Contractor and disposed of away from the job site, unless indicated otherwise on the drawings.

END OF SECTION
PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Excavation and compaction of materials for roadways.

B. Excavation and compaction of materials for roadside ditches.

1.2 MEASUREMENT AND PAYMENT

A. Measurement and payment shall be as outlined in the Bid Form. If item is not specifically outlined in bid form, it shall not be paid for directly and shall be considered subsidiary to items of work where direct payment is made.

1.3 REFERENCES


C. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D. ASTM D 3017 - Standard Test Method for Water content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).


PART 2 PRODUCTS

2.1 MATERIALS

A. Provide topsoil conforming to contract requirements.

B. Provide backfill which is excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.

C. Provide structural backfill which is select material meeting following requirements:

1. Plasticity index: not less than 12 nor more than 20.

2. Maximum liquid limit: 45
PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, and datum.

B. Identify and flag surface and aerial utilities.

C. Notify utility companies to remove or relocate utilities.

D. Identify, stake, and flag known utility locations below grade. Make temporary or permanent relocation of underground pipes, ducts, or utilities where indicated on Drawings.

E. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify ENGINEER and obtain instructions before proceeding in such areas.

F. Obtain approval of top soil quality before excavating and stockpiling.

3.2 PROTECTION

A. Protect following from damage or displacement:

   1. Trees, shrubs, lawns, existing structures, and other features outside of grading limits.
   2. Utilities either above or below grade, which are to remain.

3.3 TOPSOIL REMOVAL

A. Strip off topsoil from area to be excavated to minimum depth of 6 inches, unless indicated otherwise on Drawings.

B. Stockpile topsoil in designated location for reuse. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.4 SOIL EXCAVATION

A. Excavate to lines and grades shown on Drawings.

B. Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact to design requirements.

C. Record location and plug and fill inactive water and oil wells. Conform to Texas Department of Health, TCEQ, and Texas Railroad Commission requirements. Notify ENGINEER prior to plugging wells.

D. At intersections, grade back at minimum slope of one inch per foot. Produce smooth riding junction with intersecting street. Maintain proper drainage.
E. When area is inadvertently over excavated, fill area as required by ENGINEER at no additional cost to OWNER.

F. Remove material not qualified for use and excess soil not being reused from site in accordance with applicable local, state and federal laws.

3.5 COMPACITION

A. Maintain optimum moisture content of subgrade to attain required density.

B. Compact to following minimum densities at moisture content of optimum to 3 percent above optimum as determined by ASTM D 698, unless otherwise indicated on Drawings:
   1. Areas under future paving and shoulders: Minimum density of 95 percent of maximum dry density.
   2. Other areas: Minimum density of 90 percent of maximum dry density.

3.6 TOLERANCES

A. Top of Compacted Surface: Plus, or minus 1/2 inch in cross section, or in 16-foot length.

3.7 FIELD QUALITY CONTROL

A. Testing will be performed as outlined by Contract.

B. Test and analysis of soil materials will be performed in accordance with ASTM D 4318, ASTM D 22 I6, and ASTM D 698.

C. Compaction testing will be performed in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017.

D. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway or as required by ENGINEER.

E. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at no additional cost to OWNER.

3.8 PROTECTION

A. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.

B. Distribute construction traffic evenly over compacted areas, where practical, to aid in obtaining uniform compaction. Protect exposed areas having high moisture content from wheel loads that cause rutting.
C. Maintain excavation and embankment areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density.

END OF DOCUMENT
PART 1 – GENERAL

1.1 GENERAL

A. This specification section supplements the regulations of the Occupational Safety and Health Administration and the laws of the State of Texas.

B. Trench Excavation: All trench excavations of five feet or greater in depth and which require any person be located in the trench excavation, for any reason, will first be protected by the trench safety methods developed by the Contractor and shall comply with all applicable OSHA requirements as herein specified. Such protection shall be provided at all locations as indicated in the Plans, and at all other locations where a trench depth of five feet or greater may be required.

C. Contractor Responsibilities: Contractor shall be solely responsible for design and implementation of a trench safety program. The Contractor shall comply with the current requirements of the Occupational Safety and Health Administration, Part 1926, sub-part P. of the Code of Federal Regulations, and all other applicable regulations during the progression of constructing this project.

D. Trench Safety Foreman: The Contractor shall appoint a Trench Safety Foreman who will be on site at all times while trenching or excavation is being performed. The Contractor shall submit a letter to the Engineer naming the Trench Safety Foreman prior to the Pre-Construction Trench Safety Conference. The Contractor shall notify the Engineer at least seven (7) days in advance of any change in the Trench Safety Foreman.

E. Pre-Construction Trench Safety Conference: A Trench Safety Conference will be scheduled and held prior to proceeding with trench excavations as described above. Attendance is required for the Engineer, the Contractor, the Trench Safety Foreman, and those employees expected to work on the project.

END OF DOCUMENT
SECTION 31 23 16.13 – EXCAVATION AND BACKFILL FOR UTILITIES

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 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 ‘veil 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.
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 1 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.

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 for locations identified on Drawings.
1.3 REFERENCES

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.
H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
K. TxDOT Tex-1 10-E - Particle Size Analysis of Soils.

1.4 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.

1.5 SUBMITTALS

A. 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.
B. Submit backfill material sources and product quality information.
C. Submit trench excavation safety program.
D. 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.
E. 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 ENGINEER.

1.6 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory.

B. Perform backfill material source qualification.

1.7 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 premanufactured system selected by Contractors Professional Engineer to meet project site requirements based on manufacturer’s standard design.

PART 2 - MATERIALS

2.1 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.

B. Use only hand-operated ramping 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.

2.2 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill Materials.

B. Concrete Backfill.

C. Geotextile (Filter Fabric)

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 ENGINEER.

3.2 PREPARATION

A. Establish traffic control. 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

C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from ENGINEER and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, as applicable.

E. Install and operate necessary dewatering and surface-water control measures. 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.

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 ENGINEER 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 ENGINEER 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 infield. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide ENGINEER 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 ENGINEER 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.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pit-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 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.).

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 ENGINEER 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.

<table>
<thead>
<tr>
<th>Nominal Pipe Size, Inches</th>
<th>Minimum Trench Width, Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 18</td>
<td>O.D. + 18</td>
</tr>
<tr>
<td>18 to 30</td>
<td>O.D. + 24</td>
</tr>
<tr>
<td>36 to 42</td>
<td>O.D. + 36</td>
</tr>
<tr>
<td>Greater than 42</td>
<td>O.D. + 48</td>
</tr>
</tbody>
</table>

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 ENGINEER. 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...
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 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.

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 oxyacetylene weld is exposed, immediately notify ENGINEER. 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. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.

B. When required, provide additional backfill material.

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. 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 ENGINEER. 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 ENGINEER, in accordance with Paragraph above. Removal of unstable or unsuitable material may be required if approved by ENGINEER
   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.

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. 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—S percent of optimum as determined according to ASTM D 698, unless otherwise approved by ENGINEER.

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.

   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 H 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.

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 for pipes of nominal sizes 36 inches in diameter and smaller to level 12 inches below the pavement. For sewer pipes 42 inches in diameter and larger, under pavement or natural ground, in satisfactory soil conditions, backfill from 12 inches above top of pipe to 12 inches below pavement with suitable on-site material or select backfill. For sewer pipes 42 inches in diameter and larger, under pavement or natural ground, in unsatisfactory soil conditions, backfill from 12 inches above top of pipe to 12 inches below pavement 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.
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 ENGINEER.

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 ENGINEER.

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) maybe used as trench zone backfill outside paved areas at Contractors option. If required density is not achieved, at any additional cost to OWNER, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.


3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D698.

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, 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 manhole with cement stabilized sand; minimum of 1 foot below base, minimum 1 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with this Section.

C. In unpaved areas, use select fill for backfill. Existing material that qualifies as select material may be used, unless indicated otherwise on Drawings. Deposit backfill in uniform layers and compact each...
layer as specified. Maintain backfill material at no less than 2 percent below nor more than 5 percent above optimum moisture content, unless otherwise approved by ENGINEER. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698.

3.11 FIELD QUALITY CONTROL

A. Test for material source qualifications.

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-F and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by ENGINEER.

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 ENGINEER, 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 hill 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 Contractors 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 Federal, State and Local regulations.
B. Excess material excavated from the site may be stockpiled on construction site with written permission from the owner.

END OF DOCUMENT
SECTION 31 23 16.16 – STRUCTURAL EXCAVATION AND BACKFILL

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Excavation, backfilling, and compaction of backfill for structures.

1.2 DEFINITIONS

A. 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.

B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

C. Select Material: Material as specified.

D. Backfill: Select material meeting specified quality requirements, placed and compacted under controlled conditions around structures.

E. 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.

F. Foundation Base: For foundation base material, use 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.

G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.

H. Ground Water Control Systems: Installations external to excavation 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 excavation, and depressurization to prevent failure or heaving of excavation bottom.
I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.

J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.

K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on Drawings and backfilled with foundation backfill material.

L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.3 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lb/ft³ (600kN-m/m³).


D. ASTM D 3017 - Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).


F. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.

G. TxDOT Tex-110-E - Particle Size Analysis of Soils.


1.4 SUBMITTALS

A. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to ENGINEER that procedures meet requirements of Specifications and Drawings.

B. Submit excavation safety system plan.

   1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.
2. Submit excavation safety system for excavations that fall under State and Federal trench safety laws.

C. Submit ground and surface water control plan.

D. Submit backfill material sources and product quality information.

E. Submit project record. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.5 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.

B. Perform embedment and backfill material source qualification testing.

PART 2 - MATERIALS

2.1 EQUIPMENT

A. Perform excavation with equipment suitable for achieving requirements of this Specification.

B. Use equipment which will produce degree of compaction specified. Compact backfill within 3 feet of walls with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to depth of fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.2 MATERIAL CLASSIFICATIONS

A. Use backfill materials conforming to classifications and product descriptions specified. Use classification or product description for backfill applications as shown on Drawings and as specified.

PART 3 - EXECUTION

3.1 PREPARATION

A. Conduct an inspection to determine condition of existing structures and other permanent installations.

B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where affected by Work, and is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ an excavation safety system.
D. Remove existing pavements and structures, including sidewalks and driveways.

E. Install and operate necessary dewatering and surface water control measures.

3.2 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings.

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. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.

E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to OWNER.

3.3 EXCAVATION

A. Perform excavation work so that underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to absolute minimum necessary. No additional payment will be made for excess excavation not authorized by ENGINEER.

B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify ENGINEER and obtain instructions before proceeding in such areas.

C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from ENGINEER and agency for any repairs or relocations, either temporary or permanent.

D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.

E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.

F. Conduct hauling operations so that trucks and other vehicles do not create dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.
G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by Work.

H. Provide sheeting, shoring, and bracing where required to safely complete Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect Work and adjacent structures or improvements. Use sheeting, shoring, and bracing to protect workmen and public.

I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement stabilized sand, or other material approved by ENGINEER and compact to 95 percent standard density.

J. After completion of structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by ENGINEER in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to Work and adjacent structures or improvements.

K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or other material approved by ENGINEER and compact to 95 percent standard density.

3.4 HANDLING EXCAVATED MATERIALS

A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at sufficient distance from excavation to prevent slides or cave-ins.

B. Provide additional backfill material, if adequate quantities of suitable material are not available from excavation and trenching operations at site.

3.5 DEWATERING

A. Provide ground water control.

B. Keep ground water surface elevation minimum of 2 feet below bottom of foundation base.

C. Maintain ground water control until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of 1.2.

3.6 FOUNDATION EXCAVATION

A. Notify ENGINEER at least 48 hours prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by ENGINEER.

B. Excavate to elevations shown on Drawings, as needed to provide space for foundation base, forming level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by ENGINEER. Prior to placing material over it, recompact subgrade where indicated on Drawings, scarifying as needed, to 95 percent of maximum Standard Dry Density according to ASTM D 698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until 95 percent is
achieved over-excavate to provide minimum layer of 24 inches of foundation backfill material, or other means acceptable to ENGINEER.

C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by ENGINEER.

D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.

E. Remove soils which become unsuitable due to inadequate dewatering or other causes. after initial excavation to required subgrade, and replace with foundation backfill material, as directed by ENGINEER, at no additional cost to OWNER.

F. Place foundation base, or foundation backfill material where needed, over subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.

G. Use filter fabric to separate crushed aggregate, and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of 12 inches beyond where another material stops contact with soil.

H. Place crushed aggregate, and other Class I materials, in uniform layers of 8-inch maximum thickness. Perform compaction by means of at least two passes of vibratory compactor.

3.7 FOUNDATION BASE.

A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, seal slab with minimum thickness of 4 inches may be placed. Extend foundation base minimum of 12 inches beyond edge of structure foundation, unless shown otherwise on Drawings.

B. Where foundation base and foundation backfill are of same material, both can be placed in one operation.

3.8 BACKFILL

A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Remove forms, lumber, trash and debris from structures. Use select fill for backfill. Existing material that qualifies as select material may be used, unless indicated otherwise on Drawings. Deposit backfill in uniform layers and compact each layer as specified.

B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of 85 percent of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until slab or intermediate walls have been placed and concrete has attained sufficient strength.
C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.

D. Maintain backfill material at no less than 2 percent below nor more than 2 percent above optimum moisture content, unless otherwise approved by ENGINEER. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698 below paved areas. Compact fill to at least 95 percent around structures below unpaved areas.

E. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of next layer of backfill.

F. Place backfill using cement stabilized sand.

3.9 FIELD QUALITY CONTROL

A. Tests will be performed initially on minimum of one different sample 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.

B. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions:

1. Minimum of one test for every 50 to 100 cubic yards of compacted backfill material as directed by ENGINEER.
2. A minimum of three density tests for each full work shift.
3. Density tests will be performed in all placement areas.
4. Number of tests will be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.
5. Identify elevation of test with respect to natural ground.
6. Record approximate depth of lift tested.

C. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Perform additional moisture-density relationship test once a month or whenever there is noticeable change in material gradation or plasticity.

D. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor’s expense.

3.10 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with all required Federal, State and Local laws.

END OF DOCUMENT
SECTION 31 23 23.15 – BACKFILL SAND

PART 1 – GENERAL

Backfill sand shall be used in the installation of all pipe and underground appurtenances. All pipe, valves and fittings shall be completely encased with a minimum of eight inches (8”) of sand. The contractor shall provide submittal information on proposed backfill sand.

PART 2 - PRODUCTS

SAND: The sand shall be finely divided sand having the following specifications:

- Passing ¾ Sieve: 100% by weight
- Passing No. 4 Sieve: 80% by weight
- Clay: Less than 20% by weight
- Plasticity Index: NP-10 max.

The sand shall have low chloride content (salt) which shall not exceed 200 ppm chlorides when used in association with Concrete Steel Cylinder or Ductile Iron Pipe. Sand used for PVC pipe does not need to meet the chloride requirements. The sand shall contain no rocks, portions of any trees including stumps or roots, and no large clumps of clay which are more than 2-inches in diameter.

PART 3 – EXECUTION

The sand shall be placed and compacted to eliminate any voids around the pipe. The material shall be compacted to a minimum 85% standard proctor.

END OF DOCUMENT
SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes soil treatment for termite control.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data and application instructions.

C. Certification that products used comply with U.S. Environmental Protection Agency (EPA) regulations for termiticides.

1.4 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for preparing substrate and application.

B. Engage a professional pest control operator who is licensed according to regulations of governing authorities to apply soil treatment solution.

C. Use only termiticides that bear a federal registration number of the EPA and are approved by local authorities having jurisdiction.

1.5 JOB CONDITIONS

A. Restrictions: Do not apply soil treatment solution until excavating, filling, and grading operations are completed, except as otherwise required in construction operations.

B. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.
1.6 WARRANTY

A. Warranty: Furnish written warranty, executed by Applicator and Contractor, certifying that applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.

B. Warranty Period: 5 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT SOLUTION

A. General: Use an emulsible, concentrated termiticide that dilutes with water, specially formulated to prevent termites’ infestation. Fuel oil will not be permitted as a diluent. Provide a solution consisting of one of following chemical elements.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Chloropyrifos:
   a. Dursban TC, Dow Chemical Co. [EPA Reg. No. 62719-47]

2. Permethrin:
   a. Dragnet SFR 03-17-10, FMC Corp. [EPA Reg. No. 279-3062]

3. Cypermethrine:
   a. Prevail FT, FMC Corp. [EPA Reg. No. 279-3082]

4. Esfenvalerate

5. Isofenphose:
   a. Pryfon, Mobay Corp. [EPA Reg. No. 3125-339]

C. Dilute with water to concentration level recommended by manufacturer.

D. Other solutions may be used as recommended by Applicator if approved for intended application by local authorities having jurisdiction. Use only soil treatment solutions that are not harmful to plants.

PART 3 - EXECUTION

3.1 APPLICATION

A. Surface Preparation: Remove foreign matter that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placing compacted fill under slabs if recommended by toxicant manufacturer.
B. Application Rates: Apply soil treatment solution at rates and concentrations recommended by soil termiticide manufacturer.

1. At under slab-on-grade structures, treat soil before concrete slabs are placed.
2. At under crawlspace and basement structures, treat soil along exterior and interior walls of foundations with shallow footings.

C. Application Rates: Apply soil treatment solution as follows:

1. Under slab-on-grade structures, treat soil before concrete slabs are placed, using the following application rates:
   a. Apply 4 gallons of chemical solution per 10 linear feet (5.1 L of chemical solution per meter) to soil in critical areas under slab, including entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers.
   b. Apply 1 gallon of chemical solution per 10 sq. ft. (4.1 L of chemical solution per sq. m) as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel. Apply 1-1/2 gallon of chemical solution per 10 sq. ft. (6.1 L of chemical solution per sq. m) to areas where fill is washed gravel or other coarse absorbent material.
   c. Apply 4 gallons of chemical solution per 10 linear feet (5.1 L of chemical solution per meter) of trench for each 12 inches (300 mm) of depth from grade to footing, along outside edge of building. Dig a trench 6 to 8 inches (150 to 200 mm) wide along outside of foundation to a depth of not less than 12 inches (300 mm). Punch holes to top of footing at not more than 12 inches (300 mm) o.c. and apply chemical solution. Mix chemical solution with the soil as it is being replaced in the trench.

2. At expansion joints, control joints, and areas where slabs will be penetrated, apply at rate of 4 gallons per 10 linear feet (5.1 L per linear m) of penetration.

D. Post signs in areas of application to warn workers that soil termiticide treatment has been applied. Remove signs after areas are covered by other construction.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, landscape grading, or other construction activities following application.

END OF SECTION
PART 1 – GENERAL

1.1 DESCRIPTION

This item shall govern the designing, furnishing, installing, maintaining and removing or abandoning of temporary Excavation Safety Systems consisting of trench shields, aluminum hydraulic shoring, timber shoring, trench jacks, tied-back or braced sheeting, tied-back slurry walls, soil nailing, rock bolting, tied-back or braced soldier piles and lagging, and other systems for protecting workers in excavations. This item shall also govern the designing and constructing of sloping and benching systems for protecting workers in excavations.

A. Competent person shall mean one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The competent person shall be capable of interpreting the manufacturer’s data sheets and interpreting and implementing the Excavation Safety System Plan.

B. An excavation shall mean any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal. The Contractor shall provide an Excavation Safety System for all excavations except when 1) the excavation is in stable rock as determined by the Texas-licensed Professional Engineer who prepared the Contractor’s Excavation Safety System Plan or 2) the excavation is less than 5 feet in depth and examination of the ground by the Contractor’s competent person provides no indication of a potential cave-in.

C. Trench (trench excavation) shall mean any narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth shall be greater than the width, but the trench (measured at the bottom) shall not be wider than 15 feet. Excavation Safety Systems for such trenches shall be defined as Trench Excavation Safety Protection.

D. If the Contractor installs or constructs forms or other structures in an excavation wider than 15 feet such that the dimension measured from the forms or structures to the side of the excavation is reduced to 15 feet or less (measured at the bottom of the excavation), the excavation shall also be defined as a trench. Excavation Safety Systems for such trenches shall be defined as Special Shoring.

At a minimum, this work shall conform to United States Department of Labor Rules 29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health Regulations for Construction, Subpart P, Excavation (hereinafter called OSHA).

1.2 EXCAVATION SAFETY SYSTEM SUBMITTALS:

A. Prior to Notice to Proceed: Prior to, or at the Pre-Construction Conference, the Contractor shall submit to the Owner an Excavation Safety System Plan. Where both Trench Excavation Safety Protection and Special Shoring are required on the same project, the Contractor shall submit separate Excavation Safety System Plans for each. The Notice to Proceed with construction will not be issued by the Owner until the Contractor has submitted the necessary Excavation Safety System Plan(s) to the Owner.
B. Prior to Starting Excavation: Prior to starting any excavation, the Contractor shall submit to the Owner:

1. A certificate indicating that the Contractor’s competent person(s) has completed training in an excavation safety program based on OSHA regulations
2. Manufacturer’s tabulated data or other tabulated data for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the project.
3. Manufacturer’s tabulated data shall meet the requirements in OSHA and shall describe the specific equipment to be used on the project. Tabulated data must bear the seal of the licensed professional engineer who approved the data.

1.3 EXCAVATION SAFETY SYSTEM PLAN

The Contractor shall prepare an Excavation Safety System Plan (hereafter called the Plan) specifically for the project. The Contractor must retain a Texas-licensed Professional Engineer to prepare the Plan. The Contractor must follow qualifications-based procedures to procure the required Professional Engineering services, according to Chapter 2254 of the Texas Government Code.

The Contractor shall be responsible for obtaining geotechnical information necessary for design of the Excavation Safety System. If geotechnical information for design of the project has been acquired by the Owner, it shall be provided to the Contractor for information purposes.

A. The Plan for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the project shall include:

1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the required load carrying capacity, dimensions, materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
2. Drawings, notes, or tables clearly detailing the specific areas of the project in which each Excavation Safety System shall be used, the permissible size of the excavation, the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal of the system.

B. The Plan for Excavation Safety Systems consisting of tied-back or braced sheeting, tied-back or braced soldier piles and lagging, slurry walls, soil nailing, rock bolting or other protective systems that are designed specifically for the project shall include:

1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the design assumptions, design criteria, factors of safety, applicable codes, dimensions, components, types of materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
2. Detailed technical specifications for the Excavation Safety System addressing the properties of the materials, construction means and methods, quality control and quality assurance testing, performance monitoring, and monitoring of adjacent features, as appropriate.

C. *Drawings that clearly detail the specific areas of the project in which each type of system shall be used and showing the Special Shoring in plan and elevation (vertical profile) views.

D. *Drawings, notes or tables clearly detailing the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal or abandonment of the system or parts thereof.


1.4 EXCAVATION SAFETY SYSTEM SUBMITTAL REVIEW

Review of the Excavation Safety System submittal conducted by the Owner shall only relate to conformance with the requirements herein. The Owner's failure to note exceptions to the submittal shall not relieve the Contractor of any or all responsibility or liability for the adequacy of the Excavation Safety System. The Contractor shall remain solely and completely responsible for all Excavation Safety Systems and for the associated means, methods, procedures, and materials.

1.5 CONTRACTOR’S RESPONSIBILITY

The Contractor shall be responsible for implementing the Excavation Safety System Plan and for confirming that the Excavation Safety System(s) used on the project meets the requirements of the Plan.

The Contractor’s competent person(s) shall be on the project whenever workers are in an excavation meeting either definition of a trench given above.

1.6 CONSTRUCTION METHODS

The Contractor's competent person(s) shall maintain a copy of appropriate OSHA regulations onsite and shall implement OSHA excavation safety regulations at the work site. The Contractor shall perform all excavation in a safe manner and shall maintain safety systems to prevent death or injury to personnel or damage to structures, utilities or property in or near excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed Excavation Safety System is damaged, the Contractor shall immediately cease work in the excavation, evacuate personnel from any potentially hazardous areas and notify the Owner. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the Contractor's competent person(s). Repair and replacement of damaged Excavation Safety System shall be at the Contractor's sole expense.

1.7 CHANGED CONDITIONS
When changed conditions require modifications to the Excavation Safety System, the Contractor shall provide to the Owner or designated representative a new design or an alternate Excavation Safety System Plan that is proposed by the Contractor's Excavation Safety System Engineer to address the changed conditions. Copies of the new design or alternate system shall be provided to the Owner or designated representative in accordance with the requirements of section 509S.2, "Excavation Safety System Plan Submittals". A copy of the most current Excavation Safety System Plan shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Excavation Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Excavation Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions totally out of the control of the Contractor, the Contractor may make a written request to the Owner for a Change Order to address the anticipated work. The Contractor shall notify the Owner in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under "Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

END OF DOCUMENT
SECTION 32 01 17 – PAVEMENT REPAIR

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Repairing and resurfacing streets, highways, driveways, sidewalks, and other pavements that have been cut, broken, or otherwise damaged during construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Subgrade:
   1. Provide backfill material as required by contract
   2. Provide material for stabilization as required by contract

B. Base: Provide base material as required by contract

C. Pavement: Provide paving materials as required by contract.

PART 3 – EXECUTION

3.01 PREPARATION

A. Notify OWNER prior to commencement of excavation in pavement.

B. Conform to requirement of Section 02221 - Removing Existing Pavements and Structures, for removals.

C. Saw cut pavement 18 inches wider than width of trench needed to install utilities unless otherwise indicated on Drawings.

D. When removing pavement to existing deformed metal strip (i.e. dummy joint), saw cut pavement minimum 2 inches deep on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.

E. Protect edges of existing pavement to remain from damage during removals, utility placement, backfill, and paving operations. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.

F. Dowel in existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by ENGINEER, provide No.6 bars 24 inches long, drilled and
embedded 8 inches into center of existing slab with 'PO-ROC' epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing.

G. Provide transitional paving and earthwork as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

3.2 INSTALLATION

A. Parking Areas, Service Drives, Driveways, and Sidewalks: Replace with material equal to or better than existing or as indicated on Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01, Materials.

B. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base, and surface course with like materials or as indicated plans. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01, Materials.

C. For concrete pavement, install size and length reinforcing steel and pavement thickness indicated on Drawings. Place types and spacing of joints to match existing or as indicated on Drawings.

D. Where existing pavement consists of concrete pavement with asphaltic surfacing, resurface with minimum 2 inch depth asphaltic pavement.

E. Repair state highway and county crossings in accordance with TxDOT permit or county requirements as appropriate and within 1 week after utility work is installed.

3.3 WASTE MATERIAL DISPOSAL

A. Dispose of waste material in accordance with all applicable laws and codes.

3.4 PROTECTION

A. Maintain pavement in good condition until completion of Work.

B. Replace pavement damaged by Contractor's operations at no cost to OWNER.

END OF DOCUMENT
SECTION 32 12 13.19 – PRIME COAT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Prime coat for asphalt concrete paving

1.2 SUBMITTALS

A. Conform to requirements of Contract.

B. Submit product data for proposed prime coat.

C. Submit report of recent calibration of distributor.

PART 2 – PRODUCTS

2.1 CUTBACK ASPHALT

A. Provide moisture-free homogeneous material which will not foam when heated to 347 degrees F and which meets following requirements:

B. Asphalt material for prime coat shall be MC-30 or MC-70 and shall meet following requirements:

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>TYPE-GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC-30</td>
</tr>
<tr>
<td></td>
<td>MIN.</td>
</tr>
<tr>
<td>Water, Percent</td>
<td>-</td>
</tr>
<tr>
<td>Flash Point, T.O.C., F</td>
<td>100</td>
</tr>
<tr>
<td>Kinematic Viscosity at 140 F, cst</td>
<td>30</td>
</tr>
</tbody>
</table>

1. Distillate shall be as follows, expressed as percent by volume of total distillate to 680 degrees F:

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>TYPE-GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC-30</td>
</tr>
<tr>
<td></td>
<td>MIN.</td>
</tr>
<tr>
<td>to 437 F</td>
<td>-</td>
</tr>
<tr>
<td>to 500 F</td>
<td>40</td>
</tr>
<tr>
<td>to 600 F</td>
<td>75</td>
</tr>
<tr>
<td>Residue from 680 F Distillation, Volume, Percent</td>
<td>50</td>
</tr>
</tbody>
</table>
2. Tests on Distillation Residue:

<table>
<thead>
<tr>
<th>TEST</th>
<th>TYPE-GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC-30</td>
</tr>
<tr>
<td></td>
<td>MIN.</td>
</tr>
<tr>
<td>Penetration at 77 F, 100g, 5 sec.</td>
<td>120</td>
</tr>
<tr>
<td>Ductility at 77 F, 5 cm/min. cms</td>
<td>100*</td>
</tr>
<tr>
<td>Solubility in Trichloroethylene, %</td>
<td>99</td>
</tr>
<tr>
<td>Spot Test</td>
<td>All Negative</td>
</tr>
</tbody>
</table>

*If penetration of residue is more than 200 and ductility at 77 degrees F is less than 100 cm, material will be acceptable when its ductility at 60 degrees F is more than 100.

2.2 EMULSIFIED PETROLEUM RESIN

A. EPR-1 Prime: Slow curing emulsion of petroleum resin and asphalt cement conforming to following requirements:

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIN.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fural Viscosity at 77 F, Sec</td>
<td>14</td>
<td>40</td>
</tr>
<tr>
<td>Residue by Evaporation, % by Weight</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>Sieve Test, %</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Tests on Distillation Residue:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash Point, COC (F)</td>
<td>400</td>
<td>-</td>
</tr>
<tr>
<td>Kinematic Viscosity @ 140 F (cst)</td>
<td>190</td>
<td>350</td>
</tr>
</tbody>
</table>

B. For use, EPR-1 may be diluted with water up to maximum three parts water to one part EPR-1 in order to achieve desired concentration of residual resin/asphalt to facilitate application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify base is ready to support imposed loads.

B. Verify lines and grades are correct.
3.2 PREPARATION

A. Thoroughly clean base course surface of loose material by brooming prior to application of tack coat.

B. Prepare sufficient base in advance of paving for efficient operations.

3.3 APPLICATION, BASIC

A. Apply prime coat with approved type of self-propelled pressure distributor. Distribute prime coat evenly and smoothly under pressure necessary for proper distribution.

B. Keep storage tanks, piping, retorts, booster tanks, and distributors used in handling asphalt materials clean and in good operating condition. Conduct operations so asphalt material does not become contaminated.

C. If yield of asphaltic material appears to be in error, recalibrate distributor prior to continuing Work.

D. Maintain surface until Work is accepted by OWNER.

3.4 APPLICATION, CUTBACK ASPHALT

A. Do not use cutback asphalt during period of April 16 through September 15.

B. Do not place prime coat when air temperature is below 60 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 50 degrees F and rising.

C. Distribute at rate of 0.25 to 0.35 gallons per square yard.

D. Equipment shall accurately determine temperature of asphaltic material in heating equipment and in distributor, for determining rate of application, and for obtaining uniformity at junction of two distributor loads. Maintain in accurate working order, including recording thermometer at storage heating unit.

E. Base temperature of application on temperature-viscosity relationship that will permit application of asphalt with viscosity of 100 to 125 centistokes. Maintain asphalt within 15 degrees F of temperature required to meet viscosity. Selected temperature shall be within following range.

<table>
<thead>
<tr>
<th>Prime Coat Type</th>
<th>Minimum (F)</th>
<th>Maximum (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC – 30</td>
<td>70</td>
<td>150</td>
</tr>
<tr>
<td>MC – 70</td>
<td>125</td>
<td>175</td>
</tr>
</tbody>
</table>

F. Do not allow temperature of MC-30 to exceed 175 degrees F.

G. Do not allow temperature of MC-70 to exceed 200 degrees F.
3.5 APPLICATION, EMULSIFIED PETROLEUM RESIN

A. Do not place prime coat when air temperature is below 36 degrees F and falling.

B. Distribute at rate of 0.15 to 0.25 gallons per square yard.

3.6 PROTECTION

A. Prevent traffic or placement of subsequent courses over freshly applied prime coat until authorized by ENGINEER.

END OF DOCUMENT
PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Surface course of compacted mixture of coarse and fine aggregates and asphaltic binder.

1.2 REFERENCES


C. TxDOT Tex-I06-E - Calculating the Plasticity Index of Soils

D. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material

E. TxDOT Tex-200-F - Sieve Analysis of Fine and Course Aggregates.

F. TxDOT Tex-203-F - Sand Equivalent Test.

G. TxDOT Tex-204-F - Design of Bituminous Mixtures.

H. TxDOT Tex 206-F - Compacting Test Specimens of Bituminous Mixtures.

I. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.

J. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

K. TxDOT Tex-217-F - Determining Deleterious Material and Decantation Test for Coarse Aggregates.

L. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.

M. TxDOT Tex-530-C - Effect of Water on Bituminous Paving Mixtures.

N. TxDOT Tex-531-C - Prediction of Moisture Induced Damage to Bituminous Paving Materials Using Molded Specimens.

1.3 SUBMITTALS

A. Conform to requirements of Contract.

B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
C. Submit proposed design mix and test data for surface course.

D. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Coarse Aggregate:

1. Use gravel, crushed stone, or combination thereof, that is retained on No.10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Use aggregate conforming to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.

2. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, claylike particles, or silt when tested in accordance with Tex-217-F, Part II.

B. Fine Aggregate: Sand, stone screenings or combination of both passing No. 10 sieve. Use aggregate conforming to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course Surface (TxDot Type C)</td>
</tr>
<tr>
<td></td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>7/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>5/8&quot;</td>
<td>95 to 100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>-</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>70 to 85</td>
</tr>
<tr>
<td>#4</td>
<td>43 to 63</td>
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<td>#10</td>
<td>30 to 40</td>
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<tr>
<td>#40</td>
<td>10 to 25</td>
</tr>
<tr>
<td>#80</td>
<td>3 to 13</td>
</tr>
<tr>
<td>#200</td>
<td>1 to 6*</td>
</tr>
</tbody>
</table>

*2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.
C. Composite Aggregate: Conform to following limits when graded in accordance with TxDOT Tex-200-F. Use type specified on Drawings:

D. Asphalt Binder: Moisture-free homogeneous material which will not foam when heated to 347 F, meeting the following requirements.

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 7-day Maximum Pavement Design Temperature, C</td>
<td>&lt; 64</td>
</tr>
<tr>
<td>Minimum Pavement Design Temperature, C</td>
<td>&gt; -22</td>
</tr>
<tr>
<td>Flash Point Temperature, T48; Minimum C</td>
<td>230</td>
</tr>
<tr>
<td>Viscosity, ASTM D 4402; Maximum, 3Pa*s (3000cP) Test Temperature, C</td>
<td>135</td>
</tr>
<tr>
<td>Dynamic Shear, TP5; G*/sin[ ], Minimum, 1.00 kPa Test Temperature @ 10 rad/sec., C</td>
<td>64</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
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</thead>
<tbody>
<tr>
<td>ORIGINAL BINDER</td>
<td></td>
</tr>
<tr>
<td>ORIGINAL BINDER</td>
<td></td>
</tr>
</tbody>
</table>

**PERFORMANCE GRADED BINDER**

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 7-day Maximum Pavement Design Temperature, C</td>
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</tr>
<tr>
<td>Minimum Pavement Design Temperature, C</td>
<td>&gt; -22</td>
</tr>
<tr>
<td>Flash Point Temperature, T48; Minimum C</td>
<td>230</td>
</tr>
<tr>
<td>Viscosity, ASTM D 4402; Maximum, 3Pa*s (3000cP) Test Temperature, C</td>
<td>135</td>
</tr>
<tr>
<td>Dynamic Shear, TP5; G*/sin[ ], Minimum, 1.00 kPa Test Temperature @ 10 rad/sec., C</td>
<td>64</td>
</tr>
</tbody>
</table>

**ORIGINAL BINDER**

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash Point Temperature, T48; Minimum C</td>
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</tr>
<tr>
<td>Viscosity, ASTM D 4402; Maximum, 3Pa*s (3000cP) Test Temperature, C</td>
<td>135</td>
</tr>
<tr>
<td>Dynamic Shear, TP5; G*/sin[ ], Minimum, 1.00 kPa Test Temperature @ 10 rad/sec., C</td>
<td>64</td>
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</tbody>
</table>

**ROLLING THIN FILM OVEN (T240) OR THIN FILM OVEN (T179) RESIDUE**

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
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</thead>
<tbody>
<tr>
<td>Mass Loss, Maximum, %</td>
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<tr>
<td>Dynamic Shear, TP5; G*/sin[ ], Minimum, 2.20 kPa Test Temperature @ 10 rad/sec., C</td>
<td>64</td>
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</table>

**PRESSURE AGING VESSEL RESIDUE (PP1)**

<table>
<thead>
<tr>
<th>CRITERIA / TEST</th>
<th>PERFORMANCE GRADE (PG64-22)</th>
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<tbody>
<tr>
<td>PAV Aging Temperature, C</td>
<td>100</td>
</tr>
<tr>
<td>Dynamic Shear, TP5; G*/sin[ ], Minimum, 5000 kPa Test Temperature @ 10 rad/sec., C</td>
<td>25</td>
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<tr>
<td>Physical hardening</td>
<td>Report</td>
</tr>
<tr>
<td>Creep Stiffness, TP1; S, Maximum, 300 Mpa-value, Minimum, 0.300 Test Temperature @ 60 sec., C</td>
<td>-12</td>
</tr>
<tr>
<td>Direct Tension, TP3; Failure Strain, Minimum, 1.0% Test Temperature @ 1.0 mm/min, C</td>
<td>-12</td>
</tr>
</tbody>
</table>

E. Anti-stripping Agent:

1. Evaluate mixture of aggregate, asphalt, and additives proposed for use for moisture susceptibility and requirement for anti-stripping agents. To substantiate mix design, produce and test trial mixtures using proposed project materials and equipment prior to placement. Test for susceptibility to moisture and trial mixture may be waived by ENGINEER when similar designs using same material have previously proven satisfactory.

2. Liquid Anti-stripping Agent. Use anti-stripping agent with uniform liquid with no evidence of crystallization, settling, or separation of components. Submit sample of anti-stripping agent.
proposed for use and manufacturer's product data, including recommended dosage range, handling and storage, and application instructions.

2.2 EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.

B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device
2. Dryer
3. Screens
4. Aggregate weight box and batching scales
5. Mixer
6. Asphalt storage and heating devices
7. Asphalt measuring devices
8. Truck scales

C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. Provide one cold feed bin per stockpile.

2.3 MIXES

A. Employ certified testing laboratory to prepare design mixes. Test in accordance with TxDOT Tex-126-E or Tex-204-F, Tex-206-F, Tex-208-F, Tex-530-C and Tex-53 I-C.

B. Density, Stability and Air Void Requirements:

<table>
<thead>
<tr>
<th>Percent Density</th>
<th>Percent</th>
<th>HVEEM Stability Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>Max</td>
<td>Optimum</td>
</tr>
<tr>
<td>94.5</td>
<td>97.5</td>
<td>96</td>
</tr>
</tbody>
</table>

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.
3.2 PREPARATION

A. Tack Coat: Conform to requirements of Contract. Where mixture will adhere to surface on which it is to be placed without use of rack coat, tack coat may be eliminated when approved by ENGINEER.

B. Prepare subgrade in accordance with requirements Contract.

C. Prepare subgrade in advance of asphalt concrete paving operation.

D. Perform pavement repair and resurfacing as indicated in plans.

E. Do not use cutback asphalt.

F. Milling of pavement for speed humps: Mill pavement (concrete or asphalt) to depth of one inch and width between 18 and 24 inches around entire perimeter of proposed hump, as shown in detail for speed hump design.

3.3 PLACEMENT

A. Do not place asphalt pavement less than 2 inches thick when surface temperature taken in shade and away from artificial heat is below 50 F and falling. Asphalt may be placed when temperature is above 40 F and rising.

B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture temperature shall be between 250 F and 325 F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.

D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such a manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Place construction joints on surface courses to coincide with lane lines or as directed by ENGINEER.

E. Joints: Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing or old asphalt, saw cut existing or old asphalt to full depth to provide straight smooth joint.

G. In smaller restricted areas where use of paver is impractical spread material by hand. Compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove lumps that do not break down readily.
3.4 COMPACTION

A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids when directed by the ENGINEER. Prepare test strip at least 1,000 feet in length, comparable to placement and compaction conditions for Project.

B. Begin rolling while pavement is still hot and as soon as it will bear roller without shoving, displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water or petroleum by-products.

C. Compact surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing a minimum of 8 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 185 F.

D. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

E. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

F. Compact binder course and surface course to a minimum density of 91 percent of maximum possible density of voidless mixture composed of same materials in like proportions.

3.5 TOLERANCES

A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10 foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct surface not meeting this requirement.

C. Dimensions of speed humps shall conform to details for speed hump design and speed hump height tolerances.

3.6 QUALITY CONTROL

A. Testing will be performed under provisions of Contract.

B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density).
This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.

C. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by ENGINEER. Average densities for each street placed in a single day to determine compliance.

D. Contractor may request three additional cores in vicinity of cores indicating nonconforming in-place depths or density at no additional cost to OWNER. In-place depth and density at these locations shall be average of four cores.

E. Fill cores and density test sections with new compacted asphaltic concrete.

F. Speed humps: Measure dimensions of completed speed hump, before applying pavement markings, at locations shown on Speed Hump Height Measurement Worksheet. Complete one worksheet for each speed hump and send completed worksheets to OWNER.

3.7 NONCONFORMING PAVEMENT

A. Recompact and retest nonconforming street sections not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the OWNER.

B. Remove and replace areas of asphalt surface found deficient in thickness by more than 10 percent. Use new asphaltic surface of thickness shown on Drawings. Remove and replace areas of asphalt surface found deficient in average density.

C. Replace speed humps which do not conform to requirements of details, or which are rejected by ENGINEER.

3.8 PROTECTION

A. Do not open pavement to traffic until completion of rolling and temperature has cooled to set asphaltic concrete surface, or as shown on Drawings.

B. Maintain asphalt pavement in good condition until completion of Work.

C. Repair defects immediately by replacing asphalt pavement to full depth.

3.9 PAVEMENT MARKINGS FOR SPEED HUMPS

A. Apply pavement markings to speed humps in conformance with dimensions shown on detail for speed hump design.

END OF DOCUMENT
SECTION 32 16 13.13 – CONCRETE CURB AND GUTTER AND HEADERS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.

B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

1.2 SUBMITTALS

A. Conform to requirements Contract.

B. Submit details of proposed form work for approval.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete.

B. Reinforcing Steel: Conform to material requirements for welded wire fabric.

C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.

   1. Compressive strength
      a. at 7 days: 3500 psi
      b. at 28 days: 8000 psi

   2. Initial set time: 45 minutes

   3. Final set time: 1.5 hours

D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material.

E. Expansion Joint Filler: Conform to material requirements for expansion joint filler.

F. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by ENGINEER.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prepare subgrade in accordance with applicable portions of sections on excavation and fill,
embankment, and subgrade and roadbed.

3.2 PLACEMENT

A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.

B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.

C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.

D. Joints: Place in accordance with plans and specifications. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.

E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.3 MANUAL FINISHING

A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.

B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handed wooden darby at least 3 feet long.

C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straight edge every 5 feet.

D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.

E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.

F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.4 MECHANICAL FINISHING

A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by ENGINEER. Use of mechanical methods shall provide specified curb design and finish.

3.5 CURING

A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with
plans and specifications.

3.6 TOLERANCES

A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straight edge laid along them, except at grade changes.

3.7 PROTECTION

A. Maintain curbs and gutters in good condition until completion of work.

B. Replace damaged curbs and gutters to comply with this section.

END OF DOCUMENT
SECTION 32 16 23 – CONCRETE SIDEWALKS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Reinforced concrete sidewalks.
B. Wheelchair ramps.
C. Reinforced slope paving.

1.2 REFERENCES

A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
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.
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.

1.3 SUBMITTALS

A. Conform to requirements of Contract.
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.
B. Reinforcing Steel: Conform to material requirements per plans and specifications.
C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material per plans and specifications.

D. Expansion Joint Filler: Conform to material requirements for expansion joint material per plans and specifications.

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 per plans and specifications.

G. Sodding: Conform to material requirements for sodding per plans and specifications.

H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete per plans and specifications. 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 plans and specifications.

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 plans and specifications. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM 0698.

E. Immediately after subgrade is prepared, cover with compacted sand bed to depth as shown on Drawings. Lay concrete when sand is moist but not saturated.
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 plans and specifications.

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 plans and specifications.

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 applicable local, state and federal laws. Repair driveways and parking lots damaged by sidewalk excavation in accordance with plans and specifications.

3.4 CURING

A. Conform to requirements of plans and specifications.
3.5 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Contract.

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 ENGINEER. 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 DOCUMENT
SECTION 32 84 23 – UNDERGROUND SPRINKLERS

PART 1 – GENERAL

1.1 SUMMARY

A. Includes but not limited to:

1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:

1. Section 01400 – Quality Control
2. Section 32 91 13 – Soil Preparation
3. Section 32 92 23 – Sodding
4. Section 32 93 00 - Plants

1.2 REFERENCES

A. Definitions:

1. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
2. Non-Pressure Lateral Line: Downstream from electric control valves to pop-up spray heads and drip valve assemblies to emitters. Piping or tubing is under pressure during flow. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
3. Point of Connection: The location where the meter for the irrigation system is located.
4. Pressure Supply Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
5. Hunter Controllers: Hunter controllers are irrigation clocks that automatically adjust irrigation run times in response to environmental changes using sensors and weather information to manage watering times and frequency. As environmental conditions vary, the controller increases or decreases irrigation. Hunter controllers have the ability to turn off your sprinklers automatically during rain, high wind or low temperature.
6. Static Water Pressure: The pressure at the point of connection when the system is not operable.
7. Working Pressure: The pressure at the point of connection when the system is operable.
1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Provide Coordination for required tests and inspections.
   a. Manufacturer’s Field Service: Provide necessary manufacturer’s field service.
   b. Pressure Test: In the presence of Landscape Architect provide a pressure test.
   c. Walk through for Substantial Completion: In the presence of Landscape Architect, plan and provide walk through for Substantial Completion after Contractor has completed all Work.
   d. Final Walk Through: In the presence of the Landscape Architect, plan and provide final walk through after Contractor has completed all work listed on Substantial Completion walk through punch list provided by Architect.

B. Pre-Installation Conference:

1. Schedule pre-installation conference before irrigation system installation begins.
2. In addition to agenda items specified in Section 01 3100, review the following:
   a. Landscape architect or designated landscape consultant shall demonstrate or describe method to be used to maintain head spacing from concrete and to stabilize heads.
   b. Within the field yard, provide one installed example of each type of irrigation detail for review and approval by the architect and owner prior to beginning work in the field.

C. Sequencing:

1. Install sleeves before installation of cast-in-place concrete site elements and paving.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Manufacturer’s cut sheets for each element of system.
   b. Parts list for operating elements of system.

B. Informational Submittals:

1. Certificates:
   a. Acceptance certificate of irrigation system.
      1) Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate.
      2) Certificate will include name and signature of reviewer, reviewer's company, date of review, and reviewer's telephone number.

2. Test and Evaluation Reports:
   a. Results of mainline service pressure test before beginning work on system should be submitted as a report following the testing and before burial of the mainline.
   b. Provide the following from Main Line Irrigation test and observation:
      1) Record and submit documentation of Irrigation Main Line tests, issues, and
measure taking to correct problems.

3. Manufacturer Instructions:
   a. Manufacturer’s printed literature on operation and maintenance of operating elements of system.
   b. Instruction Manual:
      1) Includes complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site-specific conditions.

4. Qualification Submittals:
   a. Irrigation Installer:
      1) Provide documentation of the following:
      2) Firm experience in irrigation projects (minimum of five years)
      3) Financial stability.
      4) Comply with specifications and contract documents.
      5) Agree to complete reporting documents, including:
         a) Assist landscape architect in completing the Watering Schedule

C. Closeout Submittals:

1. Include following in Operations and Maintenance Manual
   b. Manufacturer's printed literature.
   c. Manufacturer's cut sheets for each element of system.
   d. Manufacturer’s parts list.
   e. Main Line Irrigation observation report.
   f. Controller Program Schedule:
      1) Watering Schedule.

2. Record Documentation:
   a. Certificates:
      1) Acceptance certificate of irrigation system.
   b. Testing and Inspection Reports:
      1) Mainline Pressure Test.
      2) Main Line Irrigation test and observation.
   c. Record drawings: As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
      1) Detail and dimension changes made during construction.
      2) Significant details and dimensions not shown in original Contract Documents.
      3) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, soil moisture sensors (soil moisture sensor technology are selected these improvements) and both ends of sleeves.
      4) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
      5) Take and record dimensions at time of installation.
      6) Reduced copy of record drawings to 11 by 17 inches with color key circuits and laminated both sides with 5 mil thick or heavier plastic. Mount on 12 x 18-inch hard board drilled with (2) two 1/2-inch holes at top of board and hang on hooks in Custodial Room or location designated by Owner’s Representative.
7) Two (2) additional reduced copies of record drawings to 11 by 17 inches with color key circuits, un laminated, and un mounted to be given to Owner’s Representative.

D. Maintenance Material Submittals:

1. Tools:
   a. Furnish following items before Final Closeout Review:
      1) As built

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
2. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications:

1. Installer Qualifications:
   a. General:
      1) Perform installation under direction of foreman or supervisor with five (5) years minimum experience in sprinkling system installations.
   b. Automatic controller:
      1) Trained certified personnel familiar with required irrigation system and controller installation procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Storage and handling during installation: protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

A. Manufacturer Warranty:

1. Standard one-year guarantee stipulated in General Conditions shall include:
   a. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
   b. Adjusting system to supply proper coverage of areas to receive water.
PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:
   a. 3M, Austin, TX www.3m.com/elpd.

B. Materials:

1. Rock-Free Soil:
   a. Backfill soil around PVC pipe.
   b. Soil having rocks no larger than 1/2 inch in any dimension.
2. Pea Gravel:
   a. For use around drains, valves, and quick couplers.
   b. 1/2-inch maximum dimension washed rock.
3. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1-1/2 inches
4. Topsoil: Remove rocks, roots, sticks, clods, debris, and other foreign matter over 1-1/2 inches longest dimension encountered during trenching.
5. Pipe, Pipe Fittings, and Connections:
   a. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
   b. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
   c. Zone Pipe:
      1) Pressure Lines: Class 200.
      2) Lateral Lines: Class 200
      3) Backflow Assembly Piping: Schedule 40.
   d. Fittings: Same material as pipe, except where detailed otherwise.
   e. Sleeves:
      1) Under Parking Area and Driveway Paving: Schedule 40 PVC Pipe.
      2) All Other: Class 200 PVC Pipe.
      3) Sleeve diameter: refer to irrigation plan.
6. Sprinkler Heads:
   a. Each type of head shall be product of single manufacturer.
   b. Shrub Head Bubblers: If Used
      1) Approved Products.
         a) Hunter: PCN series.
   c. Spray Heads in Lawn Areas:
      2) Category Four Approved Products.
         a) Rainbird: Spray 4” Pop-up
      3) Gear Driven Rotor Pop-ups:
         a) Category Four Approved Products.
b) Hunter: PGJ Series & PGP Series

7. Sprinkler Risers:
   a. All 3/4” inlet rotor pop-up sprinklers shall have an adjustable pre-assembled swing assembly riser. Swing assemblies shall be equal as approved by Landscape Architect before installation. Swing assemblies shall be 3/4” x 12” and shall be threaded both ends.
   b. Pop-up rotor sprinkler heads shall have adjustable riser assembly, three ell swing joint assembly, unless detailed otherwise on Drawings. These swing joint fittings shall be of schedule 40 PVC plastic and nipples schedule 80 gray PVC unless otherwise designated on Drawings. Horizontal nipple parallel to side of lateral line shall be 8 inches long minimum. All other nipples on swing joint riser shall be of length required for proper installation of sprinkler heads.

8. Automatic Irrigation Control Wiring and Controller:
   a. Communication wire between controller and valve.
   b. Hunter controller:
      1) Provide the specified controller see irrigation legend.
   c. Waterproof Wire Connectors:
      1) Control wire connections shall consist of a properly-sized wire nut inserted in a waterproof grease cap.
      2) Type Two Acceptable Products:
         a) DBY or DBR by 3M
         b) One Step 20111SP by King Innovation
         c) Equal as approved by Architect before installation.
   d. Automatic controllers: Hunter XC-8
   e. Automatic Rain Sensors:

9. Valve
   a. Automatic Valves:
      1) Category Four Approved Products.
         a) Hunter: PGV Series
   b. Isolation Valves:
      1) PVC ball valves, size to match pipe size
      2) Nibco T-113 non-rising stem gate valve, size to match pipe size (use in cold, northern climates- eco-regions 6.0, 9.1 and 10.1).
      3) Class Two Quality Standards.
         a) Rainbird: BV Series
         b) Salco
   c. Backflow Preventer: Make and Model shown on Drawings or as required by local code
   d. Pressure Reducing Valve: Make and model shown on Drawings or as required by local code
   e. Valve Boxes and Extensions:
      1) Lid Colors:
         a) Green: Lawn areas
      2) Type Two Acceptable Products:
         a) Rainbird or Nelson Series, 1”
   f. Valve:
      1) Type Acceptable Products:
         a) Hunter
         b) Valve Box Supports: Standard size fired clay paving bricks
without holes or compacted gravel base.

10. Other Components:
   a. Recommended by Manufacturer and subject to Architect’s review and acceptance before installation.
   b. Provide components necessary to complete system and make operational.

PART 3 – EXECUTION

3.1 INSTALLERS

A. Approved Irrigation System installers
   1. Irrigation company with five (5) years’ experience minimum.

B. Approved irrigation system installers shall be pre-approved and included in the Construction Documents.

3.2 EXAMINATION

A. Verification of Conditions
   1. Perform pressure test at stub-out on main water line provided for irrigation system, at/or nearby fire hydrant.
   2. Notify the Architect if pressure over 70 PSI or under 50 PSI are found to determine if some re-design of the system is necessary before beginning work on the system.

3.3 PREPARATION

A. Protection:
   1. Protection of in-place conditions:
      a. Repair or replace work damaged during course of the Work at no additional cost to the Owner. If damaged work is new, installer of original work shall perform repair or replacement.
      b. Do not cut existing tree roots measuring over 2-inches in diameter to install irrigation lines. Hand dig within the drip lines of all existing trees.

B. Surface Preparation:
   1. Layout of irrigation heads:
      a. Location of heads and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
      b. During layout, consult with Landscape Architect to verify proper placement and make recommendations, where revisions are advisable.
      c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
d. Make certain changes from Contract Documents are shown on record drawings.

3.4 INSTALLATION

A. Trenching and Backfilling:

1. Pulling of pipe is not permitted.
2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
3. Cover pipe both top and sides with 2 inches of rock-free soil as specified under “Part 2 – Products” of this Section.
4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.

B. Sleeving:

1. Sleeve water lines and control wires under walks and paving. Extend sleeves 18-24” inches minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.

C. Installation of Pipe:

1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Unless otherwise indicated on Drawings, install main lines and lateral lines connecting pop-up rotor and impact sprinklers with minimum cover of 18 inches based on finished grade. Install remaining lateral lines, including those connecting drip tubing, with minimum of 12 inches of cover based on finish grade.
3. Install pipe and wires under driveways or parking areas in specified sleeves 18-24 inches below finish grade or as shown on Drawings.
4. Locate no sprinkler head closer than 3 inches from building foundation. Heads immediately adjacent to walks, or curbs shall be one inch below top of walk, or curb and have one to 3 inches clearance between head and walk, or curb.
5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
6. Make solvent weld joints as follows:
   a. Do not make solvent weld joints if ambient temperature is below 35 deg F
   b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
   c. Apply uniform coat of 711 solvent to outside of pipe.
   d. Apply solvent to fitting in similar manner.
   e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
   f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
7. Tape threaded connections with Teflon tape.
D. Control Valves and Controller

1. Install valves in plastic boxes with reinforced heavy-duty plastic covers. Locate valve boxes within 12 inches of sidewalks and shrub bed edges with tops at finish grade. Do not install more than one valve in single box.

2. Place 3-inches minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.

3. Wiring:
   a. Tape control wire to side of main line every 10 feet.
   b. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.

E. Backflow Preventer:

1. As directed by Aransas County ISD and Landscape Architect.

F. Sprinkler Heads:

1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.

2. Do not install sprinklers using side inlets. Install using base inlets only.

3. Set sprinkler heads at a consistent distance from existing walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

G. Before installation of sprinkler heads and drip lines, open control valves and use full head of water to flush out system.

H. Arrange valve stations to operate in an easy-to-view progressive sequence around building

3.5 FIELD QUALITY CONTROL

A. Field Tests:

1. Main Line:
   a. Before backfilling main line, test pressure at 100 psi minimum for 2 hours minimum and make certain there are no leaks.
      1) A report of the test results along with photographs of the testing process are to be provided by the landscape architect or his authorized representative at completion of testing.
      2) This report shall be included in the Operations and Maintenance Manual along with the acceptance certificate at the end of the project.
      3) Notify Architect 2 working days minimum before conducting test.

2. Test Report:
   a. Report of the test results along with photographs of the testing process are to be provided by the landscape architect or his authorized representative at completion of testing.
   b. This report shall be included in the Operations and Maintenance Manual along with the acceptance certificate at the end of the project.
3. Notify Landscape Architect two (2) working days minimum, before conducting test.

B. Field Inspections:

1. Architect’s irrigation design consultant, or certified water auditor recommended by consultant and approved in writing by Architect, will review irrigation system before substantial completion.
2. Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate.

3.6 ADJUSTING

A. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.

B. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.

C. Adjust watering time of valves to provide proper amounts of water to plants.

3.7 CLOSEOUT ACTIVITIES

A. Training:

1. After system is installed and approved, instruct Owner’s designated personnel in complete operation and maintenance.

END OF SECTION
SECTION 32 90 01 – COMMON PLANTING REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Includes but is not limited to:

1. Common procedures and requirements for landscaping work.
2. Provide maintenance for new landscaping as described in Contract Documents.

B. Related Requirements:

1. Section 01400 – Quality Control
2. Section 32 05 01 – Common Earthwork Requirements.
5. Section 32 84 23 – Underground Sprinklers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Schedule pre-installation conference as specified in Section 31 22 13.
2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 31 22 16, but before beginning landscape work.
3. In addition to agenda items specified in Section 01200 review the following:
   a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
   b. Prepare two (2) typical landscape planting excavations and conduct percolation test to verify that water drains away within two hours. Discuss results of percolation tests with Architect and Owner's representative.

1.3 SUBMITTALS

A. Closeout Submittals:

1. Include following in Operations and Maintenance Manual specified in Section 01782:
   a. Operations and Maintenance Data:
      1) At completion of landscape work submit two (2) copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year after contract maintenance period ends.
1.4 QUALITY ASSURANCE

A. Qualifications: Requirements of Section 01400 applies, but not limited to the following:

   1. Installer:
      a. Use trained personnel familiar with required planting procedures and with Contract Documents.
      b. Planting shall be performed under direction of foreman or supervisor with minimum five years’ experience in landscape installations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

   1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
   2. Deliver plants, trees, palms and shrubs in healthy and vigorous condition.
   3. Protect materials from deterioration during delivery.

B. Storage and Handling Requirements:

   1. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
   2. Protect materials from deterioration while stored at site.

PART 2 – PRODUCTS

2.1 POST-EMERGENT WEED CONTROL:

A. Type Two Acceptable Products:

   1. Treflan or Surflan by Dow Agrosciences.
   2. Eptan by Syngenta.
   3. Equal as approved by Architect before use.

PART 3 – EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:

   1. Landscape contractors that have experience in successful landscape installation in this region.
3.2 EXAMINATION

A. Verification of Conditions:

1. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.
2. Repair damage to any irrigation, ground lighting, and utilities and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.3 PREPARATION

A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with landscape work.

1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
2. All planting indicated on Drawings is required unless indicated otherwise.

B. Protection:

1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
3. Keep site well drained and landscape excavations dry.

3.4 INSTALLATION

A. Interface with other Work:

1. Do not plant trees or shrubs until major construction operations are completed. Do not commence landscaping work until site work has been completed.

B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

C. Hand excavate as required.

D. Maintain grade stakes until parties concerned mutually agree upon removal.

E. When conditions detrimental to plant growth are encountered, such as rubble fill, high water table or adverse drainage conditions, notify Landscape Architect before planting.
3.5 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Landscape Architect will inspect landscaping installation approximately two weeks before Substantial Completion.
   2. Replace landscaping that is dead or appears dead as directed by Architect within 10 days of notification and before Substantial Completion.

3.6 CLEANING

A. Waste Management:
   1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.7 CLOSEOUT ACTIVITIES

A. Instruction of Owner:
   1. Replace damaged plantings at no additional cost to Owner.

3.8 PROTECTION

A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.

B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Landscape Architect has accepted planted areas.

3.9 MAINTENANCE

A. General:
   1. Before beginning maintenance period (during construction), plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.
   2. Maintain landscaping until final acceptance.
   3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within 10 days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional 30 days from date of replacement.

END OF SECTION
Topsoil Testing Report

Instructions to Architect
1. The architect is to determine, by investigation, the quality and quantity of topsoil on a site before the Owner's review. All information on this form must be provided.
2. A horticultural topsoil test is recommended at each site.
3. The costs for the testing and report will be paid by the Owner.
4. Copies of the report shall be made available to the landscape architect and the DTA Area office.
5. Report location where soil is from and a history of its use on the back of this form.

Instructions to the Soil Testing Laboratory Firm
1. At least two test samples shall be made of the topsoil on the project site and each anticipated topsoil source. If the site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
2. The soil report must provide interpretation and recommendations for soil amendments, fertilizers, and soil conditioners for use by the architect and the landscape architect.

(“Acceptable Levels” refers to the allowable soil specifications prior to being amended)

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>pH(1)</th>
<th>EC(1)</th>
<th>SAR(1)</th>
<th>% Sand</th>
<th>% Silt</th>
<th>% Clay</th>
<th>Text(2)</th>
<th>OM</th>
<th>NO3-N(4)</th>
<th>P(5)</th>
<th>K(5)</th>
<th>Fe(5)</th>
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</thead>
<tbody>
<tr>
<td>Acceptable Level(s)</td>
<td>5.5-8.0</td>
<td>&lt;3.0</td>
<td>&lt;6.0</td>
<td>15-60</td>
<td>10-60</td>
<td>5-30</td>
<td>(2)</td>
<td>&gt;1.0</td>
<td>&gt;20</td>
<td>&gt;11</td>
<td>&gt;130</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>

(Specification Section 32-9113 – Finish Grading and Soil Preparation)
- Fertile, loose, friable soil, capable of sustaining vigorous plant growth.
- Clean and free from toxic minerals & chemicals, noxious weeds, weed seeds and rock (coarse fragments) or other objectionable/construction materials. Remove any such objects. No more than 2% by volume of soil measuring over 2.0mm.

Acceptable Compostion

<table>
<thead>
<tr>
<th>Composition in Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
</tr>
<tr>
<td>Acceptable %</td>
</tr>
<tr>
<td>Soil Sample No.</td>
</tr>
<tr>
<td>----------------</td>
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</table>

Documented infiltration rate of test sample(s) based on texture at 90% relative density. *To the nearest 1/10 of an inch.

1. Saturated soil paste 1:1 soil:water method (please indicate)
2. Hydrometer method (Acceptable soil: sand:15-60%, silt:10-60%, clay:5-30%)
3. Potassium dichromate method (Walkey-Black) or loss of ignition
4. Chromotropic acid method
5. AB-DTPA method

--If other methods are used for NO3-N, P, K, and Fe, then note.

Changes in acceptable levels shall also be made by the testing laboratory.

Interpretation Summary of Test Results:

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Infiltration Rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inches/ Hour</td>
</tr>
<tr>
<td></td>
<td>Inches/ Hour</td>
</tr>
</tbody>
</table>

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:
SECTION 32 91 13 - SOIL PREPARATION

PART I – GENERAL

1.1 SUMMARY

A. Includes but not limited to:

1. Perform soil preparation work as described in Contract Documents.
2. Furnish and apply soil amendments as described in Contract Documents.

B. Related Requirements:

1. Section 31 05 01 - Common Site Construction Requirements.
2. Section 31 14 13 – Topsoil Stripping and Stockpiling
3. Section 31 22 13 – Rough Grading’ and pre-installation conference held in conjunction with other Division 31 and Division 32 specifications.

1.2 REFERENCES

A. Reference Standards:

1. ASTM International:

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Schedule pre-installation conference.
2. In addition to agenda items specified review the following:
   a. Review soil amendments and fertilizer requirements.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
2. Samples:
   a. Sample of soil conditioner for approval before delivery to site. Include product analysis list.
   b. Slips indicating amount of soil conditioner delivered to Project site.
B. Closeout Submittals:

1. Include following in Operations and Maintenance Manual:

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Topsoil used in landscaped areas, whether imported, stockpiled, or in place, shall be fertile, loose, friable soil meeting following criteria:
   a. Chemical Characteristics:
      1) Acidity / alkalinity range: pH 6.5 to 7.5.
      2) Soluble Salts: less than 5.0 mmhos/cm.
      3) Sodium Absorption Ratio (SAR): less than 10.0.
      4) Organic Matter: greater than one percent.
      5) Brown in color and friable.
   b. Physical Characteristics:
      1) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
         a) Sand: 15 to 60 percent.
         b) Silt: 10 to 60 percent.
         c) Clay: 5 to 30 percent.
      2) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1-1/2 inch in any dimension, and other objectionable materials.
      3) Soil shall not contain more than 2 percent by volume of rocks measuring over 3/32 inch in largest size.

B. Soil Amendments:

1. Incorporate following soil amendments into topsoil used for Project:
   a. Acceptable Soil Amendments, Soil Conditioners and application rates:
      1) Soil Prep: submit sample of the landscape mix for approval.
   b. Acceptable Fertilizers and Application Rates:
      1) Apply a NP and iron fertilizer at label rate. Submit brand and analysis for approval.
      2) Equal as approved by Architect before installation.

PART 3 – EXECUTION

3.1 PERFORMANCE

A. Soil Amendments:

1. Add specified soil amendments at specified rates to lawn areas.
2. Roto-till or otherwise mix amendments evenly into top 4 inches of topsoil.
3. Incorporate and leach soil amendments which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.

END OF SECTION
SECTION 32 92 23 - SODDING

PART 1 – GENERAL

1.1 SUMMARY

A. Including but not limited to

1. Furnish and install sodded lawn as described in Contract Documents.

B. Related Requirements:

1. Section 32 84 23: Irrigation system.
2. Section 32 90 01: Common Planting Requirements.

1.2 REFERENCES

A. Definitions:

1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.

2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the CCISD into 15 geographical areas throughout North America, and the Hawaiian Islands.

3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
   a. Sunset Western Garden Book Maps.
   b. USDA Hardiness Zone Map.
   c. Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.

4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.

5. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.3 SUBMITTALS

A. Informational Submittals:

1. Source Quality Control Submittals:
   a. Written certification confirming lawn seed quality and mix.
2. Sustainable Design Submittals:
   a. Product Data for Credit WE 1.1:
      1) For water efficient landscape.
   b. Product Data for Credit WE 1.3:
      1) For water use reduction.

B. Closeout Submittals:

   1. Include following in Operations and Maintenance Manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

   1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass
      Producers International (TPI) (formally American Sod Producers Association) Specifications
      for Turfgrass Sod Materials and Transplanting / Installing.
   2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to
      minimum without causing delays.
      a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
      b. Do not deliver small, irregular, or broken pieces of sod.

B. Storage and Handling Requirements:

   1. Cut sod in pieces approximately 3/4 to one inch thick. Roll or fold sod so it may be lifted and
      handled without breaking or tearing and without loss of soil.
   2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and
      handling.
   3. During dry weather, protect sod from drying before installation. Water as necessary to insure
      vitality and to prevent excess loss of soil in handling. Sod that dries out before installation
      will be rejected.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Description:

   1. Superior sod grown from certified, high quality, seed of known origin or from plantings of
      certified grass seedlings or stolons:
      a. Assure satisfactory genetic identity and purity.
      b. Assure over-all high quality and freedom from noxious weeds or an excessive
         amount of other crop and weedy plants at time of harvest.
   2. Sod shall be 100% Bermuda Sod weed free and 2-year-old sod.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Interface with Other Work:
   1. Do not commence work of this Section until work of Sections 32 9113 and 32 9300 has been completed and approved.

B. Tolerances:
   1. Final grade of soil after sodding of lawn areas is complete shall be one inch below top of adjacent pavement of any kind.

C. Laying of Sod:
   1. Lay sod during within 48 hours of being lifted.
   2. Lay sod while top 6 inches of soil is damp, but not muddy.
   3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
   4. Lay sod flush with adjoining existing sodded surfaces.
   5. Refer to landscape plan for areas to have the subbase scarified.

D. After Laying of Sod Is Complete:
   1. Roll horizontal surface areas in two directions perpendicular to each other.
   2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
   3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches of topsoil.

3.2 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Sodded areas will be accepted at Project closeout if:
      a. Sodded areas are properly established.
      b. Sod is free of bare and dead spots and is without weeds.
      c. No surface soil is visible when grass has been cut to height of 2 inches
   2. Sodded areas have been mowed a minimum of twice.

END OF SECTION
SECTION 32 93 00 – PLANTS

PART 1 – GENERAL

1.1 SUMMARY

A. Includes but is not limited to:

1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Requirements:

1. Section 32 84 23: Irrigation system.
2. Section 32 90 01: Common Planting Requirements.

1.2 REFERENCES

A. Definitions:

1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
2. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
   a. Sunset Western Garden Book Maps.
   b. USDA Hardiness Zone Map.
   c. Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.
3. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
4. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

B. Reference Standards:

1. American Nursery & Landscape Association / American National Standards Institute:
   a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.3 SUBMITTALS

A. Action Submittals:

1. Samples:
   a. Top dressing mulch and granite for approval before delivery to site.
B. Informational Submittals:

1. Plant material pictures for approval.

C. Closeout Submittals:

1. Include following in Operations and Maintenance Manual:
   a. Operations and Maintenance Data:
      1) Installer Instructions:
         a) Provide written instructions covering maintenance requirements by
            Owner for one year beyond Contract maintenance period.
         b. Warranty Documentation:
            1) Include final, executed copy of warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been
   completed and install immediately.
2. Do not prune before delivery, except as approved by Landscape Architect.
3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling
   and tying damage.
4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
5. Provide protective covering during delivery.

B. Storage and Handling Requirements:

1. Handle stock by root ball or container. Do not drop trees and shrubs during delivery.
2. If planting is delayed more than six hours after delivery, set planting materials in shade and
   protect from weather and mechanical damage.
3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material
   approved by Architect. Do not place on pavement.
4. Do not remove container-grown stock from containers before time of planting.
5. Water root systems of trees and shrubs stored on site with fine spray. Water as often as
   necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.5 WARRANTY

A. Special Warranty:

1. Provide written warranties as follows:
   a. Guarantee shrubs and ground covers to live and remain in strong, vigorous, and
      healthy condition for one year from date landscape installation is accepted as
      complete.
   b. Guarantee trees to live and remain in strong, vigorous, and healthy condition for one
      year from date landscape installation is accepted as complete.
PART 2 – PRODUCTS

2.1 MATERIALS

A. Plants:

1. Conform to the requirements of Plant List.
2. Nomenclature:
   a. Plant names used in Plant List conform to 'Standardized Plant Names' by American
      Joint Committee on Horticultural Nomenclature except in cases not covered. In
      these instances, follow custom of nursery trade.
3. Quality:
   a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their
      eggs, noxious weeds, and have healthy, normal root systems. Container stock shall
      be well established and free of excessive root-bound conditions.
   b. Do not prune plants or top trees prior to delivery.
   c. Plant materials shall be subject to approval by Landscape Architect as to size, health,
      quality, and character.
   d. Bare root trees are not acceptable.
   e. Provide plant materials from licensed nursery or grower.
4. Measurements:
   a. Measure height and spread of specimen plant materials with branches in their normal
      position as indicated on
   b. Drawings or Plant List.
   c. Measurement should be average of plant, not greatest diameter.
   d. Plants properly trimmed should be measured same in every direction.
   e. Tree measurements for caliper on trees to be 4” above the root ball.
   f. Where caliper or other dimensions of plant materials are omitted from Plant List,
      plant materials shall be normal stock for type listed.
   g. Plant materials larger than those specified may be supplied, with prior written
      approval of Landscape Architect, and:
         1) If complying with Contract Document requirements in all other respects.
         2) If at no additional cost to Owner.
         3) If sizes of roots or balls are increased proportionately.
5. Shape and Form:
   a. Plant materials shall be symmetrical or typical for variety and species and conform to
      measurements specified in Plant List.
   b. Well grown material will generally have height equal to or greater than spread.
      However, spread shall not be less than 2/3's of height.

2.2 ACCESSORIES

A. Planting Mix:

1. Mixture of two parts topsoil mix of one part well-rotted composted manure or approved
   commercial landscape mix from ‘New Earth’.

B. Planting Tablets:

1. 21 gram Agriform 20-10-5.
C. Tree Stakes:
   1. Acceptable Products:
      a. (3) 6’ green ‘T’ Post.

D. Tree Staking Ties:
   1. Acceptable Products:
      a. ¾ Arbor tie & ¾” green hose.

E. Pre-Emergent Herbicide:
   1. Category Four Approved Products. For all planting beds.
      a. Chipco Dimension Granular by the Andersons Inc, Maumee, IL
      b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA
         www.cdms.net.
      c. Ronstar G granular by Bayer Crop Science, Monheim, Germany

F. Weed Barrier:
   1. Acceptable Products:

G. Hardwood Top Dressing Mulch: Submit Sample of approval.
   1. Acceptable Products:
      a. Medium size.
      b. Double ground mulch.
      c. Dark brown in color.

H. Decomposed Granite
   1. Acceptable size & color:
      a. Pink to rose in color
      b. Size to ‘Fine to 3/8” in size. Install in compacted lifts (submit sample for approval)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation and Assessment:
   1. Before proceeding with work, check and verify dimensions and quantities. Report variations
      between Drawings and site to Architect before proceeding with work of this Section.
2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting indicated on Drawings is required unless indicated otherwise.

3.2 PREPARATION

A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas. Secure Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Interface with Other Work:

1. Do not commence work of this Section until site work has been completed and approved.

B. Excavation:

1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
2. Plant Excavation Size:
   a. Diameter: Twice diameter of root ball or container minimum.
   b. Depth: Equal to container or root ball depth. See landscape details.
3. Unless excavated material meets topsoil requirements as specified in Section 32 9113, remove from landscape areas and do not use for landscaping purposes.
4. Roughen sides and bottoms of excavations.

C. Planting:

1. Removing Binders and Containers:
   a. Remove top one / third of wire basket and burlap binders.
   b. Remove plastic and twine binders from around root ball and tree trunk.
   c. Remove containers from around root ball.
2. Plant immediately after removing from container. Place tree and shrub root balls on undisturbed soil. After watering and settling, top of tree root balls shall be approximately one inches higher than finished grade and trunk flare is visible. Shrub root balls shall be approximately one inch higher than finished grade
3. Properly cut off broken or frayed roots.
4. Center plant in hole, remove remaining wire basket, and backfill with specified planting mix. Make ring of mounded soil around hole perimeter to form watering basin.
5. Add planting tablets in plant pit as follows. Place tablets in relation to root ball as recommended by Manufacturer.
   a. One Gallon (4.5 L) Shrub: 1 tablet.
   b. 5 Gallon (23 L) Shrub / Tree: 3 tablets.
   c. 15 Gallon (68 L) Tree: 4 tablets.
   d. 24 inches600 mm) Box Tree or greater: 6 Tablets.
6. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Landscape Architect.
9. Thoroughly water trees and shrubs immediately after planting.
10. At base of each tree, leave 36-inch diameter circle free of any grass.

D. Supports for New Trees:

1. Provide new supports for trees noted on Drawings to be staked.
   a. Remove nursery stakes delivered with and attached to trees.
   b. Support shall consist of at least three tree stakes driven into hole base before backfilling, so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet of stake length is below finish grade.
   c. Place tree ties 6 to 12 inches below crotch of main tree canopy.

E. Ground Covers:

1. Container-grown unless otherwise specified on Drawings. Space evenly to produce a uniform effect, staggered in rows and intervals shown.

F. Post Planting Weed Control:

1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
2. Areas shall be free of existing weed growth before application of herbicide.
3. Protect existing trees to remain.

G. Weed Barrier Fabric:

1. After planting and application or herbicide in shrub beds, apply covering of specified weed barrier fabric.
2. Achieve 100 percent coverage over ground areas.
3. Overlap seams 6 inches minimum.
4. Staple at 5 feet on center each way and within 3 inches of edge of shrub bed, with two at each corner.

H. Mulching:

1. After application of herbicide, mulch shrub and ground cover planting areas with 4 inches deep layer of specified top dressing or gravel mulch.
2. Cover grass-free area at tree bases with weed barrier and 4 inches of top-dressing mulch or rock mulch.
3. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION
PART 1 – GENERAL

1.1 SCOPE

A. This specification covers the requirements for labor, equipment, and material necessary to install pressure water line for use in water supply and distribution systems.

1.2 INSPECTION

A. Inspection of Material at Delivery Point: When received from the carrier and at the time of unloading, the Contractor and Inspector shall inspect all pipe and accessories for loss or damage in transit. No shipment of material should be accepted by the Contractor unless proper exceptions are made on the receipt obtained by the carrier, at the time of delivery, as to loss and/or damage.

B. Field Inspection of Material and Workmanship: All laying, jointing, testing for defects and for leakage under pressure, and disinfection, shall be performed in the presence of the Owner's Engineer or his authorized inspector, and shall be subject to his approval before acceptance.

C. Disposition of Defective Material: All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Owner's Engineer or his authorized inspector and the Contractor shall promptly remove such defective material from the site of the work.

1.3 CONTRACTOR’S RESPONSIBILITY FOR MATERIAL:

A. Responsibility for Material Furnished by Contractor: The Contractor shall be responsible for all material furnished by him. All such material which is defective in manufacture or has been damaged in transit or has been damaged after delivery shall be replaced by the Contractor at his expense.

B. Responsibility for Safe Storage: The Contractor shall be responsible for the safe storage of all material furnished to or by him and accepted by him until it has been incorporated in the completed project.

1.4 HANDLING OF PIPE AND ACCESSORIES:

A. Handling and Care: Pipe and accessories shall, unless contrary instructions are received, be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. Material shall not be dropped or bumped against pipe or accessories already on the ground or against any other object on the ground. The pipe manufacturer will assist the Contractor in implementing proper handling procedures. The Contractor shall be responsible for any damage resulting from improper handling or care.

B. Distribution at Site of Work: In distributing material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

C. Materials Kept Clean: The interior of all pipe and accessories shall be kept free from dirt and foreign
D. Standing Water: Pipe shall never be installed in a trench where there is standing water.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION

3.1 ALIGNMENT AND GRADE:

A. General: All pipe shall be laid and maintained to the required lines and grades. Fittings and valves shall be at the required locations and with joints centered, spigots home and all valve stems plumb.

B. Protecting Underground and Surface Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense.

C. Obstructions Caused by Other Utility Structures: Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed or reconstructed by the Contractor in cooperation with the Owner of such utility structures.

D. Deviation With Engineers Consent: Deviation from the required line or grade as shown on the plans shall be made only with prior approval of the Engineer.

E. Subsurface Explorations: Whenever necessary to determine the locations of existing underground utility structures, the Contractor, after an examination of available records and upon the written order of the Engineer, shall make all explorations and excavations for such purpose.

3.2 THRUST BLOCKING:

A. If shown on construction plans, pipe ends, changes in direction, valves and all other fittings shall be thoroughly blocked by means of poured concrete. Concrete shall have a minimum compressive strength of 2500 psi at 28 days. The area bearing against undisturbed earth shall be as shown on the plans.

3.3 LOWERING PIPE AND ACCESSORIES INTO TRENCH:

B. General: Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

C. Inspection of Pipe and Accessories: The pipe and accessories shall be inspected, by both the Contractor and Inspector, for defects prior to lowering into trench. Any defective, damaged, or unsound pipe shall be
D. Pipe Kept Clean: All foreign matter or dirt shall be removed from the interior of pipe before lowering into position in the trench. Pipe shall be kept clean by means approved by the Engineer during and after laying. Pipe ends shall be tightly plugged overnight, and provisions made to avoid flotation of pipe until final backfill is placed.

E. Disinfection: When taking bacteriological tests is impossible, the Contractor shall wipe any item that will contact the water with a chlorine solution. The chlorine solution will contain a minimum of 50 mg/L chlorine. In addition, the Contractor shall place 5 pounds of HTH, 65% chlorine, in the pipe ahead of a connection, valve, or any place where the waterline has been open.

3.4 UTILITY LINE MARKING TAPE

A. Detectable underground marking tape, meeting OSHA regulation 1926.956 (c)(1), shall be installed over ALL utility lines. The detectable marking zone tape shall bear the printed identification of the Utility Line below it, such as "CAUTION - BURIED WATER LINE BELOW". Tape shall be permanently printed. Surface Printing will not be acceptable. The tape shall be constructed of material that will provide maximum color contrast and visibility in all types and colors of soil. The tape shall meet APWA color code. The tape shall be lineguard III underground detectable tape or approved equal. The detectable marking tape shall be buried 6 inches over the top of the waterline. After placing sand embedment, the tape shall be placed in the backfill and allowed to settle in place with the backfill. Tape may be installed by any other method approved by the Engineer.

3.5 TRACER WIRE

A. All non-metallic pipe installed underground shall have a tracer wire installed along the length of the pipe. The wire shall be placed adjacent to, but not touching, the pipe, and in no case shall it be wrapped around the pipe. A maximum distance from the pipe to the wire is one (1) foot. Tracer wire shall be 14 gauge minimum, copper single-conductor wire with insulation and shall be continuous along the pipeline passing through the inside of each valve box.

3.6 WATERLINE MARKERS

A. Waterline markers shall be provided on both sides of each county road, state highway, railroad track, and drainage ditch crossing for main waterlines.

3.7 MARKERS

A. The markers shall consist of a pressure penta-treated post - minimum diameter of 4’’ - and a fiberglass sign. The post shall be 8’ long and shall be buried a minimum of 3’. The top of the post shall be notched to allow the sign to be placed against a flat surface. The sign shall be constructed of a composition of fiber reinforced fiberglass, marble, and thermosetting polymers. The signs shall be 6’ high, 12” long, and 0.135 inches thick. The sign shall be resistant to U.V. degradation. The sign shall be manufactured by Carsonite or approved equal.
3.8 LETTERING

A. The sign shall be white with black letters. The letters shall be as follows:

CAUTION WATERLINE (Larger Letters)
OWNER (Larger Letters)
CALL (XXX) XXX-XXXX BEFORE (Smaller Letters)
DIGGING IN THIS AREA (Smaller Letters)

3.9 ATTACHMENT

A. The signs shall be attached to the posts using 2 stainless steel wood screws, No. 14 by 1-1/2".

END OF DOCUMENT
SECTION 33 05 19 – PIPE RESTRAINT SYSTEM

PART 1 – GENERAL

This specification shall govern the design, manufacture, fabrication and installation of Restraint systems for Ductile Iron and PVC Pipe for water supply and transmission. All material shall be new. The system shall be manufactured by Ford Uni-Flange; EBAA; Sigma or Star.

PART 2 – PRODUCTS

Material Requirements: The system shall incorporate a series of machined serrations (not “as cast”) on the inside diameter to provide positive restraint, exact fit 360 degrees contact and support of the pipe wall. Restraint device shall be manufactured of high strength Ductile Iron Material (ASTM A536) for smaller size pipe or high-grade steel for larger size pipe. Bolts and connecting hardware shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11. Bolts shall be hot-dipped galvanized or stainless steel. The devices shall meet or exceed the requirements of Uni-B-13-94.

Restraint Systems shall conform to the following:
1. C-900 PVC – Restraints may be integrated packing gland, restraint ring or restraint ring and mechanical joint packing gland
2. C-905 PVC – Restraint ring and mechanical joint packing gland
3. Ductile Iron - integrated packing gland and restraint ring

PART 3 – EXECUTION

The restraint devices shall be installed at mechanical joint fittings and at ductile iron and PVC pipe joints as noted. The devices shall be installed in accordance with manufacturer’s recommendations. Each device shall be wrapped in two layers of polyethylene sheets. The minimum downstream and upstream requirements for placing joint restraints (at bell & spigot connections) shall be as recommended by the manufacturer for the proposed laying conditions. Minimum allowable lengths are detailed in the construction plans.

END OF SECTION
SECTION 33 08 10.10 – HYDROTESTING

PART 1 – GENERAL

1.1 SCOPE:

A. This item covers the requirements for the hydrostatic test of the water lines.

PART 2 – PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 TEST PROCEDURE: Pipe sections shall be hydrostatic tested as follows:

A. The Contractor shall install new pipelines to approximately 20 feet within the new connections or proposed changes in pressure classes. A temporary cap or plug shall be installed on each pipe end and temporarily blocked for pressure testing. After the pipe has been laid, the line pressure shall be held at fifty (50) psi for a period of twenty-four (24) hours. The Engineer shall be notified before filling any section of the pipe. A pressure gauge with a minimum diameter of 4”- and 5-pound numbered marking and individual markings at each 1 pound shall be furnished by the Contractor. The Contractor shall also furnish a pressure pump with drive and a meter which will measure 0.10 gallon to perform the hydrostatic test.

B. Before applying the specified test pressure, all air shall be expelled from the pipe. If additional taps are necessary to expel this air, they shall be made at appropriate points and tightly plugged after the test is completed. All exposed pipes, fittings, valves, and joints will be examined carefully during the test. All joints showing visible leaks, drips, seeps, etc. shall be made tight, or shall be cut out and replaced, at the Contractor's expense, as directed by the Engineer. Any cracked or defective pipe joints, fittings, or valves discovered in consequence of this pressure test, shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory to the Engineer. When hydrants are in the test section, the test shall be run against the closed hydrant and not the valve on the lead. Pipes shall be tested with all service connections from main pipe to meter location installed.

C. After the 24-hour stabilization, the pipeline shall be held at the test pressure of one hundred fifty (150) psi for a minimum of two (2) hours during which time the leakage determination shall be made.

3.2 WATER FOR TESTING:

A. The Owner will provide water for one testing, disinfection, flushing and filing. Any additional water required will be purchased by the contractor from the owner at standard water rates.
3.3 LEAKAGE:

A. Acceptable leakage for ductile iron pipe, concrete steel cylinder pipe and PVC pipe shall be less than the value indicated by the following formula:

\[
L = \frac{N \times D \times (P)^{(1/2)}}{7400}
\]

where:  
L = max. allowable leakage, in gallons/hour  
N = number of joints in tested length  
D = nominal diameter of pipeline, in inches  
P = mean test pressure, in pounds/sq. inch

B. Should any test of combined sections of pipe laid disclose leakage greater than the specified limit, the Contractor shall at his own expense, locate and repair the defective joints until the leakage is within the specified allowance. Repairs and test shall be repeated until the line shows no defects and is accepted by the Engineer.

3.4 GUARANTEE:

C. The pipe Contractor shall guarantee the pipeline against leaks and breaks due to defective materials or workmanship, for a period of one (1) year from the date of completion of the contract. Damage or leaks due to the acts of God or from sabotage and/or vandalism occurring after the pipeline has been accepted and placed in operation are specifically not a part of this guarantee.

D. When defective material and workmanship are discovered requiring repairs to be made under this guarantee, all such repair work shall be done by the Contractor at his own expense within five (5) days after written notice of any leaks has been given him by the Owner. Should the Contractor fail to repair such leaks within five (5) days thereafter, the Owner may make the necessary repairs and charge the Contractor with the actual cost of all labor and material required. In emergencies demanding immediate attention, the Owner shall have the right to repair the same and charge the Contractor with the actual cost of all labor and materials required.

END OF DOCUMENT
SECTION 33 11 13.10 – 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.

D. All materials shall be approved for use in potable water systems by the National Sanitation Foundation (NSF), Standard 61.

1.2 REFERENCES


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.


M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.


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 300mm), for Water Distribution.


PART 2 – PRODUCTS

2.1 C900 WATERLINE PIPE:

A. PVC piping 4" through 12” diameters shall meet the requirements of the latest revision of AWWA Standard C900, 'Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12" for Water' and shall be furnished in cast-iron pipe equivalent outside diameters. All pipe shall be suitable for use as a pressure conduit for potable water. The pipe shall meet the requirements of Uni-Bell Standard Uni-B-3 and shall be approved by Underwriter's Laboratories for use as a fire main.

1. Pressure Class: The pipe shall be as noted on the plans with minimum Class 150 with a DR of 18.

B. Couplings: The pipe shall be joined using integral bells and spigot couplings. The bell shall consist of an integral wall section with a synthetic rubber, locked in place, gasket. The gasket shall comply with the requirements of the latest revision of ASTM F-477, "Elastomeric Seals (Gaskets) for Joining Plastic Pipe". Natural rubber rings will not be acceptable.
2.2 C905 WATERLINE PIPE:

A. PVC piping greater than 12” diameter shall meet the requirements of AWWA C-905, latest revisions for "Polyvinyl Chloride (PVC) Water transmission Pipe, Nominal Diameter 14 in through 48 in".

1. Pressure Class: The pipe shall be as noted on the plans with minimum Class 165 with a DR of 25.

B. Couplings: 14” and larger pipe shall be joined using integral bell and spigot couplings. The bell shall consist of an integral wall section with a synthetic rubber gasket ring that meets the requirements of the latest revision of ASTM F-477, "Elastomeric Seals (Gaskets) for joining Plastic Pipe". The bell section shall be designed to be at least as strong as the pipe wall. Natural rubber rings will not be acceptable.

2.3 PVC PIPE >6” IN DIAMETER:

A. Pipe sizes less than six inches in diameter shall meet the requirements of ASTM D2241 and shall be furnished in steel pipe equivalent outside diameters. Pipe and fittings 1” and smaller shall be schedule 80 PVC. The pipe shall bell and spigot, solvent cement joints, meeting the requirements of ASTM D1785 and ASTM D2672 or the pipe shall be screwed joints and fittings as required.

2.4 PRESSURE TESTING:

A. Each standard and random length of pipe shall be tested to four (4) times the pressure class of the pipe for a minimum of five (5) seconds. The integral bell shall be tested with the pipe.

2.5 RANDOM TESTS:

A. The District may subject random lengths of pipe to testing by an independent laboratory for compliance with this specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.

2.6 DELIVERY:

A. Pipe shall be bundled in pallets for ease of handling and storage. Pipe bundles shall be packaged to provide structural support to insure that the weight of upper units shall not cause deformation to pipe in lower units. No pipes bundles shall be accepted which show evidence of ultraviolet radiation “sunburn” on exposed pipe as may be caused from extended unprotected storage conditions. Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusions, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage.

B. Pipe shall be inspected by the District to assure that it meets specifications. When a load of pipe is found to have inadequate wall thickness or tolerances greater than specified, randomly selected samples of the pipe shall be immediately forwarded to an approved testing laboratory with instructions to check the pipe for compliance with applicable product standards, ASTM specifications and other specifications for the
specific contract. When the testing laboratory reports concur that the pipe does not meet specifications, it is to be understood that all of the defective pipe delivered to the site will be immediately removed and replaced by the contractor at no additional cost to the owner.

2.7 FITTINGS:

A. Fittings shall be ductile iron in accordance with AWWA C110, AWWA C153, or AWWA C606, latest revisions.

B. Cement Lining: Fittings shall be internally lined with cement mortar in accordance with AWWA C104. The lining thicknesses shall be equal to or greater than those for comparable size pipe.

C. Buried Service Fittings: Fittings, sizes 4” – 24”, with push-on, restrained push-on, or mechanical joints shall be rated for 350 psi working pressure. Fittings, sizes 30” – 64”, with push-on, restrained push-on, or mechanical joints shall be rated for 250 psi working pressure.

D. Small pipe Fittings: 3” and 2” mechanical joint fittings shall be supplied with a transition gasket, allowing them to accept iron pipe equivalent outside diameter. 4” and larger diameter pipe shall be supplied with transition gaskets, if necessary, to allow them to accept the ductile iron fittings.

2.8 WARRANTY:

A. All PVC pipe shall carry a 50-year warranty against manufacturer’s defects. Warranty shall be common to all of manufacturer’s pipe and shall not be project specific.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. PVC pipe shall be installed in accordance with specifications and with the Uni-Bell Plastic Pipe Association guide for installation of PVC pressure pipe for municipal water distribution systems.

END OF SECTION
SECTION 33 11 13.20 – DUCTILE IRON PIPE AND FITTINGS

PART 1 – GENERAL

1.1 SCOPE:

A. This specification shall govern the design, manufacture, fabrication and installation of Ductile Iron Pipe and fittings for water supply and transmission. All pipe and fittings must be new. The pipe, fittings, coatings, lubricants, gaskets, etc., must be NSF, Standard 61 approved.

1.2 STANDARDS:

A. The following standards govern ductile iron pipe and fittings. Where standards, specifications or methods are cited without dates, the reference shall be construed to apply to the latest revision in effect at the time of contract.

1. AWWA C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110: Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in for Water and Other Liquids
4. AWWA C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. AWWA C150: Thickness Design of Ductile-Iron Pipe
7. AWWA C151: Ductile-Iron Pipe, Centrifugally Cast for Water
8. AWWA C153: Ductile-Iron Compact Fittings, 3-in through 24-in and 54-in through 64-in for Water Service
9. AWWA C600: Installation of Ductile-Iron Water Mains and their Appurtenances

PART 2 - PRODUCTS

2.1 PIPE DESIGN:

A. All ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151, respectively, for the following minimum operating conditions:

1. The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi. No reduction of safety factor for transient pressures shall be allowed.
2. The external loads design criteria shall be a minimum of 4’ depth of cover at 120 lbs. per cubic feet soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150.
3. The horizontal deflection of cement-mortar lined ductile iron pipe resulting from external load conditions shall not exceed 3% of the pipe diameter.
4. The pipe trench, per AWWA C150, for design purposes shall be: Type 4 – Pipe bedded in sand, gravel or crushed stone to depth of 1/8 pipe diameter, 4” minimum. Backfill compacted to top of pipe.
2.2 MINIMUM PIPE CLASS:

A. Ductile iron pipe shall conform to AWWA C151. All pipe shall have a minimum pressure rating as indicated below, or higher ratings as indicated in the contract documents:

1. DI pipe 4”-12” dia. 350 PSI
2. DI pipe 14”-20” dia. 250 PSI
3. DI pipe 24” dia. 200 PSI
4. DI pipe 30” – 64” dia. 150 PSI

2.3 JOINTS, GASKETS, BOLTS AND NUTS:

A. Joints: Ductile Iron Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, flanged joints, and grooved joints as required.

B. Push-on Joints: Push-on joints shall conform to AWWA C111.

C. Mechanical Joints: Mechanical joints shall conform to AWWA C111.

D. Gaskets: Gaskets shall be Viton or EPDM, natural rubber and Buna N are not allowed.

E. Bolts and Nuts: Bolts shall be high-strength, low-alloy steel per AWWA C111.

2.4 FITTINGS:

A. Fittings shall be ductile iron in accordance with AWWA C110, AWWA C153, or AWWA C606, latest revisions.

1. Cement Lining: Fittings shall be internally lined with cement mortar in accordance with AWWA C104. The lining thicknesses shall be equal to or greater than those for comparable size pipe.
2. Buried Service Fittings: Fittings, sizes 4” – 24”, with push-on, restrained push-on, or mechanical joints shall be rated for 350 psi working pressure. Fittings, sizes 30” – 64”, with push-on, restrained push-on, or mechanical joints shall be rated for 250 psi working pressure.

2.5 LINING:

A. Ductile iron pipe, specials, and fittings shall be lined with cement-mortar lining with an asphaltic seal coating, 1 mil, in accordance with AWWA C104.

2.6 EXTERIOR COATING FOR BURIED DI PIPE:

A. The exterior of ductile iron pipe, special, and fittings shall be coated with a 1-mil asphaltic coating in accordance with AWWA C151. When specified, loose polyethylene encasement shall be supplied in accordance with AWWA C105.
PART 3 – EXECUTION

3.1 INSTALLATION:

A. The pipe shall be laid to the lines and grades specified by the Engineer. After the pipe has been laid, sand bedding material shall be brought up uniformly on each side of the pipe to the center of the pipe and mechanically tamped to a minimum of 85% proctor. The sand bedding material shall be placed to a point four (4") inches above the top of the pipe including bell and mechanically tamped to a minimum of 85% proctor. Care shall be exercised to see that the bedding material is well tamped under the pipe before bringing backfill up on the sides of the pipe. No voids or loose material around the pipe will be permitted. This bedding material backfill shall be mechanically tamped.

B. After this mechanically tamped bedding material has been placed, the remainder of the trench shall be backfilled and this portion of the backfill material shall be either water consolidated or mechanically tamped to a minimum of 85% proctor. The material used shall be free from rocks, roots, boulders or other unsatisfactory materials, including materials that would damage the polyethylene wrapping.

END OF SECTION
SECTION 33 12 50 – POLYETHYLENE WRAPPING

PART 1 – GENERAL

1.1 SCOPE

A. All ductile or cast iron or steel pipe, pipe restraints or other metal water system appurtenances laid below ground shall be wrapped in black polyethylene sheet as outlined below. Soil which is onto the pipe, valve, or metal shall be removed before installing the polyethylene.

PART 2 – PRODUCTS

2.1 MATERIAL

A. Polyethylene sheets shall have a minimum thickness of 8 mils.

PART 3 – EXECUTION

3.1 PLACEMENT ON PIPE

A. All ductile or cast iron pipe or steel pipe laid below ground shall be encased in two (2) layers of black polyethylene sheet placed on each joint as it is being laid, in accordance with AWWA Standard C-105, Method C, latest revision. The sheets shall be of sufficient size to provide a 12” lap at all longitudinal and transverse joints. Sheets shall be of virgin black polyethylene. The sheets shall be taped together at intervals along the joints, leaving at least 90% of the joint open.

B. Care shall be taken to avoid tearing or puncturing the sheet during installation and during placing and compaction of backfill. Tears and punctures shall be repaired with eight (8) mil black polyethylene sheet and/or tape.

3.2 PLACEMENT ON FITTINGS AND VALVES

A. Fittings and valves which are to be buried shall be loose wrapped with two layers of eight (8) mil black polyethylene sleeves or sheet. The sheet or sleeve shall be taped to the valve or fitting wherever operating parts must project. Tears and punctures shall be repaired as outlined above.

END OF DOCUMENT
SECTION 33 13 00 – DISINFECTION OF POTABLE WATERLINES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Disinfection of potable water lines.

1.2 REFERENCES

A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONDUCTING DISINFECTION

A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to water distribution system.

B. Water for disinfection and flushing will be furnished by Owner without charge.

3.2 PREPARATION

A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines prior to connection to water distribution system. Normally, each valved section of water line requires two 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.

B. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.

C. Slowly fill each section of pipe with water in manner approved by Engineer. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

D. Backfill excavations immediately after installation of risers or blow-offs.

E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.
3.3 DISINFECTION BY CONTRACTOR

A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:

1. Use not less than 100 parts of chlorine per million parts of water.
2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
4. Open and close valves in lines being sterilized several times during contact period.

3.4 BACTERIOLOGICAL TESTING

A. After disinfection and flushing of water lines, bacteriological tests will be performed by Owner or testing laboratory. When test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, the Contractor shall re-disinfect as no additional cost to the Owner including new testing.

3.5 COMPLETION

A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF DOCUMENT