SDMS DocID 2012092

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SOUTHERN MARYLAND WOOD TREATMENT SITE
Hollywood, Maryland

100% FINAL DESIGN
TECHNICAL SPECIFICATIONS
DIVISIONS 1 THROUGH 16

OHM Project 19991

Prepared by

OHM Remediation
Services Corp

September 19, 1997

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia Pennsylvania 19107-4431

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October 16 1997

Eric Brandt P E
U S Army Corps of Engineers
P O Box 56 Gunpowder Branch
Aberdeen Proving Grounds MD 21010 0056

RE Southern Maryland Wood Treating Site

Dear Eric

I reviewed the 19 September 1997 100% Final Design for the Water Treatment System prepared by OHM Remediation Services Corp And have a few comments

1 Division 1 General Requirements Several of the sections in this Division refer back to the Site Specific Work Plan (EA, July 1997), however the SSWP doesn t include the referenced information Sections not found in SSWP include 01201 01202, 01310 01490 01495 01501 01545 01580, 01610 If this information is not provided in either of these documents where will it be found?

2 Section 01625 Acceptance Test This document conflicts to some degree with the information provided in the SSWP The Design calls for a 72 hour acceptance test The SSWP called for a 7 day test The sampling frequency and analytical parameters are also different There is no mention of sampling the cascade aerator effluent There is no discussion in either document of where the effluent will be stored during testing

3 Section 11500 Vapor Phase Carbon Adsorption System During the 24 September 1997 Scoping meeting for the Sampling and Analysis Plan there was some discussion about whether and why vapor phase carbon was needed on the system and if so would air monitoring be required Kaiser was supposed to look into this issue with OHM Has this issue been resolved?

4 Sheet No C2 How will condensate from TDUs be transported to the Condensate Influent Tank of the water treatment system? There is no piping shown

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5 Sheet No C3 The concrete pad for the free product storage tank includes a containment curb The pad for the influent tanks should have a containment ~~pad~~ curb as well since the tanks will be holding contaminated ground water and condensate from the TDUs

Please provide responses to these comments within 15 days If you have any questions call me at (215) 566 3234

Sincerely

Stephanie Dehnhard
Remedial Project Manager

OHM Remediation Services Corp
A Subsidiary of OHM Corporation

SOUTHERN MARYLAND WOOD TREATMENT SITE HOLLYWOOD, MARYLAND

TECHNICAL SPECIFICATIONS DIVISION 1 THROUGH 16

Prepared for

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Prepared by

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Reviewed by

Phillip Tully P E
Project Manager

Edward Weinberg P E
Senior Project Engineer

September 19 1997
OHM Project 9901

24 SEP 1997

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Southern Maryland Wood Treatment Site
Water Treatment System
Hollywood, Maryland
OHM Project 19991

Division 1 thru 16 Technical Specifications

Section No	Specifications Title
Division 1	**General Requirements**
01010	Summary of Work
01110	Health and Safety Provisions
01201	Pre Site Mobilization and Pre Construction Conference
01202	Progress Meetings
01300	Submittal Procedures
01310	Project Schedule
01341	Samples
01490	Environmental Protection Procedures
01495	Spill Prevention and Control
01500	Temporary Construction Facilities and Controls
01501	Decontamination of Personnel and Equipment
01545	Protection of the Work and Property
01580	Project Identification and Signs
01610	Transportation and Storage of Materials and Equipment
01620	Installation of Equipment
01652	Acceptance Test
01710	Cleaning
01720	As Built Drawings
01730	Operation and Maintenance Data
01731	Treatment System Operation and Maintenance Manual
01760	Project Closeout
Division 2	**Site Work** (Not used See Site Specific Work Plan)
02110	Clearing and Grubbing
02220	Excavation and Backfill
02230	Backfill Materials
02250	Transportation and Disposal of Materials
02831	Fencing
02935	Turf
Division 3	**Concrete**
03100	Concrete Form work
03200	Concrete Reinforcement
03251	Concrete Joints
03252	Concrete Anchors
03300	Cast in Place Concrete

Southern Maryland Wood Treatment Site
Water Treatment System
Hollywood Maryland
OHM Project 19991

Division 1 thru 16 Technical Specifications

Section No.	Specifications Title
03600	Grout
Division 4	**Masonry** (not used)
Division 5	**Metals**
05120	Structural Steel
05504	Miscellaneous Metal Fabrications
Division 6	**Wood & Plastic** (not used)
Division 7	**Thermal & Moisture Protection**
07110	Liquid Applied Membrane Waterproofing
07920	Caulking and Sealants
Division 8	**Doors & Windows**
08116	Steel Doors and Frames
08710	Door Hardware
Division 9	**Finishes**
09740	Concrete Toppings
09900	Painting
Division 10	**Specialties**
10200	Metal Louvers
10400	Identification Devices
10520	Portable Fire Protection Equipment
Division 11	**Equipment**
11204	Sand Filter
11212	Centrifugal Pumps
11225	Incline Plate Separator

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Southern Maryland Wood Treatment Site
Water Treatment System
Hollywood, Maryland
OHM Project 19991

Division 1 thru 16 Technical Specifications

Section No.	Specifications Title
Division 11	**Equipment** (continued)
11241	Polymer Feed System
11242	NaOH Feed System
11244	Liquid Phase Carbon Adsorption System
11265	Oil/Water Separator
11312	Sump Pumps
11314	Filter Press
11317	Diaphragm Pumps
11325	Advanced Oxidation Process Reactor System and Appurtenances
11340	Tanks
11346	Potassium Permanganate Feed System
11370	Compressed Air Equipment
11385	Mixing Equipment
11500	Vapor Phase Carbon Adsorption System
Division 12	**Furnishings** (not used)
Division 13	**Special Construction**
13120	Pre Engineered Building
13228	Sand Filter Media
13330	Local Control Panels
13600	Process Control System
13750	Instrumentation
Division 14	**Conveying Systems** (not used)
Division 15	**Mechanical**
15051	Buried Piping Installation
15052	Exposed Piping Installation
15067	Thermoplastic Pipe
15070	Fiberglass Reinforced Plastic Pipe
15094	Pipe Hangers Supports and Restraints
15100	Valves and Appurtenances
15401	Plumbing General Purpose

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Water Treatment System
Hollywood, Maryland
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Division 1 thru 16 Technical Specifications

Section No.	Specifications Title
15402	Vent Piping Systems
15836	Unit Heaters Electric
Division 16	**Electrical**
06050	General Provisions
16111	Rigid Conduit
16112	Flexible Conduits
16114	Expansion/Deflection Fittings
16124	Instrumentation Cable
16130	Outlet Boxes
16131	Pull and Junction Boxes
16133	Receptacles
16135	Snap Switches
16321	Dry Type Transformers
16360	Disconnect Switches
16390	Grounding Systems
16470	Lighting
16480	Panelboards
16492	Manual Motor Starters

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DIVISION 1

GENERAL REQUIREMENTS

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SECTION 01010
SUMMARY OF WORK
PART 1 GENERAL

1 01 LOCATION AND DESCRIPTION OF WORK

The work consists of the construction and prove out of a 108 thousand gallons per day gpd) wastewater treatment plant in Hollywood Maryland treating contaminated groundwater and condensate (quench) water from a thermal desorption unit Construction shall commence upon receipt of the first Notice to Proceed Prove out shall commence upon receipt of a second and final Notice to Proceed under this contract The summary of the Work as described in this section is an overall summary of the responsibilities of the Contractor and his relation to the CONTRACTING OFFICER It does not supersede the specific requirements of the other Contract Documents

A Wastewater Treatment Facility Construction
The major work items for construction of the treatment plant include

1 Site preparation including site grading and tree removal and roadway access
2 Pre excavation sampling
3 Connections of utilities to the new facilities
4 Process Building including vendor supplied advanced oxidation system preceded by metals removal equipment and chemical feed and blending equipment compressed air system mechanical and plumbing equipment and electrical controls and maintenance area
5 External above grade holding tanks
6 Effluent Discharge Piping
7 Miscellaneous support structures
8 Interior and exterior piping
9 Plumbing work
10 HVAC work
11 Electrical work
12 Instrumentation work
13 Other related work

B Wastewater Treatment Facility Prove Out Period Prove out shall involve placing all equipment into operation and proving that all components of the facility are functioning for the intended purpose Throughout the prove out period a contractor (working under a separate contract with the CONTRACTING OFFICER) who will become responsible for the long term operation and maintenance (O&M) of the wastewater treatment plant shall be trained by the Contractor at operating and maintaining this facility

1 02 BACKGROUND

The Southern Maryland Wood Treatment (SMWT) site is located in Hollywood Maryland and was owned and operated by the Southern Maryland Wood Treating Company form 1965 to 1978 as a pressure treatment facility for wood preservation The SMWT site is approximately 25 acres in size Approximately 4 acres were used for wood treatment using creosote and pentachlorophenol (PCP) as

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wood preservatives

Six unlined lagoons or ponds were used for the disposal of liquid waste from the process As a result of the disposal method onsite soil and ground water beneath the lagoons became contaminated Non aqueous phase liquids (NAPL) both light (LNAPL) and dense (DNAPL) are currently found in the subsurface beneath the lagoons and above the underlying clay layer

Legal action taken by the Maryland Department of the Environment (MDE) prompted an initial cleanup action at the site in 1982 Liquid treatment waste from the six unlined lagoons was pumped and sprayed into the woods behind the site Remaining sludge from the lagoons was excavated mixed with wood chips composted sewage sludge and top soil and spread to a previously uncontaminated area of the site in an attempt to bioremediate the contaminants Excavated areas were backfilled and graded The bioremediation of waste was unsuccessful resulting in the contamination of several additional acres of property

In 1985 EPA conducted an immediate response action when it was found that contaminated material was entering freshwater pond Approximately 1 400 cubic yards (cy) of contaminated sediment was excavated from the pond stabilized and encapsulated onsite in an impermeable synthetic liner

A ROD was issued on June 29 1988 The selected remedy for the site included construction of a sheet pile barrier wall around the former lagoon and process areas excavation and onsite incineration of contaminated soil from the former lagoon area the land treatment area and other areas of the site onsite incineration of liquids and soils contained in tanks and retorts demolition of buildings and pump and treatment of contaminated ground water

Construction of the sheet pile wall was completed in 1990 Due to the opposition of the local government and citizen groups to the onsite incineration design work for the incineration and groundwater treatment system was suspended and a Focused Feasibility Study (FFS) was proposed by the EPA to re evaluate a remedy for the site

Subsequent to the completion of theFFS a new ROD was issued on September 8 1995 The current ROD stipulates that the soil and sediment shall be treated using a thermaldesorption process The process shall include two major steps

1 Volatilization of volatile andsemivolatile organic compounds and other constituents of concern (COC)
2 Off gas treatment (condensing and collection of thevolatilized COC)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01110
HEALTH AND SAFETY PROVISIONS
PART 1 GENERAL

1 01 SUMMARY

A Site Health and Safety Requirements for the Work to be performed for the on site remedial actions at the Southern Maryland Wood Treating site in Hollywood Maryland See ICF Kaiser Site Specific Health and Safety Plan and Site Specific Work Plan by EA dated July 1997

END OF SECTION

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SECTION 01201
PRE SITE MOBILIZATION AND PRE CONSTRUCTION CONFERENCES

PART 1 GENERAL

1 01 PRE SITE MOBILIZATION CONFERENCE

A This section described the general requirement of pre site mobilization and pre construction conferences See Site Specific Work Plan

END OF SECTION

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SECTION 01202
PROJECT PROGRESS MEETINGS
PART 1 GENERAL

1 01 SUMMARY

A This section describes the general requirements for the convening of the Project Progress Meetings that are necessary during execution of the construction work See Site Specific Work Plan

END OF SECTION

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SECTION 01300
SUBMITTALS/PROCEDURES
PART 1 GENERAL

1 01 SUMMARY

A This section includes general requirements and procedures necessary for scheduling preparation and submission of submittals See the Site Specific Work Plan

END OF SECTION

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SECTION 01310
PROJECT SCHEDULE
PART 1 GENERAL

1 01 SUMMARY

The work specified in this section consists of the preparation and maintenance of the project schedule through the use of a microcomputer based network analysis system See Site Specific Work Plan

END OF SECTION

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SECTION 01341
SAMPLES
PART 1 GENERAL

1 01 SAMPLE SUBMITTAL

A The submittal of Samples shall conform to the requirements of the General Conditions and to procedures described in the Site Specific Work Plan

B Samples and Shop Drawings which are related to the same unit of Work or Specification Section shall be submitted at the same time If related Shop Drawings and Samples are submitted at different times they cannot be reviewed until both are furnished to the CONTRACTING OFFICER

1 02 PROCEDURE

A Contractor shall review approve and submit all Samples promptly Samples shall be identified with correct reference to Specification Section page article and paragraph number and Drawing No when applicable Samples shall clearly illustrate functional characteristics of the product and all related parts and attachments and full range of color texture pattern and material Samples shall be furnished so as not to delay fabrication allowing the CONTRACTING OFFICER reasonable time for the consideration of the Samples submitted

B Contractor shall submit at least one Sample of each item required for the CONTRACTING OFFICER S approval The Sample shall be delivered to the CONTRACTING OFFICER S field office Submission of Samples shall conform to all applicable provisions under Shop Drawing Submittal and Correspondence Procedure If the sample material is to be evaluated by the AE two additional Samples shall be delivered to the AE S office unless otherwise authorized by the CONTRACTING OFFICER If the Contractor requires a Sample for his use he shall notify the CONTRACTING OFFICER in writing

C The Contractor shall make all corrections required and shall resubmit the required number of new Samples until approved

1 03 JOB MOCK UPS

A Job mock ups (sample panels) shall be constructed on site by the Contractor and only one of each type will be required Mock ups shall be constructed only after the individual Samples and components used in the mock up have been approved by the CONTRACTING OFFICER If a mock up is not approved Contractor shall construct additional ones until approval is received

B Contractor shall store and protect large Samples and mock ups until the Project is complete or until a time approved by CONTRACTING OFFICER

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1 04 SAMPLES FOR TESTS

A Contractor shall furnish such Samples of material as may be required for examination and test All Samples of materials for tests shall be taken according to standard methods and as required by the Contract Documents

PART 2 PRODUCT (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01490
ENVIRONMENTAL PROTECTION PROCEDURES
PART 1 GENERAL

1 01 SUMMARY

A The work covered by this section consists of furnishing all labor materials and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations during and as the result of construction operations under this Contract For the purpose of this Specification environmental pollution is defined as the presence of chemical physical or biological elements or agents which adversely affect human health or welfare unfavorably alter ecological balances of importance to human life affect other species of importance to man or degrade the utility of environment for aesthetic and/or recreational purposes

B The control of environmental pollution requires consideration of air water and land and involves management of noise and solid waste as well as other pollutants

C Refer to the Site Specific Work Plan

No ~ P

END OF SECTION

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SECTION 01495
SPILL PREVENTION AND CONTROL
PART 1 GENERAL

1 01 SUMMARY

A This section covers the Contractor s responsibilities with respect to Spill Prevention and Control See the Site Specific Work Plan

END OF SECTION

SPCC
NOA plan has been
submitted by a or

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SECTION 01500
TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
PART 1 GENERAL

1 01 SUMMARY

A This section includes furnishing installing operating and maintaining the following temporary facilities and utilities in order to afford safe and adequate working conditions at the site

1) Facilities

a Contractor s office
b Equipment storage
c Storage areas
d Fences and barriers

2) Utilities

a Electricity and lighting
b Telephone service
c Water supply
d Sanitary facilities

B Work covered by this section includes the requirements for temporary environmental controls during the performance of the work of the project

C Refer to the Site Specific Work Plan

END OF SECTION

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SECTION 01501
DECONTAMINATION OF PERSONNEL AND EQUIPMENT
PART 1 GENERAL

1 01 WORK INCLUDED

A This section covers the labor materials and equipment necessary for decontaminating all personnel drilling and driving equipment well development equipment construction equipment and construction materials complete See the Site Specific Work Plan and the Site Specific Health and Safety Plan

END OF SECTION

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SECTION 01545
PROTECTION OF THE WORK AND PROPERTY
PART 1 GENERAL

1 01 CONTRACTOR S ACTIONS

A Contractor shall be responsible for taking all precautions providing all programs and taking all actions necessary to protect the Work and all public and private property and facilities from damage herein See the Site Specific Work Plan

END OF SECTION

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SECTION 01580
PROJECT IDENTIFICATION AND SIGNS
PART 1 GENERAL

1 01 DESCRIPTION

A See the Site Specific Work Plan

No mention of
[illegible]

END OF SECTION

SECTION 01610
TRANSPORTATION AND STORAGE OF MATERIALS AND EQUIPMENT
PART 1 GENERAL

1 01 MAINTENANCE AND PROTECTION OF TRAFFIC

A See the Site Specific Work Plan

END OF SECTION

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SECTION 01620
INSTALLATION OF EQUIPMENT
PART 1 GENERAL

1 01 EQUIPMENT INSTALLATION

A This Section describes Work necessary to install equipment and materials to be incorporated into this water treatment plant It supplements the Specification requirements in Divisions 2 through 16

B Shop Drawings installation drawings and instructions furnished by the manufacturers shall be used by Contractor in the installation of the equipment and materials

1 02 ANCHOR BOLTS AND GROUT

A Anchor and expansion bolts shall be furnished by Contractor as specified and required Use expansion bolts only where shown or approved by CONTRACTING OFFICER Anchor and expansion bolts shall be of specified materials with heavy hexhead nuts Anchorage items shall conform to the applicable requirements of Section 03252

B Grouting shall be in accordance with Section 03600

1 03 TRANSPORTING, HANDLING AND INSTALLING EQUIPMENT AND MATERIALS

A Contractor shall conform to requirements of Transportation and Storage of Materials and Equipment referenced in the Site Specific Work Plan

B Contractor shall employ competent mechanics experienced in the installation of the types of equipment and materials to be furnished and shall ensure that all equipment and materials are installed in accordance with the recommendations of the manufacture

C Contractor shall furnish all bolts nuts and other fastenings and shall comply with the applicable requirements of Specification sections

1 04 EQUIPMENT ERECTION

A General Conform to the following as a minimum

1 Use only mechanics skilled in the handling setting aligning leveling and adjusting of the type of equipment and materials furnished

2 Use only an oil bath heater to expand couplings gears etc Do not force or drive them on equipment shafts nor subject them to an open flame or torch

3 Wedging will not be permitted Use the least number of flat shims possible in leveling equipment Shims shall be clean and free of slags Provide all shims filling pieces keys packing red or white lead grout or other materials necessary to properly align level and secure apparatus in place When requested by CONTRACTING OFFICER Contractor shall demonstrate that all elements so required are level and plumb Grind as necessary to bring parts to proper bearing after erection

4 Use proper tools in the assembly of equipment and materials to prevent deforming or marring the surface of shafts nuts or other parts

5 Tighten connections requiring gaskets evenly all around to ensure uniform stress over the entire gasket area

6 Equipment and materials shall not be altered or repaired and no burning or welding will be permitted on any parts having machined surfaces except by written permission of CONTRACTING OFFICER

7 No rigging shall be done from any structure without the permission of CONTRACTING OFFICER and Contractor shall be completely responsible for damage to the structure resulting from his operations

8 Use tools equipment and materials that will not damage the structure or equipment

9 Contractor shall furnish and install plugs in lubrication holes to prevent entry of foreign material

10 Electrical work testing lubricating and painting shall all comply with requirements of the applicable Section

B Setting and Erection

1 All units shall be carefully set and aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts Anchor bolts shall be set in place and the nuts tightened against the shims Bedplates or wing feet of the equipment shall be further checked after securing to the foundations and after confirmation of all alignments the sole plates shall be finally grouted in place Contractor shall be responsible for the correct alignment of equipment with its associated piping Pipe springing will not be allowed

2 Misaligned holes shall be reamed Driving of bolts or keys will not be permitted

C Alignment and Leveling

1 Field check all shafts couplings and sheaves for alignment and adjust to manufacturer s specifications where necessary

2 Couplings shall be aligned while the equipment is free from all external loads

3 Angular and parallel alignment shall be checked and the actual alignment shall be recorded and submitted to Engineer Alignment shall be within manufacturer s recommended tolerance Dial indicators shall be used for the checking of angular and parallel alignment During rotation of the half couplings in performance of this test they shall be maintained in the same relative position and the dial indicator readings shall be taken at the same place on the circumference of the coupling

D Threaded Connections

1 Apply a molybdenum disulphide anti seize compound to all threads in mechanical connections such as bolts studs cap screws tubing etc unless otherwise specified

E Equipment Drive Guards

1 Unless shown or specified otherwise provide all equipment driven by open shafts belts chains pulleys sheaves or gears with all metal guards conforming to the requirements of 29 CFR 1910 Subpart O Guards shall enclose the drive and driven mechanism Construct guards of galvanized sheet steel galvanized woven wire or expanded metal set in a frame of galvanized steel members Secure guards in position

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by steel braces or straps securely fastened to floor wall or frame of the equipment Fastenings shall permit easy removal for servicing the equipment

1 05 SERVICES OF MANUFACTURERS REPRESENTATIVE

A Equipment furnished under Divisions 11 13 15 and 16 shall include the cost of competent qualified representatives of manufacturers of all equipment to supervise the installation adjustment and testing of the equipment and to instruct operating personnel on operation and maintenance The training time and additional requirements for furnishing services of manufacturers representatives are specified in the appropriate Sections If no time is specified the training time shall be at least one day Supervision may be divided into two or more time periods as required by Contractor s schedule or as directed by CONTRACTING OFFICER

B A certificate from the manufacturer stating that the installation of the equipment is satisfactory that the unit has been satisfactorily tested and is ready for operation and that the operating personnel have been suitably instructed in the operation lubrication and care of the unit shall be submitted within thirty days of completion of the performance test Additional requirements for manufacturer s reports are specified in the appropriate Sections

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01652
ACCEPTANCE TEST
PART 1 GENERAL

1 01 WORK INCLUDED

A Equipment shakedown loop testing and integrity testing

B Tagging of equipment

C Mechanical Startup System Shakedown

D Clean Water Test

E Final changes adjustments and replacements

F Acceptance test of all systems Substantial Completion

1 02 SYSTEM TEST PROCEDURE

A Contractor shall coordinate in conjunction with equipment suppliers the test procedures for all the equipment comprising the system

B Contractor shall prepare procedures to test the full operational and specified performance range of the equipment and the system

C Costs of all test procedure preparation inspections field service mechanical start up process start up and acceptance test shall be borne by the Contractor and shall be included in the contract cost All analytical testing associated with the Acceptance Test will be paid for by the Contractor

1 03 EQUIPMENT START UP PROCEDURE

A Once the mechanical equipment has been installed and is complete with all auxiliary and support systems and is ready for operation the Contractor shall initiate the start up procedure The equipment start up procedure shall consist of the following phases and shall be performed in this sequence

1 Equipment Manufacturer s Check Out

2 Mechanical Start Up/System Shakedown

3 Clean Water Test

4 Acceptance Test

B The Contractor shall include the cost for Equipment Manufacturer check out Mechanical start up and Acceptance Test including the provision of all items necessary to complete the start up procedure

1 05 EQUIPMENT MANUFACTURER S CHECKOUT

A The Contractor shall provide the services of equipment manufacturer s qualified field representative and supporting personnel for the equipment furnished and installed under this Contract to perform the following

1 Inspection of installation work by the Contractor to determine compliance with equipment erection methods and procedures recommended by the manufacturer

2 Advise the Contractor during equipment checkout mechanical start up process start up and performance testing of the equipment and systems supplied by the equipment manufacturer

3 Adjust or modify equipment for safe and proper operation

4 Conduct the process start up including and providing personnel necessary to operate adjust calibrate and tune the equipment and systems into operating service in accordance with the design criteria

5 Prepare written approval of installation after completion of mechanical checkout Submit the report to the Contracting Officer

6 Prepare written equipment test procedure for Acceptance Test and submit to the Contracting Officer

7 Prepare written verification of satisfactory completion of Acceptance Test and submit to the Contracting Officer

1 06 MECHANICAL START UP SYSTEM SHAKEDOWN

A Upon completion of the Equipment Manufacturer s check out phase the Contractor shall mechanically check out the equipment to verify that the equipment functions correctly under non process conditions the equipment shall be fine tuned adjusted water tested and in general completely checked out prior to the 48 hour clean water test

B The Contractor will be responsible for coordinating this effort and providing all support services and facilities necessary for this phase of the work

C The equipment will not be considered ready for the Clean Water Test until the Contracting Officer is satisfied that the equipment has been satisfactorily checked out and successfully passed a non process test run

D Provide the the Contracting Officer with a detailed schedule of the test plan two weeks prior to start of the activity

E Perform testing under the supervision of a qualified technician and a representative of the equipment manufacturer present One individual will be acceptable if such individual meets both requirements

F Demonstrate that the equipment instrumentation and appurtenances are properly installed meet their operating cycles and are free from defects such as overheating overloading and undue vibration and noise in accordance with OSHA and industry standards

G Test each pump at maximum rated speed for no less than four (4) points on the pump curve for capacity head and electrical power input The rated motor nameplate current and power shall not be exceeded at any point within the specified range

H Test pumps with drive motors rated at less than five (5) horsepower only for excess current or power when overheating or other malfunction becomes evident in general testing

1 07 CLEAN WATER TEST

A After equipment checkout is successfully completed continuously operate the treatment system (equipment and instrumentation) utilizing clean tap water for two 24 hour periods with the Contracting Officer or his representative present to witness the test The Contractor shall demonstrate that system can operate continuously at the hydraulic peak flow rate of 75 gpm average flow rate of 70 gpm for two consecutive 24 hour periods

B Until all systems perform successfully for a continuous 24 hour duration the Contractor will make all necessary changes readjustments and replacements and the test will be restarted

C Discharge clean test water as directed by the The Contracting Officer upon successful completion of the clean water test

1 08 TAG EQUIPMENT

A Upon acceptance of the clean water test a tag containing the signature of the Contracting Officer will be issued and attached by Contractor to each tested piece of equipment/ system

B The tag shall not be removed and no further construction work shall be performed on the unit except as required during acceptance testing and directed by the Contracting Officer s Representative

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1 09 ACCEPTANCE TEST

A Once all equipment necessary for Plant Operation including controls and instrumentation has successfully completed mechanical start up and the support systems can deliver the process media the Contractor shall start up the equipment under process conditions and conduct acceptance test to verify compliance with the Specifications

B The Contractor shall provide the necessary supervision and technical personnel and services required to perform the work

C The equipment shall be considered ready for the Acceptance Test only after the Contractor has demonstrated to the the Contracting Officer that the equipment can operate continuously without mechanical interruption under process flow conditions for up to 72 hours

1 After it has been determined that the equipment will operate satisfactorily under process conditions the Acceptance Test shall be made by the Contractor to verify that the equipment can meet the requirements outlined in the Specification

D The Acceptance Test shall be conducted at a minimum flow rate of 75 gpm for 72 hours Contractor shall collect and analyze the influent to determine its composition Sampling frequency shall be every 24 hours beginning at the start of the test Influent samples shall be collected to analyze for TCL/TAL volatile and semivolatile organics iron metals and TSS and other required conventional parameters (i e manganese pH etc) LNAPL DNAPL constituents AOP system influent and effluent and carbon samples for volatile and semivolatile organics and pressure filter influent and effluent samples for TSS and conventional parameters Samples shall be taken after every process unit including oil/water separator inclined plate separator AOP system and the carbon beds (for VOA s only) Analytical turnarounds shall be less than 48 hours for all samples

E Analysis on the Acceptance Test samples must be conducted at a Maryland certified laboratory

F Personal Protective Equipment (PPE) and any other residual waste material from this phase of the project only shall be stored for subsequent disposal during the O&M period

1 10 ACCEPTANCE TEST CRITERIA

Individual equipment effluent shall meet the following criteria

Equipment	Effluent Criteria	Method	Number of Samples
Oil/Water Separator	5 mg/L oil	SW 846 EPA 8015 SW 846 EPA 8100	7/week
Inclined Plate Separator	10 mg/L TSS	EPA 160 2	7/week
Sand Filter	5 mg/L TSS	EPA 160 2	7/week
Filter Press (% solids in cake)	30% by wt	EPA 160 3	One/cycle
UV/OX System (phenol)	35 mg/L	EPA 420 1 EPA 420 2	7/week
Liquid Phase Carbon	See Table 5 1 for VOCs and SVOCs	SW 846 EPA 8260 (VOCs) SW 846 EPA 8270 (SVOCs)	7/week

? Particle aeration eff + [illegible]

The treatment system effluent shall comply with the effluent criteria listed in Table 5 1

1 11 ACCEPTANCE TEST FAILURE

A If the system fails to meet the performance criteria Contractor shall modify or replace defective equipment and system components

B Contractor shall obtain manufacturer s written authorization for modifications to equipment stating that guarantees will not be voided by modifications

C Contractor or Manufacturer shall obtain the written authorization from the Contracting Officer for modifications to the system or equipment before making changes

D Contractor or Manufacturer shall conduct another Acceptance Test

E Modifying or replacing equipment and the system retesting because of performance test failure shall be at no cost to the government

F If the Contractor fails to correct any defects or deviations or if the replaced equipment when tested fails to meet the guarantees or specified requirements the Contracting Officer not withstanding the government having made partial payment for work and materials which have entered into the manufacture of such equipment may reject that equipment and order the contractor to remove it from the premises at the Contractor s expense

1 12 EQUIPMENT REJECTION

A If the equipment which causes the Acceptance Test failure is not corrected or if the system is again tested and fails the Contracting Officer may reject the equipment

B Contractor shall provide use of rejected equipment at no cost to the government until alternate equipment can be installed Provide temporary facilities required to maintain correct system

operation

C Contractor shall remove rejected equipment

D Contractor shall install replacement equipment as required

1 13 FINAL ACCEPTANCE

A The Contractor shall certify in writing that plant meets effluent criteria based on the Acceptance Test results

B After successful completion of process testing and completion of inspection and cleaning the Contracting Officer will provide a certificate of Substantial Completion

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

TABLE 5 1 DESIGN INFLUENT AND EFFLUENT CONDITIONS
SOUTHERN MARYLAND WOOD SUPERFUND SITE

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max
SEMIVOLATILE COMPOUNDS			
2 4 Dimethylphenol	12	0 018	0 036
2 Methylnaphthalene	1 94		
2 Methylphenol	28 9		
4 Methylphenol	89 1		
Acenaphthene	3 2	0 022	0 059
Acenaphthylene		0 022	0 059
Anthracene	0 44	0 022	0 059
Benzo(a)anthracene	0 55	0 022	0 059
Benzo(a)pyrene		0 023	0 061
Benzo(b)fluoranthene		0 022	0 059
Chrysene		0 022	0 059
Dibenzofuran	1 96		
Fluoranthene	3 2	0 025	0 068
Fluorene	1 9	0 022	0 059
Naphthalene	19	0 022	0 059
Phenanthrene	6 4	0 022	0 059
Phenol	110	0 015	0 026
Pyrene	1 7	0 025	0 067
PCP		0 013	0 02
Bis(2 ethylhexyl)phthalate		0 103	0 279
Di n butyl phthalate		0 027	0 057
Diethylphthalate		0 081	0 203
Dimethyl phthalate		0 019	0 047
VOLATILE COMPOUNDS			
Acetone	0 19		
Benzene	1 4	0 037	0 136
Chloroform	0 006	0 021	0 046
Ethylbenzene	0 22	0 032	0 108
Methyl ethyl ketone	0 091		

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TABLE 5 1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
Methylene chloride		0 040	0 089
Styrene	0 21		
Toluene	0 69	0 026	0 080
Xylene	0 48		
Total Purgeable VOC			0 1
INORGANICS			
Aluminum	0 324+		
Arsenic (total)	0 0155	0 2	0 4
Arsenic (trivalent)		0 019	0 036
Barium	0 109	1 0	2 0
Beryllium	0 0065		
Cadmium	<0 003	0 0011	0 0039
Calcium	19 2		
Chromium (hexavalent)		0 0011	0 0039
Chromium (total)	0 101	0 5	1 0
Cobalt	0 0104		
Copper	0 0102	0 012	0 018
Cyanide		0 0073	0 0313
Iron (total)	184		
Iron (soluble)	154	1 5	3 0
Lead	0 0875	0 0032	0 082
Magnesium	14 6		
Manganese	13 0		
Mercury	0 0009	0 000012	0 0024
Nickel	<0 014	0 16	1 4
Potassium	11		
Selenium	0 0022	0 005	0 02
Silver	<0 0049	0 00012	0 00^1
Zinc	0 0724	0 11	0 12

TABLE 5 1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
GENERAL			
BOD		5	10
TKN			20
TPH			15
TSS		30	45
Turbidity		50 NTU	150 NTU
pH		-	6 5 8 5 (min max)
Temperature			90°F
Dissolved Oxygen			5 0 (min)
Fluoride		10	20
Phosphorus		0 5	1 0
Ammonia (pH dependent)		1 2@pH 7 0 76@pH 8	18 9@pH7 5 6@pH8

SECTION 01710
CLEANING
PART 1 GENERAL

1 01 CLEANING REQUIREMENTS

A Execute cleaning during progress of the Work and at completion of the Work

B Requirements of Regulatory Agencies
1 In addition to the requirements herein maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal state and local fire and safety laws ordinances codes and regulations
2 Comply with all federal state and local anti pollution laws ordinances codes and regulations when disposing of waste materials debris and rubbish

C Scheduling of Cleaning and Disposal Operations
1 So that dust wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces
2 To prevent accumulation of dust dirt debris rubbish and waste materials on or within the Work or on the premises surrounding the Work

D Waste Disposal
1 Shall be in accordance with Section 02250 Transportation and Disposal of Material
2 Dispose of all waste materials surplus materials debris and rubbish off the plant site
3 Do not burn or bury rubbish and waste materials on the plant site
4 Do not dispose of volatile or hazardous wastes such as mineral spirits oil or paint thinner in storm or sanitary drains
5 Do not discharge wastes into streams or waterways

E Cleaning Materials
1 Use only cleaning materials recommended by manufacturer of surface to be cleaned
2 Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer
3 Use only materials which will not create hazards to health or property

F During Construction
1 Keep the Work and surrounding premises within work limits free of accumulations of dirt dust waste materials debris and rubbish
2 Keep dust generating areas wetted down
3 Provide suitable containers for storage of waste materials debris and rubbish until time of disposal
4 Dispose of waste debris and rubbish off site at legal disposal areas

G When Project is Completed
1 Remove and dispose of all excess or waste materials debris rubbish and temporary facilities from the site structures and all facilities

2 Repair pavement roads sod and all other areas affected by construction operations and restore them to original condition or to minimum condition specified
3 Remove spatter grease stains fingerprints dirt dust labels tags packing materials and other foreign items or substances from interior and exterior surfaces equipment signs and lettering
4 Repair patch and touch up chipped scratched dented or otherwise marred surfaces to match specified finish
5 Remove paint clean and restore all equipment and material nameplates labels and other identification markings
6 Wash and shine mirrors glazing and polished surfaces
7 Clean all floors slabs pavements and ground surfaces
8 Maintain cleaning until final acceptance by the Contracting Officer

PART 2 PRODUCT (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01720
AS BUILT DRAWINGS
PART 1 GENERAL

1 01 GENERAL

A This section covers the preparation of as built drawings complete as a requirement of this contract The terms drawings contract drawings drawing files and final as built drawings refer to a set of computer aided design and drafting (CADD) contract drawings in electronic file format which are to be used for as built drawings

1 02 PROGRESS MARKED UP AS BUILT PRINTS

A The Contractor shall revise one set of paper prints to show the as built conditions during the prosecution of the project These as built marked prints shall be kept current and available on the jobsite at all times All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes The as built marked prints will be jointly reviewed for accuracy and completeness by the Contracting Officer and a responsible representative of the construction Contractor prior to submission of each monthly pay estimate If the Contractor fails to maintain the as built drawings as specified herein the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as built drawings and will continue the monthly deduction of the 10% retainage even after 50% completion of the contract This monthly deduction will continue until an agreement can be reached between the Contracting Officer and a representative of the Contractor regarding the accuracy and completeness of updated drawings The prints shall show the following information but not be limited thereto

1 The location and description of any utility lines or other installations of any kind or description known to exist within the construction area The location includes dimensions to permanent features

2 The location and dimensions of any changes within the building or structure

3 Correct grade cross section or alignment of roads earthwork structures or utilities if any changes were made from contract plans

4 Correct elevations if changes were made in site grading

5 Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to fabrication erection installation plans and placing details pipe sizes insulation material dimensions of equipment foundations etc

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6 The topography invert elevations and grades of all drainage installed or affected as a part of the project construction

7 All changes or modifications which result from the final inspection

8 Where contract drawings or specifications present options only the option selected for construction shall be shown on the as built prints

1 03 PRELIMINARY SUBMITTAL

A At the time of final inspection the Contractor shall prepare two copies of the progress as built prints and these shall be delivered to the Contracting Officer for review and approval These as built marked prints shall be neat legible and accurate The review by Government personnel will be expedited to the maximum extent possible Upon approval one copy of the as built marked prints will be returned to the Contractor for use in preparation of final as built drawings If upon review the drawings are found to contain errors and/or omissions they shall be returned to the Contractor for corrections The Contractor shall complete the corrections and return the as built marked prints to the Contracting Officer within ten (10) calendar days

1 04 DRAWING PREPARATION

A Upon approval of the as built prints submitted the Contractor will be furnished by the Government one set of contract drawings with all amendments incorporated to be used for as built drawings These contract drawings will be furnished on electronic media as specified by the Using Agency/Sponsor These drawings shall be modified as may be necessary to correctly show all the features of the project as it has been constructed by bringing the contract set into agreement with the approved as built prints adding such additional drawings as may be necessary These drawings are part of the permanent records of this project and the Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government

B Only personnel proficient in the preparation of engineering CADD drawings to standards satisfactory and acceptable to the Government shall be employed to modify the contract drawings or prepare additional new drawings All additions and corrections to the contract drawings shall be equal in quality to that of the originals Line work line weights lettering layering conventions and symbols shall be the same as the original line work line weights lettering layering conventions and symbols If additional drawings are required they shall be prepared using the specified electronic file format applying the same guidance specified for original drawings The title block and drawing border to be used for any new as built drawings shall be identical to that used on the contract drawings All additions and corrections to the contract drawings shall be accomplished using CADD media files supplied by the Government These contract drawings will already be compatible with the Using Agency/Sponsor s system when received by the Contractor The OHM uses AutoCAD Release 13 software system The media files will be supplied on a 3 ½ diskette The Contractor is responsible for providing all program files and hardware necessary to prepare

as built drawings The Contracting Officer will review all as built drawings for accuracy and the Contractor shall make all required corrections changes additions and deletions

C When final revisions have been completed the cover sheet drawing shall show the wording RECORD DRAWING AS BUILT followed by the name of the General Contractor in letters at least 3/16 (5 mm) high All other contract drawings shall be marked either As Built drawing denoting no revisions on the sheet or Revised As Built denoting one or more revisions All original contract drawings shall be dated in the revision block (SEE ATTACHMENTS 1 and 2 while the title block sample attachments do not depict the contract drawings title blocks the sample revision blocks above these attachments are to be used as guidance in completing the actual contract drawings revision blocks)

1 05 FINAL REQUIREMENTS

A After receipt by the Contractor of the approved marked as built prints and the original contract drawing files the Contractor will within 30 days for contracts less than $5 million or 60 days for contracts $5 million and above make the final as built submittal This submittal shall consist of two sets of completed as built contract drawings on separate media consisting of both CADD files (compatible with the Using Agency/Sponsor s system on electronic storage media identical to that supplied by the Government) and mylars two blue line prints of these drawings and the return of the approved marked as built prints They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government Any translations or adjustments necessary to accomplish this is the responsibility of the Contractor The Government reserves the right to reject any drawing files it deems incompatible with its CADD system All paper prints drawing files and storage media submitted will become the property of the Government upon final approval Failure to submit as built drawing files and marked prints as required herein shall be cause for withholding any payment due the Contractor under this contract Approval and acceptance of final as built drawings shall be accomplished before final payment is made to the Contractor

1 06 PAYMENT

A No separate payment will be made for the as built drawings required under this contract and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor

ATTACHMENTS

Attachment 1
Attachment 2

END

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SECTION 01730
OPERATION AND MAINTENANCE DATA
PART 1 GENERAL

1 01 SUBMITTALS

The Contractor shall submit the following as specified below for approval

A Instructional Manuals
B Lubrication Survey
C Spare Parts and Special Tools Data
D Operations and Maintenance Manuals
E Maintenance and Lubrication Schedules

1 02 INSTRUCTIONAL MANUALS

A Provide operation and maintenance data in the form of instructional manuals for use by the CONTRACTING OFFICER s personnel for
  1 All equipment and systems
  2 All valves gates and related accessories
  3 All instruments and control devices
  4 All electrical gear

1 03 LUBRICATION SURVEY

A Provide a lubrication survey subject to the approval of CONTRACTING OFFICER
B Lubrication survey shall list all equipment the equipment manufacturer s lubrication recommendations and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible
C Contractor shall supply all lubricants applicators and labor for lubricating the equipment in accordance with manufacturer s recommendations for field testing and prior to final acceptance A supply of required lubricants sufficient for start up and one year of operation shall be furnished
D Six copies of the approved lubrication survey shall be furnished prior to final acceptance

1 04 SPARE PARTS AND SPECIAL TOOLS

A Spare Parts
  1 As soon as practicable after approval of the list of equipment Contractor shall furnish spare parts data for each different item of equipment listed The data shall include a complete list of parts and supplies with current unit prices and source or sources of supply This information shall also be included in the Operations and Maintenance Manuals
  2 Contractor shall also furnish a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for the particular installation for a period of one year or the guarantee period whichever is greater

3 For spare parts required to be furnished by the Contractor parts shall be securely boxed and tagged and clearly marked on the box and individually for identification as to the name of manufacturer or supplier applicable equipment part number description and location in the equipment All parts shall be protected and packaged for a shelf life of at least ten years

B Special Tools

1 Contractor shall furnish with each piece of equipment as a minimum two complete sets or the number of sets called for in the Technical Specifications of suitably marked special tools and appliances which may be needed to adjust operate maintain or repair the equipment

2 Contractor shall submit for approval by CONTRACTING OFFICER a complete list of the special tools and appliances to be furnished Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys

1 05 OPERATION AND MAINTENANCE MANUALS

A Final Operations and Maintenance Manual

1 Contractor shall prepare submit and obtain CONTRACTING OFFICER S approval of an operation and maintenance manual for each item of equipment supplied under this Contract Each manual shall be prepared specially for this installation and shall include all approved Shop Drawings all pertinent and legible instructions technical bulletins and other printed matter required to provide fully accurate and comprehensive information for the safe and proper operation maintenance and repair of the equipment item It shall include but not limited to the following

a Catalogs diagrams schematics drawings instruction bulletins and manuals marked by underlining checking the use of arrows or the obliteration or removal of extraneous data so as to pertain only to the specific equipment item for which the manual is supplied Original reprints of manufacturers catalog information and maintenance data shall be furnished photocopies will not be acceptable

b Complete electrical schematics and wiring diagrams Complete wiring between terminal points must be shown Computerized diagrams are not acceptable

c Drawings diagrams and illustrations shall be original quality and clearly legible

d Reference to features and elements of equipment such as operational limits of time speed pressure temperature etc shall be clear complete and compatible with authoritative published engineering reference documents Torque ratings shall be given for all bolted connections All functional components electrical systems equipment etc shall be shown on diagrams and discussed In the text so as to identify their proper system relationship Operation service trouble shooting checkout and in line and bench repair procedures identifying specific system characteristics of the equipment shall be provided Detailed start up and shut down procedures shall be included as a separate section for each piece of equipment or system

e Recommended procedures and frequencies for preventive maintenance such as inspection adjustment lubrication calibration and cleaning shall be provided including pre startup checklists for each piece of equipment and long term shut down maintenance

f Equipment parts shall be identified by manufacturer s part number and located with relation to other components of the equipment utilizing exploded type drawings for clarity Complete parts lists shall be included which indicate the part number the part description applicable serial and model numbers current unit prices and the name address and telephone number of the nearest equipment manufacturer s representative and nearest service and spare parts warehouse Complete instructions for the ordering of all replaceable parts shall be noted in this section of the Manual Recommendations as to spare parts and spares inventory levels shall be made Lead time and shelf life values and preservation packaging and labeling methods shall be recommended

g All copyrighted material used in the manual or in any operation required in the performance of the Contract will be preceded by the Contractor obtaining the copyright holder s written permission to use such material Contractor shall hold the CONTRACTING OFFICER free of any legal responsibility for its use

2 Each operation and maintenance manual shall be bound in a durable permanent stiff cover binder of one (more if required) volume with a complete index of the manual s contents arranged by subject matter and in order of presentation in each volume The title of the manual shall be securely affixed to the binder in two places the front cover and the binder back edge The title shall identify the Project by number and name state the volume is an O&M manual generally classify the equipment and state the manufacturer s name equipment model number and equipment identification number

a Covers shall permit easy removal of pages and shall be of the three post metal hinged self expanding type and shall not be overfilled Covers shall be oil moisture and wear resistant and approximately 9 by 12 inches in size

b Page size shall be 8 1/2 by 11 inches paper shall be 60 pound and holes reinforced with plastic cloth or metal

c Drawings diagrams and illustrations shall be attached foldouts up to 11 by 17 inches in size larger sizes shall be inserted in the attached clear plastic envelopes marked as to contents

3 Contractor s submittal to CONTRACTING OFFICER for approval shall consist of three complete sets of each operation and maintenance manual and two copies of an itemized listing providing cross reference identification between the Specification Sections of the Contract Documents the approved Shop Drawings and the operations and maintenance manual submittal One copy of the manual and itemized listing will be returned to Contractor stamped either Approved or Disapproved the latter when the Manual submittal is considered inadequate inaccurate or lacking essential information Discrepancies will be noted on the return itemized listing of a Disapproved submittal Contractor shall rectify all unapproved submittals by replacing submitted portions or adding additional data as required to the manual The manual s index of contents and the itemized cross referenced listing shall be

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revised to reflect all revisions or additions made Then two copies of the entire package shall be resubmitted to CONTRACTING OFFICER for approval

4 Upon approval of the operation and maintenance manuals Contractor shall submit ten copies of the manual and the itemized listing to the CONTRACTING OFFICER

1 06 MAINTENANCE AND LUBRICATION SCHEDULES

A For all items of equipment furnished the Contractor shall provide a list including the equipment name and address and telephone number of the manufacturer s representative and service company so that service and/or spare parts can be readily obtained In addition a maintenance and lubrication schedule for each piece of equipment shall be submitted with the Shop Drawings Submission shall be in fifteen copies The schedules shall be In the form indicated below

Example Maintenance Schedule

Item	Action	Frequency	Remarks
Thickener Drive Unit	Remove shear pin clean off rust grease and replace	2 mos	
Overflow	Check Serviceability	Daily	

Typical Lubrication Schedule

Item	Manufacturer s Recommendations	Type Lubricant	Frequency
Gear Drives	Check oil level	See below same as for oil change	Weekly
	Change oil	80 90 NSMP Gen Oil	6 mos
	Flush out drives before oil change	Kendall Flushing Oil	Prior to oil change
*Gear Motors	Change oil	Kendall 072 R&O	2 000 hours or 6 mos

*See manufacturer s instruction manual for initial operation instructions

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01731
TREATMENT SYSTEM OPERATION AND MAINTENANCE MANUAL
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall provide a treatment system Operations and Maintenance Manual to cover routine facility operation maintenance administration safety and permit compliance according to these specifications and contract drawings The Manual shall address the total water treatment plant as a complete operating system

1 02 REFERENCE SECTIONS

A The Contractor shall utilize the Operation and Maintenance Data submitted under Section 01730 the technical information and operation descriptions found on the contract documents for this project and all other available engineering information to prepare the Operations and Maintenance Manual described herein

1 03 SUBMITTALS

A The draft Operations and Maintenance Manual shall be submitted to the CONTRACTING OFFICER 90 days prior to the initiation of hydraulic testing of equipment and startup Contractor shall not be given the Notice to Proceed for prove out until the draft manual has received an approved status The Contractor shall maintain and update the draft manual during startup period The final Manual shall be submitted to the CONTRACTING OFFICER at most 21 days after the completion of performance testing The final Manual shall include all updates made during performance testing The Contractor shall have 35 days after the completion of performance testing to have the final version of the Manual approved

1 The Contractor shall keep the Operations and Maintenance Manual up to date The Contractor shall update the Manual as necessary to immediately reflect changes in safety procedures operation and maintenance and from information gained during actual operation of all equipment processes systems and appurtenances Updates shall be handwritten or otherwise identified in the working copies of the Manual Approved updates shall be formally incorporated into the Manual with replacement pages Replacement pages shall be transmitted to the CONTRACTING OFFICER in the quantity of copies specified in Paragraph E The Contractor shall also maintain one clean revised copy at all times for future reproduction if required The manual shall be made available at the Project Site and kept at an area accessible to all parties

2 The submittal shall cite reasons why the changes are occurring (e g additional equipment design or procedure change original equipment out of manufacture new regulatory requirement) Updates and additions to the Manual shall include appropriate information logs schedules references catalog cuts regulatory guidelines and requirements concerning the design operation maintenance and management of all equipment processes systems appurtenances and facilities

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1 04 OPERATIONS AND MAINTENANCE MANUAL

A The Operation and Maintenance (O&M) Manual shall detail the step by step procedures required for system start up safe operation and shutdown The Manual shall also include an index equipment data a schedule for routine maintenance requirements master equipment list recommended testing equipment emergency operations and procedures sampling procedures routine maintenance procedures troubleshooting guides adjustment and calibration procedures and drawings including a piping and equipment and layout diagram and simplified wiring and control diagrams of the systems as installed

B The sludge storage/disposal part of the Manual shall include safety features and procedures to be used to protect employees and the public during the transport of hazardous waste pursuant to the requirements of the Health and Safety Plan As a minimum Contractor shall include proposed disposal sites their priority of use primary and alternate routes to each disposal site and document forms to be recorded and submitted

C Each volume of the Operation and Maintenance Manual shall be bound in a durable permanent stiff cover binder with a complete index of the Manual s contents arranged by subject matter and in order of presentation in each volume The title of the Manual shall be securely affixed to each binder in two places the front cover and the binder back edge The title shall identify the Project by number and name and state the volume is the O&M Manual

1 Covers shall permit easy removal of pages and shall be of the three post metal hinged self expanding type maximum of 2 inches each volume and shall not be overfilled Covers shall be oil moisture and wear resistant and approximately 9 by 12 inches in size

2 Page size shall be 8 1/2 by 11 inches paper shall be 60 pound and holes reinforced with plastic cloth or metal

3 Drawings diagrams and illustrations shall be attached foldouts up to 11 by 17 inches in size larger sizes shall be inserted in the attached clear plastic envelopes marked as to contents

D Contractor s submittal to CONTRACTING OFFICER for approval shall consist of three complete sets of the Operation and Maintenance Manual One copy of the Manual will be returned to Contractor stamped either Approved or Disapproved the latter when the Manual submittal is considered inadequate inaccurate or lacking essential information Discrepancies will be noted on the return itemized listing of a Disapproved submittal Contractor shall rectify unapproved submittal by replacing submitted portions or adding additional data as required to the Manual The Manual s index of contents shall be revised to reflect all revisions or additions made Then two copies of the entire package shall be resubmitted to CONTRACTING OFFICER for approval

E Upon approval of the Operation and Maintenance Manual at the completion of the performance testing period Contractor shall submit ten copies of the Manual to the CONTRACTING OFFICER

F The format of the Manual shall comply with following table of contents

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SOUTHERN MARYLAND WOOD TREATING SITE
GROUNDWATER TREATMENT SYSTEM
OPERATIONS AND MAINTENANCE MANUAL
PROPOSED TABLE OF CONTENTS

VOLUME I

1 0 INTRODUCTION TO SOUTHERN MARYLAND WOOD TREATING SITE GROUNDWATER TREATMENT SYSTEM

- 1 1 Introduction and Background
- 1 2 Purpose of Facility
- 1 3 Purpose of Manual
- 1 4 General Process Overview
- 1 5 Treatment Plant Design Criteria by Unit Operation
  - 1 5 1 Oil/Water Separation
  - 1 5 2 Equalization
  - 1 5 3 Chemical Oxidation Iron Removal
  - 1 5 4 Flocculation and Sedimentation
  - 1 5 5 Sand Filtration
  - 1 5 6 Advanced Oxidation
  - 1 5 7 Carbon Adsorption System
  - 1 5 8 Discharge
  - 1 5 9 Sludge Dewatering

2 0 MAJOR EQUIPMENT ITEMS AND SUBSYSTEM DESCRIPTIONS

- 2 1 Oil/Water Separator
- 2 2 Oxidation and Coagulation Tanks
- 2 3 Flocculation and Inclined Plate Separator
- 2 4 Sand Filter
- 2 5 AOP Reactor
- 2 6 Carbon Adsorption
- 2 7 Discharge Outfall
- 2 8 Sludge Storage Tank and Filter Press
- 2 9 Pumps Valves and Miscellaneous Equipment
- 2 10 Chemical Storage and Feed Systems
- 2 11 HVAC System
- 2 12 Potable Water System
- 2 13 Air Compressor System
- 2 14 Electrical Distribution System

3 0 PERMITS AND AUTHORIZATIONS

- 3 1 Introduction
- 3 2 Environmental Permits
- 3 5 Miscellaneous Permits

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4 0 FACILITY START UP AND SHUTDOWN

4 1 Introduction
4 2 Start up Procedures
4 2 1 Recommended On site References
4 2 2 Equipment Verification
4 2 3 Submittal Requirements
4 2 4 Data Collection
4 2 5 Start up Plan Review/Walkthrough
4 3 Pre Startup System Preparation
4 3 1 Startup Outline
4 3 2 Pre Startup
4 3 3 Start up
4 3 4 Operation
4 3 5 Shutdown
4 4 Monitoring and Sampling

5 0 STANDARD OPERATING PROCEDURES

5 1 Introduction
5 2 Standard Operating Procedures *for each major equipment item and/or system provide a numerical setup sequence and detailed information as appropriate for the following SOPs*

Summary of Operations
Pre startup and Safety Check
Startup
Normal Operating Mode
Operational Control/Monitoring
Short term shutdown
Complete shutdown and
Emergency shutdown

5 3 Troubleshooting Guides *for each major process equipment item and/or system, provide a listing of operating problems probable causes and corrective actions*

6 0 MAINTENANCE

6 1 Introduction
6 2 Preventive and Corrective Maintenance
6 3 Electrical and Instrumentation Maintenance
6 4 Mechanical Equipment Maintenance
6 5 Maintenance Materials
6 6 Record Keeping
6 7 Spare Parts
6 8 Warranties/Guaranties

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7 0 DISPOSALS AND RESIDUALS MANAGEMENT

7 1 Introduction
7 2 Sludge Storage
7 3 Sludge Disposal

8 0 HOUSEKEEPING

8 1 Introduction
8 2 Site Improvements and Upkeep
8 3 Cleaning of Facility Work Areas

9 0 RECORD KEEPING

9 1 Introduction
9 2 Daily Monthly Operational and Maintenance Records
9 3 Analytical Data
9 4 Process Monitoring and Reporting
9 5 Effluent Discharge Monitoring and Reporting
9 6 Record Keeping and Scheduling Forms
9 7 Inventory Control

10 0 SAFETY

10 1 Introduction
10 2 Safety Inspections
10 3 In Plant Protective Devices
10 3 1 Handrails
10 3 2 Belt Guards
10 3 3 Pressure Relief Valves
10 3 4 Fire Extinguishing Equipment
10 4 Personnel Protective Devices
10 4 1 Safety Shower and Eyewash Facilities
10 4 2 Personnel Protective Equipment (PPE)
10 4 3 Medical Services and First Aid
10 4 4 Personal Hygiene
10 5 Plant Hazards and Safety Procedures
10 5 1 Physical
10 5 2 Mechanical
10 5 3 Electrical
10 5 4 Chemical
10 6 Confined Space Entry Program

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11 0 EMERGENCY OPERATING PROCEDURES

11 1 Introduction
11 2 Planning
11 3 Emergency Response

12 0 EQUIPMENT PARTS SUPPLIES

12 1 Special Tools Required
12 2 Onsite Equipment and Tools
12 3 Spare Parts
12 4 Expendable Supplies
12 5 Laboratory Equipment and Supplies
12 6 Chemical Procurement

13 0 PLANT STAFF REQUIREMENTS AND DUTIES

VOLUME II

1 0 MANUFACTURER S PRODUCT LITERATURE AND DATA

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

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SECTION 01760
PROJECT CLOSEOUT
PART 1 GENERAL

1 01 SUMMARY

A The work specified in this section consists of the requirements for project closeout and Contractor demobilization from the site See the Site Specific Work Plan

END OF SECTION

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DIVISION 2

SITE WORK

SECTION 02110
CLEARING AND GRUBBING
PART 1 GENERAL

1 1 DESCRIPTION

A Scope CONTRACTOR shall furnish all labor materials equipment and incidentals required to perform all tree and vegetation removal required to complete the Work Tree and vegetation removal shall not extend beyond the construction boundary shown on the Contract Drawings

B Related Work Specified Elsewhere

1 Section 01490 Environmental Protection
2 Section 02220 Excavation and Backfill
3 Section 02250 Transportation and Disposal of Materials

C Definitions

1 Clearing Clearing shall consist of the felling trimming and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal including down timber snags brush and rubbish occurring in the areas to be cleared

2 Grubbing Grubbing shall consist of the removal and disposal of stumps roots larger than 3 inches in diameter and matted roots from the designated grubbing areas

1 2 QUALITY ASSURANCE

A Codes and Standards State and local laws and code requirements shall govern the hauling and disposal of trees stumps roots rubbish debris and other matter (see Section 02250 Transportation and Disposal of Materials)

1 3 JOB CONDITIONS

A Protection

1 Streets roads adjacent property and other works and structures shall be protected throughout the entire project CONTRACTOR shall return to original condition satisfactory to the CONTRACTING OFFICER damaged facilities caused by the CONTRACTOR s operations

2 Trees shrubs and grassed areas which are to remain shall be protected by fences barricades wrapping or other methods as shown specified or approved by the CONTRACTING OFFICER Equipment stockpiles etc will not be permitted within tree branch spread Trees shall not be removed without approval of the CONTRACTING OFFICER unless shown or specified

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1 4 GUARANTEE

A CONTRACTOR shall guarantee that Work performed under this Section will not permanently damage trees shrubs turf or plants designated to remain or other adjacent work or facilities If damage resulting from CONTRACTOR s operations appears during the period up to 18 months after completion of the project the CONTRACTOR shall replace damaged items at no expense to the GOVERNMENT

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3 1 CLEARING

A Clearing shall be limited to areas within the Construction Boundary as shown on the Contract Drawings only the extent necessary to facilitate construction

B Within areas where contaminated soil is not expected to be encountered (as shown on the Contract Drawings) trees stumps roots brush and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface except such trees and vegetation as may be indicated or directed to be left standing Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1 1/2 inches or more in diameter and shall be trimmed of all branches to the heights indicated or directed Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches Cuts more than 1 1/2 inches in diameter shall be painted with an approved tree wound paint Trees and vegetation to be left standing shall be protected from damage incident to clearing grubbing and construction operations by the erection of barriers or by such other means as the circumstances require Clearing shall also include the removal and disposal of debris that obtrudes encroaches upon or otherwise obstructs the work

C Within areas where contaminated soil is expected to be encountered (as shown on the Contract Drawings) trees stumps brush and other vegetation in areas to be cleared shall be cut off flush with the original ground surface except such trees and vegetation as may be indicated or directed to be left standing No materials shall be removed (i e grubbed) from below the original ground surface a spart of clearing activities These materials shall be removed as part of excavation activities specified in Section 02220 Excavation and Backfill Trees and vegetation to be left standing as well as limbs and branches to be trimmed shall be handled in accordance with paragraph 3 1 B

3 2 GRUBBING

A Grubbing shall not be performed within areas where contaminated soil is expected to be encountered (as determined through the CONTRACTOR s sampling and testing program specified in these documents) All materials below original ground surface in these areas shall

be handled as excavated materials in accordance with Section 02220 Excavation and Backfill

B Material to be grubbed together with logs and other organic or metallic debris visible at the surface not suitable for foundation purposes shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract such as areas for buildings and areas to be paved Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground

3 3 TREE REMOVAL

A Trees and stumps designated to be removed from areas outside those areas designated for clearing and grubbing shall be handled in accordance with the requirements of paragraphs 3 1 and 3 2 This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph 3 2 Trees shall be disposed of as specified in paragraph 3 4

3 4 DISPOSAL OF MATERIALS

A Logs stumps roots brush rotten wood and other refuse from the clearing and grubbing operations shall be disposed of in accordance with Section 02250 Transportation and Disposal of Materials Disposal of refuse debris and any material cleared and any accidental loss or damage attendant thereto shall be the CONTRACTOR s responsibility

END OF SECTION

SECTION 02220
EXCAVATION AND BACKFILL

PART 1 GENERAL

1 01 DESCRIPTION

A General

1 The work also includes delineation classification handling and stockpiling of materials as either satisfactory or unsatisfactory for use as backfill and verifying the suitability of all materials and appropriate compaction requirements by means of laboratory and in place soil testing

B Scope

1 Contractor shall provide all labor materials equipment and incidentals to perform all excavation and backfilling as required for performing site grading constructing structures roads utilities conduits piping vaults and appurtenances and other facilities required to complete the Work in every respect

2 All necessary preparation of subgrade for footings foundations slabs piping and pavements

3 All temporary means needed to control surface drainage and prevent sediment discharge to water courses because of dewatering systems or erosion

4 Provide all backfill materials including common fill select fill crushed stone crushed concrete pavement subbase topsoil filter material and rip rap

5 Compaction of backfill and final site grading

6 All necessary stockpiling and relocation of excess uncontaminated excavated materials and excavated materials which are classified as contaminated

7 Excavation includes all materials regardless of type character composition moisture or condition thereof

C Source of Materials

1 Clean uncontaminated common fill materials for non structural areas areas at least 3 feet beyond the limits of the foundation wall backfill zone for site grading below pavement subbase and all other areas requiring common fill shall be identified and obtained by the Contractor from on site excavation work sources To be used as common fill on site fill shall meet the requirements of Section 02230 Backfill Materials The soil may be screened to meet the maximum gradation requirements and any material retained on the screen shall be disposed of accordingly

2 Select fill crushed stone crushed concrete topsoil filter material and rip rap shall be obtained by the Contractor from off site sources

3 All fill materials shall meet the requirements specified in Section 02230 Backfill Materials

D Related Sections

1 Section 01490 Environmental Protection

2 Section 02110 Clearing and Grubbing

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3 Section 02230 Backfill Materials
4 Section 02250 Transportation and Disposal of Materials
5 Section 02551 Paving
6 Division 3 Concrete

E Definitions

1 Degree of Compaction Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in Method ASTM D 1557 or ASTM D 4253

2 Satisfactory Fill Materials Satisfactory fill materials shall be those on site or off site materials which meet the requirements of Section 02230 Backfill Materials and which are properly worked by the Contractor to obtain the specified degree of compaction while maintaining the moisture content as specified hereinafter Satisfactory off site materials shall have been tested by the Contractor and found to be certified clean as defined in these Contract Documents Satisfactory on site materials shall have been tested by the Contractor

3 Unsatisfactory Materials Unsatisfactory materials shall be those materials not meeting the requirements of Section 02230 Backfill Materials

1 02 QUALITY ASSURANCE

A Testing Laboratory

1 The Contractor shall engage a qualified testing laboratory to perform tests to determine acceptability of soil gradations and compaction requirements as listed hereinafter All tests shall be performed by a Corps validated and State approved commercial testing laboratory

2 Testing shall include laboratory testing of all soil materials proposed for use on the project performed prior to the construction period and field testing of in place soils for quality control during the construction period

3 Testing Services

a Perform Proctor tests/gradation tests in lab for soils to be compacted including both on site soils used for backfill and imported fill materials as specified

b Perform field moisture content and density tests to assure that the specified compaction of fill has been obtained

c Report all test results to the CONTRACTING OFFICER within 48 hours after performance of tests

B Permits and Regulations

1 Contractor shall be responsible for complying with requirements of all federal state and local permits and licenses including building and construction permits

2 Contractor shall comply with all necessary permits for work in roads rights of way etc

3 Contractor shall perform excavation work in compliance with OSHA requirements and local state and federal authorities

C Reference Standards The Contractor shall comply with applicable provisions and recommendations of the following except as otherwise noted

1 ASTM A 36 Structural Steel
2 ASTM D 422 Particle Size Analysis of Soils
3 ASTM D 1556 Density of Soil in Place by the Sand Cone Method
4 ASTM D 1557 Moisture Density Relations of Soils using 10 0 lb Rammer and 18 in Drop
5 ASTM D 2922 Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
6 ASTM D 2487 (1990) Classification of Soils for Engineering Purposes
7 ASTM D 2922 Density of Soil and Soil Aggregate in place by Nuclear Method (shallow depth)
8 ASTM D 2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
9 ASTM E 548 (1991) General in Industrial Stds Criteria Used for Evaluating Laboratory Competence
10 AISC Specifications for the Design Fabrication and Erection of Structural Steel for Buildings
11 29 CFR 1910 Occupational Safety and Health Standards
12 29 CFR 1926 Safety and Health Regulations for Construction

1 03 SUBMITTALS

A Shop Drawings

1 Prepare and submit shop drawings for the following items as required
   a Temporary lateral support for excavations
   b Protection methods anticipated (e g structures utilities erosion control etc)
   c Underpinning
   d Dewatering system
   f Benchmark elevation
2 Shop Drawings shall be sealed by a professional engineer The drawings shall be submitted to the CONTRACTING OFFICER for purposes of established that the terms of the Specifications are complied with Calculations shall be submitted along with other pertinent information Drawing submissions will not be checked and will not imply approval by CONTRACTING OFFICER of the work involved

B Excavation Plan

1 The Contractor shall submit to the CONTRACTING OFFICER for approval a written excavation plan The excavation plan shall include at a minimum the following
   a Methods and techniques to be used for excavation temporary lateral support segregation of excavated materials hauling and placing excavated material at on site staging areas segregating excavation work from backfilling operations equipment decontamination (in accordance with Section 01501 Decontamination of Personnel and Equipment) and final backfilling

b Shop Drawing showing the limits of proposed excavation determined from pre excavation sampling

c Schedule and sequencing of activities

d Plan of proposed reuse or disposal options for the various materials encountered during the excavation work

e A demonstration of compliance with OSHA Standard Title 29 Code of Federal Regulations 1926 Subpart P Excavations This shall include copies of other tabulated data or manufacturer s data if protective system(s) are designed on the basis of such data

2 Approval of the Excavation Plan by the CONTRACTING OFFICER is required prior to any excavation work

C Test Reports

1 Compaction of fill Submit copies of the following reports directly to CONTRACTING OFFICER for approval

a Laboratory determinations of maximum density and optimum moisture content by either Modified Proctor or Maximum Index Density test methods for all soils to be compacted

b Gradation plots for all materials to be used for backfilling

c Field in place density test results for compacted materials

D Manufacturer s specifications performance characteristics and operating instructions for compaction equipment

1 04 JOB CONDITIONS

A Existing Structures

1 Prior to execution of the Work Contractor shall check and verify governing dimensions and elevations

B Existing Utilities

Contractor shall locate existing underground utilities in the areas of Work If utilities are to remain in place the Contractor shall provide adequate means of support and protection during earthwork/excavation operations

1 Should uncharted or incorrectly charted piping or other utilities be encountered either on or off site during excavation the Contractor shall consult CONTRACTING OFFICER immediately The Contractor shall cooperate with CONTRACTING OFFICER and utility companies in keeping respective services and facilities in operation The Contractor shall repair damaged utilities to satisfaction of utility owner at no cost to the CONTRACTING OFFICER

2 The Contractor shall not interrupt existing utilities serving facilities occupied and used by CONTRACTING OFFICER or others except when permitted in writing by CONTRACTING OFFICER and then only after acceptable temporary utility services have been provided

C Use of Explosives

1 Blasting will not be allowed

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D Protection of Persons and Property

The Contractor shall barricade open excavations occurring as part of this Work and post with warning lights Warning lights shall be operated during hours from dusk to dawn each day and as otherwise required

1 The Contractor shall protect structures utilities sidewalks pavements and other facilities from damage caused by settlement lateral movement undermining washout and other hazards created by earthwork operations

2 The Contractor shall protect environment and persons from exposure to contaminated soil by stockpiling the contaminated material in accordance with Paragraph 3 05

E Dust Control

Contractor shall maintain work areas including sweeping and sprinkling of roadways to minimize creation and dispersion of dust in accordance with Section 01490 Environmental Protection and Section 01110 Health and Safety Provisions

PART 2 PRODUCTS

2 01 GENERAL

A All backfill materials shall be provided by the Contractor and are specified in Section 02230 Backfill Materials

B Plastic Warning Tape and Marking Wire Warning tapes shall be installed directly above underground pipe and conduit at a depth of 12 inches below finished grade unless otherwise shown on the Contract Drawings Plastic marking tape shall be acid and alkali resistant polyethylene film 6 inches wide with minimum thickness of 0 004 inch Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent The tape shall be manufactured with integral wires foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep The tape shall be of a type specifically manufactured for marking and locating underground utilities The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion Tape color shall be approved by the CONTRACTING OFFICER prior to installation and shall bear a continuous printed inscription describing the specific utility

C Equipment

1 All equipment used in earthwork operations shall be sufficient in size and number and in satisfactory working condition to complete the work on schedule

2 Compaction equipment provided shall be suitable for the soil material being compacted and capable of obtaining the required density throughout the entire lift or layer being compacted

D Contractor shall use good serviceable conditioned materials for shoring and bracing such as uprights stringers and cross braces Timber used for shoring and bracing shall be sound and free of large or loose knots Timber used for lagging shall have a minimum allowable working stress of 1500 psi

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PART 3 EXECUTION

3 01 INSPECTION

A Contractor shall provide CONTRACTING OFFICER with sufficient notice time and means to examine areas and conditions under which excavating filling and grading are performed (e g pipe subgrades and bearing surface preparation) Contractor shall notify CONTRACTING OFFICER if conditions are found that may be detrimental to the proper and timely completion of the Work Work shall not proceed until all unsatisfactory conditions have been corrected in a manner acceptable to the CONTRACTING OFFICER

3 02 BORINGS AND TEST PITS

A After award of the Contract borings or test pits may be made by the Contractor for his own use at his option to supplement available information Any borings or test pits made by the Contractor shall be at no additional cost to the GOVERNMENT Contractor shall perform all work required in connection with drilling boreholes backfilling and repairing boring locations and excavating stockpiling supporting backfilling and replacing pavement for test pits

B Contractor shall obtain approval from the CONTRACTING OFFICER prior to making any borings or test pits All material handling operations shall be subject to approval

3 03 EROSION CONTROL

A Contractor shall comply with requirements of Section 01490 Environmental Protection

B Excavation work shall be performed as indicated The Contractor shall provide appropriate soil erosion and sediment control in order to prevent sediment runoff from any disturbed areas Grading shall be done as may be necessary to prevent surface water from flowing into open or incomplete excavations All dewatering shall meet the requirements of the Specifications

3 04 EXCAVATION

A Contractor shall perform all excavation required to complete the Work as shown and specified Excavation work may encounter pavement fill natural sand and boulders not requiring drilling and blasting to remove Excavation consists of the removal stockpiling and/or disposal of all materials encountered to obtain the specified subgrade elevations

B Excavations shall be sloped or temporarily supported in accordance with OSHA regulations contained in 29 CFR Part 1926 to prevent possible injury to workmen and damage to new and existing structures and pipelines Temporary lateral support will be required in areas and shall be installed in accordance with drawings and Excavation Plan to be submitted as required under Paragraph 1 03 above Shoring and bracing shall be used where sloping is not possible either because of space restrictions or stability of the excavation Side slopes shall

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be maintained in a safe condition until completion of backfilling by scaling benching shelving or bracing

C Precautions shall be taken to prevent slides or cave ins when excavations are made in locations adjacent to backfilled excavations or structures and when sides of excavations are subjected to vibrations from vehicular traffic or the operation of machinery or any other source

D During the removal and hauling of excavated material care shall be taken so as to not allow vehicles to follow former tracks in order to reduce the possibility of piping in the existing soil

E The elevation of the bottom of footings shall be as shown All structure excavations shall be hand trimmed to permit the placing of full widths and lengths of footings on horizontal beds Rounded and undercut edges will not be permitted When excavations are made below the required grades they shall be backfilled with compacted select fill (compacted to the requirements of the appropriate subgrade) as directed by CONTRACTING OFFICER at the expense of Contractor

F Excavations in the dry shall conform to the dimensions and elevations indicated within a tolerance of plus or minus 0 05 foot and extend a sufficient distance from footings and foundations to permit setting and removal of forms installation of temporary lateral support installation of services and other construction indicated for inspection or for the safe sloping of banks Excavations in the wet shall be performed in accordance with Paragraph 3 4 G below

G Frozen and/or Wet Conditions

1 Subgrades shall be firm and dense shall be free from mud muck frozen soil and other soft or unsuitable materials and shall remain firm and intact under all construction operations Where the Contractor must excavate below the water table (i e in the wet) or where the water table is encountered at the excavation subgrade level compaction and proof rolling shall not apply However the Contractor shall over excavate a depth of one foot below the planned excavation subgrade to stabilize the subgrade by placement of filter fabric overlain by crushed stone in lieu of select fill The finished elevation of stabilized subgrades shall be within a tolerance of plus or minus 0 1 foot of the subgrade elevations shown In addition the Contractor shall insulate the subgrade when necessary to prevent subgrades from freezing as outlined in Paragraph 3 10

2 When working in the wet the Contractor shall perform all decontamination procedures as specified in Section 01501 Decontamination of Personnel and Equipment

3 05 MATERIAL STOCKPILING

A Satisfactory Material

1 During excavation satisfactory materials to be used as backfill shall be stockpiled in approved areas in an orderly manner Stockpiles shall be located a sufficient distance

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from the banks of the excavation to avoid overloading and to prevent slides or cave ins until required for backfill Place grade and shape stockpiles for proper drainage

a Locate and retain soil materials at least 30 feet away from edge of excavations

b Stockpiles of suitable materials shall be placed and graded as specified Stockpiles shall be kept in a neat and well drained condition giving due consideration to drainage at all times Stockpiles of suitable materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material If the Contractor fails to protect the stockpiles and any material becomes unsuitable such material shall be removed and replaced with suitable material from approved sources

c All excess satisfactory materials (i e quantities of excavated satisfactory material in excess of those required for backfill) shall be stockpiled by the Contractor at an approved on site location Off site disposal of satisfactory materials if necessary shall be in accordance with federal state and local regulations and Section 02250 Transportation and Disposal of Materials

3 06 DRAINAGE AND DEWATERING

A General

1 Perform excavation in a manner so as to prevent surface water from flowing into excavations and from flooding adjacent areas This work shall be consistent with Section 01490 Environmental Protection

2 Contractor shall convey surface water to collecting or run off areas The Contractor shall provide and maintain temporary drainage ditches and other diversions outside the excavation limits for each structure The use of trench excavations for site utilities as temporary drainage ditches will not be permitted

3 07 TEMPORARY LATERAL SUPPORT

A General

1 Excavations for structures and utilities shall be sloped or laterally supported in accordance with OSHA regulations contained in 29 CFR part 1926 and all other local state and federal regulations

2 New or used lateral support materials may be used for temporary work Used material shall be in good condition

3 All steel work for temporary lateral support systems shall be designed in accordance with the provisions of the Specifications for the Design Fabrication and Erection of Structural Steel for Buildings of the AISC except that field welding will be permitted

4 Maintain temporary lateral support regardless of time period excavations will be open Lower the support system as excavation progresses

5 Wherever subsequent removal of shoring and bracing could permit lateral movement of soil under adjacent structures Contractor shall install steel sheet piling which shall be left permanently in place and cut off as required The Contractor shall

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design furnish install and maintain such sheeting and bracing as may be required to support the sides of the excavations and provide safe working conditions

6 Safe and satisfactory sheeting shall be the entire responsibility of the Contractor

7 If underpinning of structures is required the Contractor shall submit proposed method to CONTRACTING OFFICER for approval before proceeding with the work

B Removal of Temporary Lateral Supports

1 Remove temporary lateral supports from excavation when Work is completed unless otherwise ordered in writing by CONTRACTING OFFICER Removal shall not cause injury to the Work Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure

2 Defer removal of temporary lateral supports where removal may cause soil to come into contact with concrete until concrete has cured a minimum of 7 days

3 08 BACKFILLING

A All backfill required for structures and trenches required to provide the finished grades shown and as described herein and in Section 02230 Backfill Materials shall be furnished placed and compacted by Contractor On site soil such as fill and alluvium is suitable for reuse as common fill provided it meets criteria specified in Section 02230 Material not meeting gradation criteria for select fill can be re used as common fill provided it meets the additional requirements of Section 02230

B Fill shall be placed only after the excavation has been completed and the subgrade thoroughly prepared in accordance with Paragraph 3 04

C Backfill excavations as promptly as Work permits but not until completion of the following

1 Acceptance by CONTRACTING OFFICER of construction below finish grade including dampproofing waterproofing of walls below the water table and perimeter insulation

2 Removal of concrete form work

3 Removal of temporary lateral support and backfilling of voids with satisfactory materials

4 Removal of trash and debris

5 Permanent or temporary horizontal bracing is in place on horizontally supported walls

D Complete backfilling in the dry Backfill around structures and piping shall be brought up evenly on all sides The degree of compaction shall be as specified in this Section Place backfill uniformly and with adequate slope to provide for runoff of heavy precipitation Do not work following heavy precipitation without approval of the CONTRACTING OFFICER

E Levels of backfill against concrete walls shall not differ by more than 2 feet on either side of walls unless walls are adequately braced or all floor framing is in place up to and including grade level slabs

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F Fill shall be compacted by at least four coverages of the surface of each lift by compaction equipment One coverage is when the entire surface of the fill lift has been subjected to the direct contact of the compactor

G Equipment

1 Compaction of fill shall be performed with equipment suitable for the type of material placed and which is capable of providing the densities required The Contractor shall select compaction equipment and submit relevant specifications performance criteria etc and proposed procedure to the CONTRACTING OFFICER for approval as part of his Excavation Plan

2 Backfill around Structures Contractor shall compact backfill within 10 feet of foundations and underground structures using light compaction equipment with a gross equipment weight not exceeding 7 000 pounds Contractor shall provide equipment that is capable of the required compaction next to structures and around piping

3 The effectiveness of the equipment selected by Contractor shall be verified per Paragraph 3 09 below If tests show that the required degree of compaction is not obtained Contractor shall increase the amount of coverages decrease the lift thickness or vary the compaction equipment until the required results are achieved

H Schedule of Locations Materials and Compaction Requirements

1 The required degree of compaction for select fill and common fill is expressed as a percentage of the Modified Proctor maximum density obtained by ASTM D 1557 Where freely draining uniformly graded on site fill is used as common fill and a Proctor test cannot be performed the degree of compaction is specified in terms of a percentage of the maximum index density obtained by ASTM 4253 Required degrees of compaction for work in the dry are as follows

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Table 1
Schedule of Compaction

Location	Minimum Percent Compaction	Material	Maximum Compacted Lift Thickness (in)
Dry subgrade below footings slabs vaults and other structures (compaction verified within upper 12 inches of subgrade)	95	In situ soil	N/A
Backfill below and adjacent to footings slabs vaults and other structures	95	Select Fill	6
Cushion below footings slabs vaults and other structures	N/A*	Crushed Stone	6
Backfill around structures	95	Common Fill	9
Roadway subgrade (compaction verified within upper 12 inches of subgrade)	95	In situ soil	N/A
Backfill beneath roadways	95	Common Fill	6
Sidewalk subgrade (compaction verified within upper 12 inches of subgrade)	90	In situ soil	N/A
Backfill below sidewalks	90	Common Fill	9
Pipe trench subgrade (compaction verified within upper 12 inches of subgrade)	90	In situ soil/Common Fill	N/A
Pipe bedding (up to 18 inches above crown of highest pipe)	95	Select Fill/Crushed Concrete	6
Backfill around lateral fittings and cleanouts for recovery mains	N/A*	Crushed Stone	12

* Crushed stone shall be tamped with no less than two passes of a mechanical tamper or vibratory plate compactor

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2 For backfilling around vaults utilities or structures in the wet the above Table 1 Schedule of Compaction shall not apply The Contractor shall prepare the subgrade as specified shall place the vault structure or utility at the specified elevation and then backfill up to the level of the water table using crushed stone Once backfilling is in the dry the Contractor shall proceed with backfilling and compaction in accordance with the above Table 1 Schedule of Compaction

3 Density tests shall be performed as specified in Paragraph 3 11 Laboratory tests for moisture density relations shall be determined in accordance with ASTM D 1557 Procedure A B or C For free draining soils where testing by ASTM D 1557 is not possible maximum density shall be determined by ASTM D 4253 Field in place density shall be determined in accordance with ASTM D 2922 Lifts improperly compacted shall be re excavated to the depth directed by the CONTRACTING OFFICER then filled and compacted to the density specified at no additional cost to the CONTRACTING OFFICER

4 If the tests indicate unsatisfactory compaction Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction Additional compaction work shall be performed by Contractor at no additional cost to the CONTRACTING OFFICER until the specified degree of compaction is obtained

J Moisture Control

1 The Contractor shall control the water content of all material during placement within the range necessary to obtain the compaction specified

2 In general the Contractor shall maintain the moisture content of the fill within 2 percent of the optimum moisture content for compaction as determined by laboratory tests

3 The Contractor shall perform all necessary work to adjust the water content of the material to within the range necessary to permit the compaction specified

4 Where the subgrade or layer of soil must be moisture conditioned before compaction the Contractor shall uniformly apply the required amount of water to the surface in such a manner as to prevent free water appearing on the surface during or subsequent to compaction operations

5 The Contractor shall not place fill material when free water is standing on the surface of the area where the fill is to be placed

6 No compaction of fill will be permitted with free water on any portion of the fill to be compacted The Contractor shall remove any soil that is too wet to permit compaction to the specified maximum density and replace with compacted fill material

7 Soil material removed because it is too wet to permit compaction may be stockpiled spread on the surface and permitted to dry or assisted by discing harrowing or pulverizing until the moisture content is reduced to a satisfactory value as determined by moisture density relationship tests after which the soil material may be used as fill

K Settlement

1 Contractor shall repair any settlement that occurs at Contractor s expense

2 Make all repairs and replacement necessary within 30 days after notice from CONTRACTING OFFICER

L Disturbed Materials

1 Provide place and compact select fill necessary to replace subgrade materials disturbed or softened as a result of the Contractor s operations

2 Furnish additional fill at Contractor s expense

M Replacement of Unacceptable Excavated Materials

1 In the cases where over excavation for the replacement of unacceptable soil materials is required the excavation shall be backfilled to the required subgrade with select fill material and compacted to the requirements as specified in layers not thicker than 6 inches

3 09 FIELD QUALITY CONTROL

A Quality Control Testing During Construction

Testing agency must inspect and approve subgrades and fill layers before further construction work is performed thereon Tests of backfill materials subgrades and fill layers shall be taken as follows

1 Natural soil subgrades and backfill soils shall be tested to meet specified criteria by performing the following tests Grain size analysis by ASTM D 422 and determination of maximum density by ASTM D 1557 or ASTM D 4253 Testing shall be performed at the following frequency

a Natural on site soil perform one grain size analysis and one determination of maximum density per 200 cubic yards of excavated soil or more frequently whenever material encountered is visibly different

b Imported select fill or common fill perform one grain size analysis and one determination of maximum density and optimal moisture content where applicable per delivery to the site or per material source or where material is visibly different whichever is most frequent Testing shall be at a minimum of one test per 200 cubic yards of fill material

2 In place densities shall be verified by the testing agency for all excavation subgrades in the dry and for all compacted fill layers (below structures footings mats slabs or paved areas and below around and above installed piping) in accordance with ASTM D 2922 In place density testing shall be performed at the following frequency

a One in place density test and moisture content determination for every 2000 square feet of subgrade or compacted lift but in no case shall less than 3 tests be performed for each subgrade or compacted lift For perimeter walls a minimum of one in place density test and moisture content determination shall be performed for every 25 linear feet of wall footing or compacted lift beneath the perimeter wall Additionally a minimum of one in place density test and moisture content determination shall be performed for every footing subgrade or for each compacted lift beneath footings

b One in place density test and moisture content determination for every 100 linear feet of utility trench subgrade or compacted lift but in no case shall less than 1 test be performed for each utility trench subgrade or compacted lift

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3 Field density tests to insure that the specified density is obtained will be performed by the testing laboratory during each day of compaction work

4 If any sign of disturbance of subgrade or compacted lift is evident following testing and approval or if the surface is ponded or mucked the soil layer shall be retested and reapproved prior to placing subsequent lifts or placing concrete pipe bedding etc Any disturbed or softened soil which does not meet the specified density requirements shall be excavated replaced and recompacted to approval of the testing agency

B If based on reports of testing service and inspection subgrade or fills which have been placed are below specified density the Contractor shall provide additional compaction and testing

3 10 SPECIAL PRECAUTIONS FOR WINTER CONSTRUCTION

A Subgrade Preparation

1 The final excavation to subgrade level should not be made until fill placement can begin

2 Excavation and backfilling in the wet shall not be performed during freezing weather

3 If a delay in fill placement is necessary following excavation during freezing weather the subgrade must be protected by temporary insulating material such as hay and plastic (total thickness of at least six inches) or other insulation blanket material

B Placement of Compacted Select Fill

1 It is not desirable to place fill during freezing weather Granular soils which contain snow ice or frozen soil may appear dense following compaction however low densities accompanied by settlements may occur when the soil thaws The magnitude of settlement depends on a number of variables including lift thickness percent compaction achieved volume of frozen soil snow and ice in total mass and gradation of backfill soil During freezing weather it is difficult if not impossible to place and compact granular soils to the required densities specified prior to formation of ice crystals or lumps of frozen soil To minimize the potential of future foundation settlement the Contractor shall use the following construction techniques with the approval of the CONTRACTING OFFICER when placing fill during periods of freezing temperature

a Use crushed stone beneath structures in place of select fill to prevent frost heave

b Use select fill only when the morning temperature is at least 25 F and the weather forecast is for temperature to rise above freezing during the day Otherwise used crushed stone or do not place fill

c Keep soils to be used as fill free from ice snow and frozen soil It may be desirable to keep a large stockpile of select fill on site such that freezing is confined to the outer surface of the stockpile

d Remove ice snow and uncompacted frozen soil from any surface on which backfill soil is to be placed

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C Spread Footings and Floor Slabs

1 Concrete for spread footings and floor slabs must not be cast on frozen ground Once cast the Contractor shall prevent the supporting soil from freezing

2 For footings protection against freezing may consist of establishing bottoms of footings a minimum of 2 5 feet below the surface to be exposed to freezing and backfilling around footings and walls up to that surface Alternatively various types of insulating materials in thicknesses required to prevent soil freezing below footing bottom may be used It is recommended that floor slabs not be cast until the area can be enclosed and continuously maintained above freezing temperatures Otherwise extensive use of fill or insulation will be required above the slab to prevent subgrade freezing

3 Where slabs are to be placed on fill that was allowed to freeze the slabs should not be cast until all ground frost has thawed and the fill surface has been recompacted retested and approved Compaction should consist of a minimum of 6 passes of a heavy vibratory roller Unstable soil noted during this process shall be removed and replaced with compacted select fill

3 11 GRADING

A General Uniformly grade areas within limits of grading under this Section including adjacent transition areas Smooth subgrade surfaces within specified tolerances compact with uniform levels or slopes between points where elevations are shown or between such points and existing grades

B Grading Outside Building Lines Grade areas adjacent to building lines to drain away from structures and to prevent ponding Finish surfaces free from irregular surface changes and as follows

1 Turfed Areas or Areas Covered with Gravel Stone Wood Chips or Other Special cover Finish areas to receive topsoil or special cover areas to within not more than ½ inch above or below the required subgrade elevations

2 Walks Shape surface of areas under walks to line grade and cross section with finish surface not more than 1 inch above or below the required subgrade elevation

3 Pavements Shape surface of areas under pavement to line grade and cross section with finish surface not more than ½ inch above or below the required subgrade elevation

C Grading Surface of Fill Under Building Slabs or mats Grade smooth and even free of voids compacted as specified and to required elevation Provide final grades within a tolerance of ½ inch when tested with a 10 foot straightedge

3 12 TEMPORARY FENCING

A Contractor shall furnish and install a temporary fence surrounding excavations and work area in accordance with Section 02831 Fencing It shall have openings only at vehicular equipment and pedestrian access points

++ END OF SECTION ++

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SECTION 02230
BACKFILL MATERIALS

PART 1 GENERAL

1 1 DESCRIPTION

A Scope The CONTRACTOR shall provide all labor material and equipment to provide backfill materials for all associated earthwork to complete the Work in every respect All material obtained from on site excavation activities shall not contain heavy metals or other contaminants at levels above USEPA s remedial action level and all off site borrow material shall be certified clean

B Related Sections
1 Section 02220 Excavation and Backfill

1 2 QUALITY ASSURANCE

A Testing Laboratory
1 The CONTRACTOR shall engage a qualified testing laboratory in accordance with the requirements of Section 02220 Excavation and Backfill to make tests to determine acceptability of materials requirements as listed hereinafter
2 Testing Services
a Perform gradation tests Modified Proctor density tests and maximum index density tests on proposed materials in the laboratory and/or field for compliance with the Specifications as outlined in Section 02220 Excavation and Backfill
b Certified Clean Testing
1) The CONTRACTOR shall not place any imported material unless it is certified clean Any material placed by the CONTRACTOR that is not certified clean shall be removed by the CONTRACTOR as directed by the Contracting Officer at no expense to the GOVERNMENT
c Testing and certification of K 4 fill permeability shall be in accordance with all state and local regulations
d All materials from on site excavations shall be tested to confirm to contaminant levels below USEPA s remedial action limit

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise noted
1 ASTM D 422 Particle Size Analysis of Soils
2 ASTM D 1557 Moisture Density Relations of Soils Using 10 lb Rammer and 18 in Drop
3 ASTM D 2487 (1990) Classification of Soils for Engineering Purposes
4 ASTM D 2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports

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5 ASTM D 4253 Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table

6 ASTM E 548 (1991) General in Industrial Stds Criteria Used for Evaluating Laboratory Competence

1 3 SUBMITTALS

A Test Reports

1 Borrow materials Submit copies of the following reports directly to CONTRACTING OFFICER

a Gradation tests on borrow material including all sources (both on site and off site sources) of common fill select fill crushed stone crushed concrete topsoil filter material gabion fill K 4 fill and rip rap

b Modified Proctor maximum density tests or maximum index density tests on all soils to be compacted including all sources (both on site and off site sources) of common fill and select fill

c Certified Clean statement or test results for all off site borrow material including all sources of common fill select fill crushed stone crushed concrete topsoil filter material and K 4 fill

d Certification of the permeability of K 4 fill in accordance with State and local regulations

PART 2 PRODUCTS

2 1 COMMON FILL

A Common fill for backfill may be obtained from project related on site excavation activities however all on site excavated material proposed for use as common fill shall be determined to be free of contamination greater than the USEPA remedial action level for site soils

B All common fill shall be free of clay deleterious material particles larger than 4 inches in size and organic material such as leaves grass roots brush and rubbish Common fill shall be material with gradation of not more than 35 percent passing the No 200 standard sieve

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2 2 SELECT FILL

A Select fill shall be sand gravel sandy gravel or gravelly sand free of organic material loam trash snow ice frozen soil and other objectionable material and shall be well graded within the following limits

Sieve Size	Percent Passing by Weight
3 inch*	100
No 4	30 90
No 40	10 50
No 200	0 8

* 1 inch maximum for select fill within 6 inches of concrete ½ inch maximum for select fill within trenches for all HDPE pipe installation

2 3 CRUSHED STONE

A Crushed stone or graded gravel shall conform to the following gradation

Sieve Size	Percent Passing by Weight
1 inch*	100
3/4 inch	85 100
3/8 inch	50 80
No 4	35 60
No 40	15 30
No 200	0 7

2 4 CRUSHED CONCRETE

A Crushed concrete or recycled concrete aggregate shall conform to the following gradation

Sieve Size	Percent Passing by Weight
1 to ½ inch*	100
3/4 inch	55 90
No 4	25 60
No 50	5 25

B In addition the composition of the crushed concrete shall conform to the following requirements

	Percent by Weight	
	Minimum	Maximum
Portland cement concrete	90	
Bituminous concrete		10*
Brick mica schist and other friable material		4*
Wood		0 1*

* The percent shall be determined by separating the material retained on the No 4 sieve and expressing that amount as a percentage of the total weight of the material retained on the No 4 sieve

2 5 TOPSOIL

A This material shall meet the following particle size distribution requirements

Sieve Size	Percent Passing by Weight
2 inch	100
No 4	90 100
No 200	35 60

B Acceptable topsoil shall not contain less than 5 percent nor more than 20 percent organic matter as determined by ASTM D 2974 87

2 6 FILTER MATERIAL

A This material shall consist of Jersey washed stone with particle size between 3/4 inch and 2 1/2 inch diameter and shall be free of fines dust clay and deleterious material

2 7 K 4 FILL

A This material shall meet the criteria specified by N J A C 7 9A 10 1 (f) 4 CONTRACTOR shall submit certification of the permeability of this material to the CONTRACTING OFFICER in accordance with state and local regulations at no additional cost to the GOVERNMENT

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2 8 RIP RAP

A Rip rap shall consist of well graded durable quarry stone or broken field stone At least fifty percent (50%) of the stones shall measure four (4) inches in size with maximum stone size of six (6) inches

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 02250
OFF SITE TRANSPORTATION AND DISPOSAL
PART 1 GENERAL

1 01 SUMMARY

The work specified under this section shall involve off site transportation and treatment/disposal of all waste material generated and encountered on site during excavation and construction in accordance with all applicable regulations (see Section 01060) including Resource Conservation and Recovery Act (RCRA) and including Part 268 Land Disposal Restrictions

APPLICABLE REGULATIONS

1 02 The Contractor shall ensure that all operations in the loading and hauling of all materials are in compliance with the Federal and State Departments of Transportation (DOT) regulations Revised Procedures for Implementing off Site Response Actions (EPA OSWER Directive Number 9834 11 November 13 1987) Federal USEPA and Maryland Department of Environment Hazardous Waste Regulations and all local requirements and any other applicable requirements

Hazardous waste material transportation and disposal regulations shall include but not be limited to

A U S Code of Federal Regulations 49 CFR 171 through 179

B RCRA Land Disposal Restrictions and Treatment Standards (40 CFR 268)

C Maryland Department of Environment Standards Applicable to Transporters of Hazardous Waste (COMAR 26 13 04)

D Maryland Department of Environment Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities (COMAR 26 13 05)

E RCRA Generator and Transporter Regulations (40 CFR 261 263)

F RCRA Hazardous Waste Management Facility Regulations (40 CFR 264 265)

G OSHA Standards

H Posted weight limitations on roads and bridges

SUBMITTALS

1 03 The Contractor shall provide to the CONTRACTING OFFICER a program including Letters of Commitment and Traffic/Route Plan for the proposed transportation and disposal of solids sludges and liquids and drummed materials The Contractor shall submit letters of commitment from the properly licensed and insured waste haulers and the treatment disposal or recovery facility to haul and accept shipments The Contractor shall submit a Traffic/Route Plan for the off site transportation of all material The Contractor shall submit the following information on the off site treatment and

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disposal facility or facilities where he is planning to take the waste materials removed from the site These items may be required for certification of the treatment and/or disposal facility before award of the Contract All information shall be furnished at the Contractor s expense

A General Information

Facility name and EPA Identification Number
Facility location
Name of responsible contact for the facility
Telephone number for the contact
Signed letter of agreement to accept wastes as specified in this contract
Unit of measure utilized at facility for costing purposes

B A listing of all permits licenses letters of approval and other authorizations to operate held by the proposed facility as they pertain to receipt and management of wastes derived from this contract

C A listing of all permits licenses letters of approval and other authorizations to operate applied for by the proposed facility but not yet granted or issued Provide dates of application(s) submitted Planned submittals shall also be noted

D The Contractor shall specify and describe the units the proposed facility will use to manage the waste and provide dates of construction and beginning of use if applicable Drawings may be provided The Subcontractor shall identify the capacity available in the units and the capacity reserved for the subject waste

E The Contractor shall provide the date of the proposed facility s last compliance inspection under RCRA (if applicable)

F List of all acute (unresolved) compliance orders (or agreements) enforcement notices or notices of violation issued to the proposed facility State the source and nature of the cause of contamination if known

The Contractor shall also submit documentation demonstrating that the proposed transporter(s) of all waste have current permits for such work and are in good standing with the state

PART 2 PRODUCTS

2 01 The Contractor shall utilize appropriate vehicles and operating practices to prevent spillage or leakage of transported material from occurring enroute

2 02 The Contractor shall arrange for access to certified scales to record quantities for measurement of debris quantities and off site transportation and disposal Contractor shall be responsible for providing documentation showing that the scales are calibrated and operated in accordance with the manufacturer s instructions and recommendations The Contractor shall coordinate recording of quantities with the CONTRACTING OFFICER

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2 03 FACILITIES

The Subcontractor shall provide install and maintain temporary loading/staging facilities required for all material handling activities The location and design of such facilities shall be included in the Equipment and Material Handling Plan and be submitted to the CONTRACTING OFFICER for acceptance

2 04 TRANSPORTATION

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A Manifests The Contractor shall organize and maintain the material shipment records/manifests required by the Federal Resource Conservation and Recovery Act (RCRA) (Public Law 94 580) the State of New Jersey and the state where the treatment/disposal facility is located The manifests will be signed by the CONTRACTING OFFICER or its designated representative

B The Contractor shall coordinate the schedule for truck arrival and material deliveries at the disposal site to meet the approved project schedule The schedule shall be compatible with the availability of equipment and personnel for material handling operations

C All vehicles leaving the Exclusion Zone (EZ) shall be decontaminated at the Contamination Reduction Zone (CRZ) The Contractor shall visually inspect all vehicles to ensure that soil does not adhere to wheels or undercarriage after decontamination

D The Contractor shall periodically inspect all routes that the vehicles take from the job site to ensure that no leakage or tracking of mud has occurred Inspections shall take place at least monthly and shall be documented/certified by the Contractor

E The Contractor shall not deliver waste to any facility other than the disposal facility(ies) listed on the shipping manifest and previously accepted by the CONTRACTING OFFICER

F The Contractor shall coordinate vehicle inspection and recording of quantities leaving the site with the CONTRACTING OFFICER The Contractor shall arrange for access to certified scales for the recording of quantities These quantities shall be verified with recorded quantities at the disposal facility(ies) If any deviation between the two weight records occurs the matter is to be reported immediately to the CONTRACTING OFFICER

G The Contractor shall be held responsible for any and all actions necessary to remedy situations involving material spilled in transit or mud and dust tracked off site This cleanup shall be accomplished at the Contractor s expense

H The Contractor shall be responsible for inspecting the access routes for road conditions overhead clearance and weight restrictions

I The Contractor shall ensure that trucks are protected by properly covering and lining them and by decontaminating them as required prior to any use other than hauling the same type of contaminated materials

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J The Contractor shall only use the transporter(s) identified in his bid for the performance of work Any use of substitute or additional transporters must have previous written acceptance from the CONTRACTING OFFICER Transporters shall be certified by EPA and the State of Maryland

K The CONTRACTING OFFICER or its designated representative will provide a hazardous waste generator identification number and will sign the manifest

2 05 OFF SITE DISPOSAL

A The Contractor shall use only the treatment disposal and recovery facility(ies) identified in his bid for the performance of the work Substitutions or additions shall not be permitted without prior written acceptance by the CONTRACTING OFFICER

B The Contractor shall be responsible for acceptance of solids sludges and liquids at an approved treatment disposal or recovery facility for ensuring that the facility is properly permitted including RCRA treatment storage and disposal permits to accept and handle the stated material and that the facility provides the stated treatment and disposal services The Contractor shall define within his Proposal the analytical analyses if any required by the off site treatment disposal facility to accept the solids sludges and liquids

C The letters of commitment will be used by the CONTRACTING OFFICER to evaluate the acceptability of the Contractor s proposed facility(ies) in accordance with Revised Procedures for Implementing Off Site Response Actions (EPA OSWER Directive Number 9834 11 November 13 1987) and Off Site Policy RFA or Equivalent Investigation Requirement at RCRA Treatment and Storage Facilities (EPA Memorandum from J W Porter January 4 1988) Briefly the Directive describes procedures for response actions under CERCLA or Section 7003 of RCRA involving the off site treatment storage or disposal of CERCLA waste The memorandum states that as an interim measure the policy has been revised to include all not just land disposal Subtitle C facilities

D The CONTRACTING OFFICER reserves the right to contact and visit the disposal facilities and regulatory agencies to verify the agreement to accept the stated material and to verify any other information provided This does not in any way relieve the Contractor of his responsibilities under this Contract

E In the event that the identified and accepted facility(ies) ceases to accept the stated materials or the facility(ies) ceases operations it is the Contractor s responsibility to locate an alternate approved and permitted facility(ies) for accepting materials The Subcontractor is responsible for making the necessary arrangements to utilize the facility(ies) and the alternate facility(ies) must be accepted in writing by the CONTRACTING OFFICER in the same manner and with the same requirements as for the original facility(ies) This shall be accomplished at no extra cost to the USEPA

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PART 3 EXECUTION

3 01 RECORDKEEPING

A The Contractor shall obtain manifest forms obtain material code numbers and complete the shipment manifest records and all other associated documentation as required by the appropriate regulatory agencies for verifying the material type (Code No) and quantity of each load in units of volume and weight The manifests will be signed by the CONTRACTING MANAGER or its designated representative Each manifest shall be submitted to the CONTRACTING OFFICER within two (2) business days following shipment and within two (2) business days after notification of receipt of the disposal facility The Contractor must submit the original manifest form copies photocopies will not be acceptable as project record submittals Any manifest discrepancies shall be reported immediately to the CONTRACTING OFFICER and be resolved by the Contractor

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SECTION 02831
FENCING

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

The Work described herein consists of furnishing all labor materials equipment and incidentals required to provide fencing to the extent as shown and specified on the Contract Drawings The fence shall be the height shown on the plans and shall include gates for vehicular and worker access Also included herein is all temporary fencing used for traffic and personnel control

B Applicable Publications

The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

1 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- ASTM C 94 (1992) Ready Mixed Concrete
- ASTM F 883 (1990) Padlocks
- A 121 86 Zinc Coated (Galvanized) Steel Barbed Wire
- A 153 87 Zinc Coating (Hot Dip) on Iron and Steel Hardware
- A 392 89 Zinc Coated Steel Chain Link Fence Fabric

2 AMERICAN WELDING SOCIETY (AWS)
- AWS WZC (1972) Welding Zinc Coated Steels

3 FEDERAL SPECIFICATIONS (FS)
- FS RR F 191/GEN (Rev K) Fencing Wire and Post Metal (and Gates Chain Link Fence Fabric and Accessories)
- FS RR F 191/1 (Rev D) Fencing Wire and Post Metal (Chain Link Fence Fabric)
- FS RR F 191/2 (Rev D) Fencing Wire and Post Metal (Chain Link Fence Gates)
- FS RR F 191/3 (Rev D) Fencing Wire and Post Metal (Chain Link Fence Posts Top Rails and Braces)
- FS RR F 191/4 (Rev D) Fencing Wire and Post Metal (Chain Link Fence Accessories)

1 2 SUBMITTALS

A Shop Drawings shall be submitted in accordance with the Section 01340 Submittals Drawings shall show post sizes and sections post setting and bracing gate details barbed wire support arms details of attachment of fabric and barbed wire to support members and any other details required to erect the fence or barrier along the lines indicated The CONTRACTOR shall include copies of manufacturer s technical data test reports on physical properties and installation instruction for steel fences and gates for approval by the CONTRACTING OFFICER

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PART 2 PRODUCTS

2 1 PRODUCTS

A Materials shall conform to the following

1 Chain Link Fence Fed Spec RR F 191/GEN and detailed specifications forming the various parts thereto

2 Fabric Fed Spec RR F 191/1 Type I zinc coated steel wire with minimum coating weight of 1 2 ounces of zinc per square foot of coated surface or Type II aluminum coated steel wire Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh Fabric height shall be as shown The top selvage shall be twisted and barbed and the bottom selvage knuckled

3 Gates Fed Spec RR F 191/2 Gate shall be the type and swing shown Gate frames shall be constructed of Class 1 Grade A or B steel pipe size SP2 as specified in Fed Spec RR F 191/3 Gate fabric shall be as specified for chain link fabric Each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction free from sag or twist Gate leaves less than 8 feet wide shall have truss rods or intermediate braces Gates over 10 feet wide shall be additionally braced with a 3/8 inch minimum thickness diagonal truss rod Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted Latches hinges stops keepers rollers and other hardware items shall be furnished as required for the operation of the gate Latches shall be arranged for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement Stops shall be provided for holding the gates in the open position

4 Posts Fed Spec RR F 191/3 zinc coated Class 1 Grade A or B steel pipe Class 3 formed steel sections or Class 6 steel square sections Class 4 steel H section may be used for line posts in lieu of line post shapes specified for the other classes Sizes shall be as specified in Fed Spec RR F 191/3 for the class used Line posts shall be of the same class throughout the fence Terminal (corner gate and pull) posts selected shall be of the same class throughout the fence Gate post shall be either round or square subject to the limitation specified in Fed Spec RR F 191/3

5 Braces and Rails Fed Spec RR F 191/3 zinc coated Class 1 Grade A or B steel pipe size SP1 Class 3 formed steel sections size FS1 conforming to Fed Spec RR F 191/3 may be used as braces and rails if Class 3 line posts are furnished

6 Accessories Fed Spec RR F 191/4 Ferrous accessories shall be zinc or aluminum coated conforming to ASTM A 153 87

a Truss rods shall be furnished for each end post Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment

b Barbed wire shall be zinc or aluminum coated steel wire double strand with 4 point barbs spaced 5 inches on center conforming to ASTM A 121 86 Class 3

c Barbed wire support arms shall be the 45 degree angled arm type and of the design required for the post furnished On tubular posts support arms may

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be integral with the weathertight closure cap Tie wire for attaching fabric to braces and posts shall be 9 gauge steel wire

d Post Tops Pressed steel wrought iron or malleable iron designed as a weather tight closure cap for tubular posts Furnish one cap for each post unless equal protection is afforded by combination post top cap and barbed wire supporting arm where barbed wire is required

e Stretcher Bars One piece lengths equal to full height of fabric with a minimum cross section of 3/16 inch by 3/4 inch The CONTRACTOR shall provide one stretcher bar for each gate and end post and 2 for each corner and pull post except where fabric is integrally woven into the post

f Stretcher Bar Bands Steel wrought iron or malleable iron spaced not over 15 inches on center to secure stretcher bars to end corner and pull and gate posts

7 Concrete ASTM C 94 using 3/4 inch maximum size aggregate and having minimum compressive strength of 3 000 psi at 28 days Grout shall consist of one part Portland cement to three parts clean well graded sand and the minimum amount of water to produce a workable mix

8 Padlocks ASTM F 883 Type P01 Grade 2 Size 1 3/4 inch Padlocks shall be keyed alike and each lock shall be furnished with two keys

9 Tension Wire Tension wire shall be aluminized 7 gauge coiled spring wire

B Temporary Fencing

1 CONTRACTOR shall furnish and install a temporary fence surrounding excavations and any other work areas that need protection It shall have openings only at vehicular equipment and personnel access points The fence shall be a snow fence type enclosure 48 inches tall and constructed of vertical hardwood slats measuring 1 1/2 by 1/4 inch interwoven with strands of horizontal wire or approved equal snow fence Posts shall be of steel either U Y T or channel section and shall have corrugations knobs notches or studs so placed and constructed as to engage a substantial number of fence line wire in the proper position Posts shall have tapered anchors weighing 0 67 pounds or more each firmly attached by means of welding riveting or clamping Posts shall have a nominal weight of 1/3 pound per linear foot exclusive of the anchor Each post shall be furnished with a sufficient number of galvanized wire fasteners or clamps of not less than 0 120 inch in diameter for attaching fence wire to the post

PART 3 EXECUTION

3 1 EXECUTION

A General

1 Fence shall be installed to the lines and grades indicated The area on either side of the fence line shall be cleared to the extent indicated Line posts shall be spaced equidistant at intervals not exceeding 10 feet Terminal (corner gate and pull) posts shall be set at abrupt changes in vertical and horizonal alignment Fabric shall be continuous between end posts However runs between end posts shall not exceed 500 feet Damage to the galvanized surface due to welding shall be repaired with

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repair sticks of zinc cadmium alloys or zinc tin lead alloys per AWS WZC Installation shall conform to the requirements of the Chain Link Manufacturers Institute Standards For Chain Link Fence Installation

B Posts

1 Posts shall be set plumb and in alignment

2 Except where solid rock is encountered posts shall be set in concrete to the depth of 36 inches

3 Installation in Rock Where solid rock is encountered with no overburden posts shall be set to a minimum depth of 18 inches in rock Where solid rock is covered with an overburden of soil or loose rock posts shall be set to a minimum depth of 36 inches unless a penetration of 18 inches in solid rock is achieved before reaching the 36 inch depth in which case depth of penetration shall terminate

4 All portions of posts set in rock shall be grouted Portions of posts not set in rock shall be set in concrete from the rock to ground level Posts set in concrete shall be set in holes not less than 10 inches in diameter for end post and 8 inches in diameter for line posts Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post

5 Concrete and grout shall be thoroughly consolidated around each post so as to be free of voids and finished to form a dome Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts

6 Driven Posts Class 3 type line posts may be mechanically driven for temporary fence construction only provided that soil conditions are such that the driven posts develop strengths at least equal to posts set in concrete and rock is not encountered Driven posts shall be set to a minimum depth of 36 inches and shall be protected with drive caps when being set

C Braces and Truss Rods shall be installed as required and in conformance with the standard practice of the fence furnished Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height Braces and truss rods shall extend from end posts to line posts Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal

D Tension wires shall be installed along the top and bottom of the fence line and attached to the end posts of each stretch of the fence Top tension wires shall be installed within the top 3 inches of the installed fabric Bottom tension wire shall be installed within the bottom 3 inches of the installed fabric Tension wire shall be pulled taut and free of sag

E Chain link fabric shall be installed on the outside of the posts Fabric shall be attached to end posts with stretcher bars and tension bands Bands shall be spaced at approximately 15 inch intervals Fabric shall be pulled taut to provide a smooth uniform appearance free from sag Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to tension wires at approximately 24 inch intervals Fabric shall be cut by untwisting and removing pickets Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined The bottom of the installed fabric shall be 2 inches (plus or minus ½ inch) above the ground

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F Barbed wire supporting arms and barbed wire shall be installed as recommended by the manufacturer Supporting arms shall be anchored to the posts in such a manner to prevent easy removal with hand tools Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal

G Gates shall be installed at the locations as shown on the Contract Drawings Hinged gates shall be mounted to swing as indicated Latches stops and keepers shall be installed as required Padlocks shall be attached to gates or gate posts with chains to prevent padlock removal Hinge pins and hardware shall be secured to prevent removal Where barbed wire is shown above gates the CONTRACTOR shall extend the end members of gate frames 12 inches above the top member and prepare them to receive 3 strands of wire The CONTRACTOR shall provide necessary clips for securing wire to extensions

++ END OF SECTION ++

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SECTION 02935
TURF
PART 1 GENERAL

1 01 DESCRIPTION

A Scope
1 The CONTRACTOR shall provide all labor materials and equipment to establish turf on the areas indicated on the contract drawings

B Related Sections
1 Section 01300 Submittal Procedures
2 Section 02220 Excavation and Backfill
3 Section 02230 Backfill Materials

1 02 REFERENCES

A The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by basic designation only
1 AGRICULTURAL MARKETING SERVICE 01 Federal Seed Act Regulations (Part 201 202)
2 ASTM D 977 Emulsified Asphalt
3 ASTM D 2028 Cutback Asphalt (Rapid Curing Type)
4 ASTM D 2607 Peats Mosses Humus and Related Products
5 COMMERCIAL ITEM DESCRIPTIONS A A 1909 (Basic) Fertilizer
6 FEDERAL SPECIFICATIONS JJJ S 181 (Rev B) Seeds Agricultural

1 03 SUBMITTALS

A The following shall be submitted in accordance with SECTION 01300 Submittal Procedures
1 Manufacturer s Literature Manufacturer s literature discussing physical characteristics application and installation instructions for erosion control material and for chemical treatment material
2 Turf Establishment Period Written calendar time period for the turf establishment Period When there is more than one turf establishment period the boundaries of the turfed area covered for each period shall be described
3 Statements
a Pesticide treatment plan with proposed sequence of pesticide treatment work The pesticide trade name chemical composition formulation concentration application rate of active ingredients and method of application for all materials and the name and state license number of the state certified applicator shall be included
b Written record of maintenance Work performed
4 Certificates
a Certificates of compliance certifying that materials meet the

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requirements specified prior to the delivery of materials Certified copies of the reports for the following materials shall be included

b Seed For mixture percent pure live seed minimum percent germination and hard seed maximum percent weed seed content date tested and state certification

c Fertilizer For chemical analysis composition percent

d Topsoil For pH particle size chemical analysis and mechanical analysis

1 04 QUALITY ASSURANCE

A Seeded areas will be subject to inspection by the CONTRACTING OFFICER at the growing site

1 05 DELIVERY INSPECTION STORAGE, AND HANDLING

A Delivery

1 Protection Seed shall be protected from drying out and contamination during delivery

2 Topsoil A soil test shall be provided for topsoil delivered to the site as described in SECTION 02230 Backfill Materials

B Inspection

1 Seed shall be inspected upon arrival at the job site by the CONTRACTING OFFICER for conformity to type and quality in accordance with paragraph 2 1 Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site

C Storage

1 Materials shall be stored in areas designated by the CONTRACTING OFFICER Seed lime and fertilize shall be stored in cool dry locations away from contaminants Chemical treatment materials shall not be stored with other landscape materials

PART 2 PRODUCTS

2 01 MATERIALS

A Seed

1 Seed Classification New Jersey State approved seed of the latest season s crop shall be provided in original sealed packages bearing the producer s guaranteed analysis for percentages of mixture purity germination hard seed weed seed content and inert material Labels shall be in conformance with AMS 01 and applicable state seed laws

2 Seed Mixtures Seed mixtures shall be proportioned by weight as follows

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Botanical Name	Common Name	Mixture Percent by Weight
Festuca longfolia	Reliant Hard Fescue	80
Festuca rubra var commutata	Jamestown Chewings	20

3 Quality Seed shall conform to FS JJJ S 181 Weed seed shall not exceed 1 percent by weight of the total mixture Wet moldy or otherwise damaged seed shall be rejected

4 Temporary Seed The temporary seed for erosion control shall be as follows

Botanical Name	Common Name	Percent Pure Live Seed
Lolium multiflorum	Annual Ryegrass	98

5 Wetlands Grass Seed Seed shall be Aqrostis Dalustris with germination rate of 90% and degree of purity of 95X

6 Seed Mixing The field mixing of seed shall be performed on site in the presence of the CONTRACTING OFFICER

B Soil Amendments Soil amendments shall consist of lime fertilizer organic soil amendments and soil conditioners meeting the following requirements

1 Fertilizer Fertilizer shall be commercial grade free flowing uniform in composition and conforming to CID A A 1909 Granular Fertilizer Consists of nitrogen phosphorus potassium ratio 5 percent nitrogen 10 percent phosphorus and 5 percent potassium

C Water Water shall not contain elements toxic to plant life

PART 3 EXECUTION

3 01 SEEDING TIMES AND CONDITIONS

A Seeding Time

1 Seed shall be sown from 4/1 to 5/31 for spring planting and from 8/16 to 10/15 for fall planting

3 02 SITE PREPARATION

A Grading

1 The CONTRACTING OFFICER will verify that finished grades are as indicated on the Contract Drawings and the placing of topsoil and the smooth grading has been completed in accordance with Section 02220 Excavation and Backfill

B Application of Soil Amendments

1 Soil Test A soil test shall be performed for pH chemical analysis and mechanical analysis to establish the quantities and type of soil amendments

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required to meet local growing conditions for the type and variety of turf specified

2 Fertilizer Fertilizer shall be applied at the rate 20 pounds per 1000 square feet Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches and may be incorporated as part of the tillage or hydroseeding operation

C Tillage

1 Minimum Depth Soil on slopes gentler than 3 horizontal to 1 vertical shall be tilled to a minimum depth of 4 inches On slopes between 3 horizontal to 1 vertical and 1 horizontal to 1 vertical the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes or other method Rototillers shall be used where soil conditions and length of slope permit On slopes 1 horizontal to 1 vertical and steeper no tillage is required

D Finished Grading

1 Preparation Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade Drainage patterns shall be maintained as indicated on Contract Drawings Turf areas compacted by construction operations shall be completely pulverized by tillage Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in SECTION 02230 Backfill Materials Finished grade shall be 25 mm (1 inch) below the adjoining grade of any surfaced area New surfaces shall be blended to existing areas

2 Lawn Area Debris Lawn areas shall have debris and stones larger than 25 mm (1 inch) in any dimension removed from the surface

3 Protection Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion

3 03 SEEDING

A General

1 Prior to seeding any previously prepared seedbed areas compacted or damaged by interim rain traffic or other cause shall be reworked to restore the ground condition previously specified Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution

B Applying Seed

1 Broadcast Seeding Seed shall be uniformly broadcast at the rate of four pounds per 1000 square feet using broadcast seeders Wetlands grass seed shall be applied at a rate of 50 pounds per acre Half of seed shall be broadcast in one direction and the remainder at right angles to the first direction Seed shall be covered to an average depth of 1/4 inch by disk harrow steel mat drag cultipacker or other approved device

2 Rolling Immediately after seeding except for slopes 3 horizontal to 1 vertical and greater the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width Areas seeded with seed drills equipped with rollers shall not be rolled

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3 Hydroseeding Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed fertilizer and water have been thoroughly mixed to produce a homogeneous slurry Slurry shall be uniformly applied under pressure over the entire area The hydroseeded area shall not be rolled

C Mulch

1 Straw or Hay Mulch Straw or hay mulch shall be spread uniformly at the rate of 2 tons per acre Mulch shall be spread by hand blower type mulch spreader or other approved method Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered The mulch shall not be bunched All seeded areas shall be mulched on the same day as the seeding

2 Mechanically Anchoring Immediately following spreading the mulch shall be anchored to the soil by a V type wheel land packer a scalloped disk land packer designed to force mulch into the soil surface or other suitable equipment

3 Wood Cellulose Fiber Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation

D Water

1 Watering shall be started within 2 days after completing the seeded area Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm (1 inch) Run off and puddling shall be prevented

3 04 EROSION CONTROL

A Erosion Control Material

1 Erosion control material where indicated or required shall be installed in accordance with manufacturer s instructions Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade

B Temporary Turf Cover

1 General When there are Contract delays in the turfing operation or a quick cover is required to prevent erosion the areas designated for turf shall be seeded with a temporary seed as directed by the CONTRACTING OFFICER

2 Application When no other turfing materials have been applied the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph 3 2 Seed shall be uniformly broadcast and applied at the rate of 4 pounds per 1000 square feet The area shall be watered as required

3 05 RESTORATION AND CLEAN UP

A Restoration

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1 Existing turf areas pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at CONTRACTOR S expense

B Clean up

1 Excess and waste material shall be removed from the planting operation and shall be disposed of off the site Adjacent paved areas shall be cleaned

3 06 PROTECTION OF TURFED AREAS

A Immediately after turfing the area shall be protected against traffic or other use by erecting barricades and providing signage as required or as directed by the CONTRACTING OFFICER

3 07 TURF ESTABLISHMENT PERIOD

A Commencement

1 The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of Work under this Contract and shall end three (3) months after the last day of turfing operations required by this Contract Written calendar time period shall be furnished to the CONTRACTING OFFICER for the Turf Establishment Period When there is more than one turf establishment period describe the boundaries of the turfed area covered for each period

B Satisfactory Stand of Turf

1 Seeded Area

a Lawn Area A satisfactory stand of turf from the seeding operation for a lawn area is defined as a minimum of 130 grass plants per square foot Bare spots shall be no larger than 6 inches square The total bare spots shall not exceed 2 percent of the total seeded area

b Field Area A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 130 grass plants per square foot The total bare spots shall not exceed 10 percent of the total seeded area

C Maintenance During Establishment Period

1 General Maintenance of the turfed areas shall include eradicating weeds eradicating insects and diseases protecting embankments and ditches from erosion maintaining erosion control materials and mulch protecting turfed areas from traffic mowing watering and post fertilization

2 Watering Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf Run off puddling and wilting shall be prevented

3 Post Fertilization After initial application of fertilizer as specified fertilizer shall be applied at a rate of 10 pounds per 1000 square feet during post fertilization applications All areas shall be post fertilized twice at 1 5 months and again at 3 months from initial planting of the area to be

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post fertilized

4 Repair The CONTRACTOR shall re establish as specified herein eroded damaged or barren areas Mulch shall also be repaired or replaced as required

5 Maintenance Report A written record shall be submitted to the CONTRACTING OFFICER of the maintenance Work performed

3 08 FINAL ACCEPTANCE

A Preliminary Inspection

1 Prior to the completion of the Turf Establishment Period a preliminary inspection will be held by the CONTRACTING OFFICER Time for the inspection shall be established in writing The acceptability of the turf in accordance with the Turf Establishment Period shall be determined An unacceptable stand of turf shall be repaired as soon as turfing conditions permit

B Final Inspection

1 A final inspection shall be held by the CONTRACTING OFFICER to determine that deficiencies noted in the preliminary inspection have been corrected Time for the inspection shall be established in writing

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SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1 1 DESCRIPTION

A Scope
1 CONTRACTOR shall provide concrete formwork in accordance with the specifications The work also includes
a Providing openings in formwork to accommodate the Work under this and other Sections and building into the formwork all items such as sleeves anchor bolts inserts and all other items to be embedded in concrete for which placement is not specifically provided under other Sections

B Coordination
1 Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork

C Related Sections
1 Section 03200 Concrete Reinforcement
2 Section 03251 Concrete Joints

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ACI 301 Specifications for Structural Concrete for Buildings
2 ACI 347 Guide for Concrete Formwork
3 US Product Standard PS 1 83 for Construction and Industrial Plywood

B Allowable Tolerances
1 Construct formwork to provide completed concrete surfaces complying with tolerances specified in ACI 347 Chapter 3 3 except as otherwise specified

C All items for permanent or temporary facilities shall be used in accordance with manufacturers instructions

1 3 PRODUCT DELIVERY, STORAGE AND HANDLING

A On delivery to job site place materials in area protected from weather

B Store materials above ground on framework or blocking Cover wood for forms with protective waterproof covering Provide for adequate air circulation or ventilation

C Handle materials to prevent damage

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PART 2 PRODUCTS

2 1 FORM MATERIALS

A Forms for Exposed Finish Concrete

1 Unless otherwise shown or specified construct formwork for exposed concrete surfaces with plywood metal metal framed plywood faced or other panel type materials acceptable to CONTRACTING OFFICER to provide continuous straight smooth as cast surfaces Furnish in largest practical sizes to minimize number of joints and to conform to joint system shown or specified Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection

B Forms for Unexposed Finish Concrete

1 Form concrete surfaces that will be unexposed in the finished structure with plywood lumber metal or other acceptable material Provide lumber that is dressed on at least 2 edges and 1 side

C Form Ties

1 Provide factory fabricated removable or snapoff metal form ties designed to prevent form deflection and to prevent spalling of concrete surfaces upon removal Materials used for tying forms will be subject to approval of CONTRACTING OFFICER

2 Unless otherwise shown provide ties so that portion remaining within concrete after removal of exterior parts is at least 1 inch from the outer concrete surface Unless otherwise shown provide form ties that will leave a hole no larger than 1 inch diameter in the concrete surface

3 Ties for exterior walls and walls subject to hydrostatic pressure shall have waterstops

4 Provide wood or plastic cones for ties where concrete is exposed in the finish structure and in the interior of tanks

5 Provide stainless steel form ties for planned exposed tie hole locations where shown on the Drawings When used tie break back point shall be at least 1 inch from outer concrete surface

6 Wire ties are not acceptable

D Forms Coatings

1 Provide commercial formulation form coating compounds that will not bond with stain nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds For concrete surfaces which will be in contact with potable water the form coating shall be a mineral oil base coating

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2 2 DESIGN OF FORMWORK

A Design erect support brace and maintain formwork so that it shall safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure Carry vertical and lateral loads to ground by formwork system or in place construction that has attained adequate strength for this purpose Construct formwork so that concrete members and structures are of correct size shape alignment elevation and position

B Design forms and falsework to include values of live load dead load weight of moving equipment operated on formwork concrete mix height of concrete drop vibrator frequency ambient temperature foundation pressures stresses lateral stability and other factors pertinent to safety of structure during construction

C Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations using wedges or jacks or a combination thereof Provide trussed supports when adequate foundations for shores and struts cannot be secured

D Support form facing materials by structural members spaced sufficiently close to prevent significant deflection Fit forms placed in successive units for continuous surfaces to accurate alignment free from irregularities and within allowable tolerances For long span members without intermediate supports provide camber in formwork as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads

E Design formwork to be readily removable without impact shock or damage to concrete surfaces and adjacent materials

F Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement Solidly butt joints and provide backup material at joints as required to prevent leakage and fins

PART 3 EXECUTION

3 1 INSPECTION

A CONTRACTOR and his installer shall examine the substrate and the conditions under which Work is to be performed and notify CONTRACTING OFFICER in writing of unsatisfactory conditions Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 2 FORM CONSTRUCTION

A Construct forms complying with ACI 347 to the exact sizes shapes lines and dimensions shown as required to obtain accurate alignment location and grades to tolerances specified and to obtain level and plumb work in finish structures Provide for openings offsets keyways recesses moldings rustications reglets chamfers blocking screeds bulkheads

anchorages and inserts and other features required Use selected materials to obtain required finishes Finish shall be as determined by approved mock up or sample panel if specified

B Fabricate forms for easy removal without damaging concrete surfaces Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only Kerf wood inserts for forming keyways reglets recesses and the like to prevent swelling and assure ease of removal

C Provide temporary openings where interior area of formwork is inaccessible for cleanout for inspection before concrete placement and for placement of concrete Brace temporary closures and sel tightly to forms to prevent loss of concrete mortar Locate temporary openings on forms in locations as inconspicuous as possible consistent with requirements of the Work Form intersecting planes of openings to provide true clean cut corners with edge grain of plywood not exposed as form for concrete

D Falsework

1 Erect falsework and support brace and maintain it to safely support vertical lateral and asymmetrical loads applied until such loads can be supported by in place concrete structures Construct falsework so that adjustments can be made for take up and settlement

2 Provide wedges jacks or camber strips to facilitate vertical adjustments Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure make necessary adjustments to produce finished Work of required dimensions

E Forms for Exposed To View Concrete

1 Do not use metal cover plates for patching holes or defects in forms

2 Provide sharp clean corners at intersecting planes without visible edges or offsets Back joints with extra studs or girts to maintain true square intersections

3 Use extra studs walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete Do not use narrow strips of form material that will produce bow

4 Assemble forms so they may be readily removed without damage to exposed concrete surfaces

5 Form molding shapes recesses rustication joints and projections with smooth finish materials and install in forms with sealed joints to prevent displacement

F Corner Treatment

1 Form exposed corners of beams walls foundations bases and columns to produce smooth solid unbroken lines except as otherwise shown Except as specified below for reentrant or internal corners exposed corners shall be chamfered

2 Form chamfers with 3/4 inch by 3/4 inch strips unless otherwise shown accurately formed and surfaced to produce uniformly straight lines and tight edge joints Use rigid PVC chamfers for all architecturally formed concrete Extend terminal edges to required limit and miter chamfer strips at changes in direction

3 Reentrant or internal corners and unexposed corners may be formed either square or chamfered

G Joints

1 Refer to Section 03251 of these Specifications for treatment of joints Locate as shown and specified

H Openings and Built In Work

1 Provide openings in concrete formwork shown or required by other Sections Refer to Paragraph 1 1 B herein for the requirements of coordination

2 Accurately place and securely support items to be built into forms

I Cleaning and Tightening

1 Thoroughly clean forms and adjacent surfaces to receive concrete Remove chips wood sawdust dirt or other debris just before concrete is to be placed Re tighten forms immediately after concrete placement as required to eliminate mortar leaks

3 3 FORM COATINGS

A Coat form contact surfaces with a non staining form coating compound before reinforcement is placed Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete Apply in compliance with manufacturer s instructions

B Coat steel forms with a non staining rust preventative form oil or otherwise protect against rusting Rust stained steel formwork is not acceptable

3 4 INSTALLATION OF EMBEDDED ITEMS

A Set and build into the formwork anchorage devices and other embedded items shown specified or required by other Sections and other contracts Refer to Paragraph 1 1 B herein for the requirements of coordination Use necessary setting drawings diagrams instructions and directions

B Edge Forms and Screeds Strips for Slabs

1 Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface Provide and secure units to support screeds

3 5 FIELD QUALITY CONTROL

A Before concrete placement CONTRACTOR shall check the formwork including tolerances lines ties tie cones and form coatings He shall make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems

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B During concrete placement CONTRACTOR shall check formwork and related supports to ensure that forms are not displaced and that completed Work shall be within specified tolerances

C If CONTRACTOR finds that forms are unsatisfactory in any way either before or during placing of concrete placement of concrete shall be postponed or stopped until the defects have been corrected and reviewed by CONTRACTING OFFICER

3 6 REMOVAL OF FORMS

A Conform to the requirements of ACI 301 Chapter 4 and ACI 347 Chapter 3 7 except as specified below

1 Removal of Forms and Supports

	Temperature (F)				
	Over 95F	70F 95F	60F 70F	50F 60F	Below 50F
a Wells	2 days	1 day	2 days	3 days	Do not remove forms until site cured test cylinder develops 50% of 28 day strength
b Columns	7 days	2 days	3 days	4 days	
c Beam Soffits	10 days	4 days	5 days	6 days	
d Slabs 5 in thick or less	10 days	5 days	6 days	7 days	
e Slabs over 5 in thick	12 days	6 days	8 days		

B When high early strength concrete is specified a schedule for removal of forms will be developed in the field from the age/ strength relationships established for the materials and proportions used by tests in accordance with ACI 301 Section 3 8

C Form facing material shall remain in place a minimum of 4 days after concrete placement unless otherwise approved by CONTRACTING OFFICER

D Do not remove supporting forms or shoring until the members have acquired sufficient strength to safely support their weight and the load upon them Results of suitable control tests may be used as evidence that the concrete has attained sufficient strength

E The time for removal of all forms will be subject to CONTRACTING OFFICER S approval

3 7 PERMANENT SHORES

A Provide permanent shores as defined in ACI 347 Chapter 3 7

B Reshores will not be permitted

3 8 RE USE OF FORMS

A Clean and repair surfaces of forms to be re used in the Work Split frayed delaminated or otherwise damaged form facing material will not be acceptable Apply new form coating compound material to concrete contact surfaces as specified for new formwork

B When forms are extended for successive concrete placement thoroughly clean surfaces remove fins and laitance and tighten forms to close all joints Align and secure joints to avoid offsets Do not use patched forms for exposed concrete surfaces Form surfaces shall be subject to CONTRACTING OFFICER S approval

++ END OF SECTION ++

SECTION 03200
CONCRETE REINFORCEMENT
PART 1 GENERAL

1 01 DESCRIPTION

A Scope
- 1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install concrete reinforcement
- 2 The extent of concrete reinforcement is shown
- 3 The Work includes fabrication and placement of reinforcement including bars ties and supports and welded wire fabric for concrete encasements and fireproofing

B Related Sections
- 1 Section 03300 Cast In Place Concrete
- 2 Section 04150 Masonry Accessories
- 3 Section 05504 Miscellaneous Metals

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
- 1 Concrete Reinforcing Steel Institute Manual of Standard Practice includes ASTM standards referred to herein
- 2 ACI 315 Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
- 3 ACI 318 Building Code Requirements for Reinforced Concrete
- 4 Steel Structures Painting Council Surface Preparation Specification No 10 Near White Blast Cleaning

B Allowable Placing Tolerances Comply with ACI 318 Chapter 7 Details of Reinforcement except as specified below
- 1 Concrete surfaces which are in contact with liquids 2 inches minimum coverage

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
- 1 Manufacturer s specifications and installation instructions for all materials and reinforcement accessories
- 2 Drawings for fabrication bending and placement of concrete reinforcement Comply with ACI 315 Parts A and B For walls show elevations to a minimum scale of 1/4 inch to 1 foot For slabs show top and bottom reinforcing on separate plan views Show bar schedules stirrup spacing diagrams of bent bars arrangements and assemblies as required for the fabrication and placement of

concrete reinforcement unless otherwise noted Splices shall be kept to a minimum Splices in regions of maximum tension stresses shall be avoided whenever possible

a Drawings detailing the location of all construction and expansion joints as required under Section 03251 shall be submitted and approved before Shop Drawings for reinforcing steel are submitted

B Certificates

1 Submit 1 copy of steel producer s certificates of mill analysis tensile and bend tests for reinforcing steel

1 04 DELIVERY HANDLING AND STORAGE

A Deliver concrete reinforcement materials to the site bundled tagged and marked Use metal tags indicating bar size lengths and other information corresponding to markings shown on placement diagrams

B Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust Store on heavy wood blocking so that no part of it ~ill come in contact with the ground

PART 2 PRODUCTS

2 01 MATERIALS

A Reinforcing Bars ASTM A 615 and as follows

1 Provide Grade 60 for all bars except for stirrups and ties which shall be Grade 40

B Mechanical Couplers Reinforcement bars may be spliced with a mechanical connection This connection shall be a full mechanical connection which shall develop in tension or compression as required at least 125 percent of specified yield strength (f_y) of the bar in accordance with ACI 318 Section 12 14 3 4

C Steel Wire ASTM A 82

D Welded Smooth Wire Fabric ASTM A 185

E Column Spirals Hot rolled rods for spirals ASTM A 615

F Supports for Reinforcement Bolsters chairs spacers and other devices for spacing supporting and fastening reinforcement in place

1 Use wire bar type supports complying with CRSI recommendations except a s specified below Do not use wood brick or other unacceptable materials

2 For slabs on grade use supports with sand plates or horizontal runners where

base material will not support chair legs

3 For all concrete surfaces where legs of supports are in contact with forms provide supports complying with CRSI Manual of Standard Practice as follows

a Either hot dip galvanlzed plastic protected or stainless steel legs

4 Over waterproof membranes use precast concrete chairs

2 02 FABRICATION

A General Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances complying with CRSI Manual of Standard Practice In case of fabricating errors do not re bend or straighten reinforcement in a manner that will injure or weaken the material

B Unacceptable Materials Reinforcement with any of the following defects will not be permitted in the Work

1 Bar lengths bends and other dimensions exceeding specified fabrication tolerances

2 Bends or kinks not shown on approved Shop Drawings

3 Bars with reduced cross section due to excessive rusting or other cause

PART 3 EXECUTION

3 01 INSPECTION

A CONTRACTOR and his installer shall examine the substrate and the conditions under which concrete reinforcement is to be placed and notify CONTRACTING OFFICER in writing of unsatisfactory conditions Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 02 INSTALLATION

A Comply with the applicable recommendations of specified codes and standards and CRSI Manual of Standard Practice for details and methods of reinforcement placement and supports

B Clean reinforcement to remove loose rust and mill scale earth ice and other materials which reduce or destroy bond with concrete

C Position support and secure reinforcement against displacement during formwork construction or concrete placement operations Locate and support reinforcing by metal chairs runners bolsters spacers and hangers as required

1 Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 318 Arrange space and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations Set wire ties so that twisted ends are directed

away from exposed concrete surfaces

2 Prior to placement of concrete contractor shall demonstrate to CONTRACTING OFFICER that the specified cover of reinforcement has been attained by using a surveying level or string line

3 Reinforcing steel shall not be secured to forms with wire nails or other ferrous metal Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces

D Install welded wire fabric in as long lengths as practical Lap adjoining pieces at least one full mesh and lace splices with 16 gage wire Do not make end laps midway between supporting beams or directly over beams of continuous structures Offset end laps in adjacent widths to prevent continuous laps

E Provide sufficient numbers of supports of strength required to carry reinforcement Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support Do not use supports as bases for runways for concrete conveying equipment and similar construction loads

F Splices

1 Provide standard reinforcement splices by lapping ends placing bars in contact and tying tightly with wire Comply with requirements shown for minimum lap of spliced bars

G Mechanical Couplers in Lieu of Lap Splicing

1 Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices Bars shall be flame dried before butt splicing Adequate jigs and clamps or other devices shall be provided to support align and hold the longitudinal centerline of the bars to be butt spliced in a straight line

2 Mechanical coupler provided shall meet all the requirements of ACI 318 providing 125 percent of the specified minimum yield tensile strength of the spliced bars without requiring an increase in the bar size

3 03 INSPECTION OF REINFORCEMENT

A Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by CONTRACTING OFFICER All concrete placed in violation of this provision will be rejected

++ END OF SECTION ++

SECTION 03251
CONCRETE JOINTS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope
- 1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install concrete joints
- 2 The types of concrete joints required include the following
  - a Construction joints
  - b Expansion joints and fillers
  - c Control joints

B General All joints subject to hydrostatic pressure shall be provided with continuous waterstop

C Related Sections
- 1 Section 03100 Concrete Formwork
- 2 Section 07920 Calking and Sealants

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
- 1 ACI 301 Specifications for Structural Concrete for Buildings Chapter 6 Joints and Embedded Items
- 2 ASTM A 36 Standard Specification for Structural Steel
- 3 ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for concrete Paving and Structural Construction
- 4 CRD C572 Corps of Engineers Specifications for Polyvinyl Chloride Waterstop

B All manufactured items shall be installed in accordance with manufacturer s instructions

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
- 1 Manufacturer s specifications and installation instructions for all materials required
- 2 Layout of all construction joint locations prior to the submittal of steel reinforcing drawings
- 3 Adhesive waterstop

B Samples Submit for approval the following
- 1 Polyvinyl chloride waterstops for joints
- 2 Cork expansion joint fillers

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PART 2 PRODUCTS

2 01 WATERSTOPS

A Polyvinyl Chloride
- 1 Reference Standard CRD C572
- 2 Construction Joints Minimum of 3/8 inch thick
  - a Width shall be as shown or if not shown as recommended by the manufacturer
- 3 Expansion Joints Uniform minimum thickness of 1/4 inch by 9 inches minimum width Center bulb shall be O or U shaped The O shall have an outside diameter of 3/4 inch minimum The top of the U shall be jointed by a membrane which will tear when the expansion occurs
- 4 Manufacturer Provide polyvinyl chloride waterstops of one of the following
  - a W R Meadows Incorporated
  - b Tamms Industries
  - c Greenstreak
  - d Or equal

B Adhesive Waterstop
- 1 Provide preformed adhesive waterstop in construction joint locations as shown
- 2 The preformed waterstop shall meet or exceed all requirements of Federal Specifications SS S 210A Sealing Compounds for Expansion Joints

2 02 PREFORMED EXPANSION JOINT FILLER

A Provide preformed expansion joint filler complying with ASTM D 1752 Type II cork

2 03 CONCRETE CONSTRUCTION JOINT ROUGHENER

A Provide a water soluble non flammable surface retardant roughener

B Product and Manufacturer Provide one of the following
- 1 Rugasol S as manufactured by Sika Corporation for horizontal joints only
- 2 EAC S as manufactured by Preco Industries Ltd for horizontal joints only
- 3 Tuf Cote (Deep Etch) as manufactured by Preco Industries Ltd for vertical joints
- 4 Or equal

2 04 EPOXY BONDING AGENT

A Provide an epoxy resin bonding agent two component type

B Product and Manufacturer Provide one of the following
- 1 Sikadur 32 Hi Mod LPL as manufactured by Sika Corporation
- 2 Eucopoxy LPL as manufactured by the Euclid Chemical Company
- 3 Concresive Liquid LPL as manufactured by Master Builders Inc
- 4 Or equal

PART 3 EXECUTION

3 01 INSPECTION

A Contractor and his installer shall examine the substrate and the conditions under which Work is to be performed and notify CONTRACTING OFFICER in writing of unsatisfactory conditions Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 02 CONSTRUCTION JOINTS

A Comply with ACI 301 Chapter 6 and as specified below

B Locate and install construction joints as shown Additional construction joints shall be located as follows

1 In walls locate joints at a spacing of 40 feet maximum and approximately 12 feet from corners

2 In foundation slabs and slabs on grade locate joints at a spacing of approximately 40 feet Place concrete in a strip pattern

3 In mats and structural slabs and beams at a spacing of approximately 40 feet Locate joints in compliance with ACI 301 Chapter 6

4 Provide other additional construction joints as required to satisfactorily complete all work

C Horizontal Joints

1 Roughen concrete at the interface of construction joints by sandblasting to expose the aggregate and remove accumulated concrete on rebar immediately subsequent to form stripping unless otherwise approved by CONTRACTING OFFICER Immediately before placing fresh concrete thoroughly clean the existing contact surface using a stiff brush or other tools and a stream of water under pressure The surface shall be clean and wet but free from pools of water at the moment the fresh concrete is placed

2 Remove laitance waste mortar or other substance which may prevent complete adhesion

3 Place a 2 inch thick coat of mortar of similar proportions to the mortar in the concrete over the contact surface of the old concrete Place fresh concrete before the mortar has attained its initial set

D Vertical Joints

1 Apply roughener to the form in a thin even film by brush spray or roller in accordance with the manufacturer s instructions After roughener is dry concrete may be placed

2 When concrete has been placed and the form removed wash loosened material off with high pressure water spray to obtain roughened surface subject to approval by CONTRACTING OFFICER

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3 03 EXPANSION JOINTS

A Comply with ACI 301 Chapter 6 and as specified below

B Locate and install expansion joints as shown Install cork filler in accordance with manufacturer s instructions Calking and sealants shall be installed as specified in Section 07920

3 04 WATERSTOPS

A General
1 Comply with ACI 301 Chapter 6 and as specified below All joints shall be made in accordance with manufacturer s instructions
2 Obtain CONTRACTING OFFICER S approval for waterstop locations not shown
3 Provide waterstops in all foundations tanks and other substructures up to an elevation at least 12 inches above grade or to an elevation at least 12 inches above liquid level in tanks whichever is higher except where otherwise shown or noted

B Polyvinyl Chloride Waterstop
1 Tie waterstop to reinforcement so that it is securely and rigidly supported in the proper position during concrete placement Continuously inspect waterstops during concrete placement to insure their proper positioning
2 Waterstops shall be fused using equipment as supplied by or recommended by the manufacturer

3 05 BONDING WITH EPOXY ADHESIVE

A Use adhesive for the following
1 Bonding of fresh concrete to concrete cured at least 45 days or to existing concrete
2 Bonding of horizontal surfaces which will receive a topping

B Handle and store epoxy adhesive in compliance with the manufacturer s printed instructions including safety precautions

C Mix the epoxy adhesive in complete accordance with the instructions of the manufacturer

D Before placing fresh concrete thoroughly roughen and clean hardened concrete surfaces and coat with epoxy grout not less than 1/16 inch thick Place fresh concrete while the epoxy material is still tacky without removing the in place grout coat and as directed by the epoxy manufacturer

++ END OF SECTION ++

SECTION 03252
CONCRETE ANCHORS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope
1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install anchor bolts expansion anchors and concrete inserts

B This Section includes all bolts anchors and inserts required for the Work but not specified under other Sections

C The types of work using concrete anchors includes but is not limited to the following
1 Hangers and brackets
2 Equipment
3 Piping
4 Tanks
5 Grating and floor plate
6 Electrical Plumbing and HVAC Work
7 Partitions and ceilings

D Related Sections
1 Section 05504 Miscellaneous Metal Fabrications
2 Section 15094 Pipe Hangers Supports and Restraints

1 02 QUALITY ASSURANCE

A Reference Standards Comply with the applicable provisions and recommendations of the following except as otherwise shown and specified
1 ASTM A 123 Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
2 ASTM A 153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
3 ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs 60 000 psi Tensile Strength
4 ASTM A 320 Standard Specification for Alloys Steel Bolting Materials for Low Temperature Service
5 ASTM A 484 Standard Specification for General Requirements for Stainless and Heat Resisting Steel Bars Billets and Forgings
6 ASTM A 525 Standard Specification for General Requirements for Steel Sheet Zinc Coated (Galvanized) by the Hot Dip Process
7 ASTM A 536 Standard Specification for Ductile Iron Castings
8 ASTM A 570 Standard Specification for Steel Sheet and Strip Carbon Hot Rolled Structural Quality

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9 ASTM B 633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
10 Federal Specification FF S 325 for Concrete Expansion Anchors
11 Federal Specifications WW H 171E for Malleable Iron

B Expansion anchors and inserts shall be UL or FM approved

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Setting drawings and templates for location and installation of anchorage devices
2 Copies of manufacturer s specifications load tables dimension diagrams and installation instructions for the devices

B Samples Submit for approval the following
1 Representative samples of bolts anchors and inserts as may be requested by CONTRACTING OFFICER Review will be for type and finish only Compliance with all other requirements is exclusive responsibility of Contractor

PART 2 PRODUCTS

2 01 DESIGN CRITERIA

A When the size length or load carrying capacity of an anchor bolt expansion anchor or concrete insert is not shown provide the size length and capacity required to carry the design load times a minimum safety factor of four

B Determine design loads as follows
1 For equipment anchors use the design load recommended by the manufacturer and approved by CONTRACTING OFFICER
2 For pipe hangers and supports use one half the total weight of pipe fittings valves accessories and water contained in pipe between the hanger or support in question and adjacent hangers and supports on both sides
3 Allowances for vibration are included in the safety factor specified above
4 Anchors shall develop ultimate shear and pull out loads of not less than the following values in concrete

Bolt Diameter (Inches)	Min Shear (Pounds)	Min Pull Out Load (Pounds)
½	4 500	6 300
5/8	6 900	7 700
3/4	10 500	9 900

2 02 MATERIALS

A Anchor Bolts

1 Provide carbon steel bolts complying with ASTM A 307 non headed type unless otherwise indicated

2 In buried or submerged locations provide stainless steel bolts complete with nuts and washers complying with ASTM A 320 AISI Type 316 Other AISI types may be used subject to CONTRACTING OFFICER S approval

3 For equipment provide anchor bolts which meet the equipment manufacturer s recommendations for size material and strength

4 Provide anchor bolts as shown or as required to secure structural steel to concrete or masonry

5 Locate and accurately set the anchor bolts using templates or other devices as necessary

6 Protect threads and shank from damage during installation of equipment and structural steel

7 Comply with required embedment length and necessary anchor bolt projection

B Wedge Expansion Anchors

1 Provide stainless steel wedge expansion anchors nuts and washers complying with ASTM A 240 A 276 or F 594 and AISI Type 316

2 Product and Manufacturer Provide one of the following

a Kwik Bolt II as manufactured by Hilti Inc

b Trubolt Wedge as manufactured by ITW Ramset/Red Head Inc

c Kelistud as manufactured by Kelken Gold Inc

d Or equal

C Adhesive Anchors

1 Provide stainless steel anchors complying with ASTM A 320 AISI Type 316

2 Anchors shall be of the size required for the concrete strength specified

3 Anchors shall utilize epoxy resin or vinylester resin

a Provide system utilizing a screen tube with a cartridge dispenser which contains two parallel tubes of resin and hardener The installed system shall achieve minimum strength requirements recommended by the following manufacturer

1) HIT C 20 Adhesive Anchors as manufactured by Hilti Incorporated

2) Epcon System as manufactured by ITW Ramset/Red Head

3) Sika/FI System with Sikadur Injection Gel Epoxy

4) Masterbuilders Concresive Epoxy Cartridge Dispensing System and Concresive Paste LPL

5) Or equal

D Concrete Inserts

1 For piping grating floor plate and masonry lintels provide malleable iron inserts Comply with Federal Specification WW H171E (Type 18) Provide those recommended by the manufacturer for the required loading

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2 Finish shall be black
3 Product and Manufacturer Provide one of the following
   a Figure 282 as manufactured by ITT Grinnell
   b No 380 as manufactured by Hohmann and Barnard Incorporated
   c Figure 108 as manufactured by Carpenter and Patterson Incorporated
   d Or equal

E Powder actuated fasteners and other types of bolts and fasteners not specified herein shall not be used unless approved by CONTRACTING OFFICER

PART 3 EXECUTION

3 01 INSPECTION

A Contractor shall examine areas and conditions under which anchor bolts expansion anchors and concrete insert Work is to be installed and notify CONTRACTING OFFICER in writing of conditions detrimental to proper and timely completion of Work Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 02 INSTALLATION

A Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer s instructions

B Assure that embedded items are protected from damage and are not filled in with concrete

C Expansion anchors may be used for hanging or supporting pipe 2 inches diameter and smaller Expansion anchors shall not be used for larger pipe unless otherwise shown or approved by CONTRACTING OFFICER

D Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer

E Unless otherwise shown or approved by CONTRACTING OFFICER conform to following for expansion anchors
1 Minimum embedment depth in concrete 5 diameters
2 Minimum anchor spacing on centers 10 diameters
3 Minimum distance to edge of concrete 5 diameters
4 Increase dimensions above if required to develop the required anchor load capacity

F For the adhesive anchors and adhesive material Contractor shall comply with the manufacturer s installation instructions on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar Contractor shall properly clean out the hole utilizing a wire brush and compressed air to remove all loose material from the hole prior to installing adhesive capsules or material

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G Adhesive anchor manufacturer s representative shall observe and demonstrate the proper installation procedures for the adhesive anchors and adhesive material at no additional expense to CONTRACTING OFFICER Each installer shall be certified in writing by the manufacturer to be qualified to install the adhesive anchors

3 03 CLEANING

A After embedding concrete is placed remove protection and clean bolts and inserts

3 04 FIELD QUALITY CONTROL

A Contractor shall employ a testing laboratory to perform field quality testing of installed anchors CONTRACTING OFFICER is to determine the level of testing which is required for the various types of expansion anchors and bolts A minimum of ten percent of the adhesive anchors and reinforcing bars are to be tested to fifty percent of the ultimate tensile capacity of the anchor or reinforcing bar

B If failure of any of the adhesive anchors or reinforcing bars occur Contractor will be required to pay for the costs involved in testing the remaining ninety percent

C Contractor shall correct improper workmanship remove and replace or correct as instructed all anchors or bars found unacceptable or deficient

D Contractor shall pay for all corrections and subsequent tests required to confirm the integrity of the anchor or bar

E The independent testing and inspection agency shall complete a report on each area The report should summarize the observations made by the inspector and be submitted to CONTRACTING OFFICER

F Provide access for the testing agency to places where work is being produced so that required inspection and testing can be accomplished

++ END OF SECTION ++

SECTION 03300

CAST IN PLACE CONCRETE

PART 1 GENERAL

1 01 REFERENCES

The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211 1	1989 Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
ACI 301	1989 Structural Concrete for Buildings
ACI 302 1R	1989 Concrete Floor and Slab Construction
ACI 304R	1989 Measuring Mixing Transporting and Placing Concrete
ACI 304 2R	1991 Placing Concrete by Pumping Methods
ACI 305R	1991 Hot Weather Concreting
ACI 306 1	1990 Cold Weather Concreting
ACI 315	1980 (R 1986) Details and Detailing of Concrete Reinforcement
ACI 318	1989 (R 1992) Building Code Requirements for Reinforced Concrete
ACI 347R	1989 Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	1990 (Rev A) Steel Wire Plain for Concrete Reinforcement
ASTM A 123	1989 (Rev A) Zinc (HotDip Galvanized) Coatings on Iron and Steel Products
ASTM A 185	1990 (Rev A) Steel Welded Wire Fabric

	Plain for Concrete Reinforcement
ASTM A 496	1990 (Rev A) Steel Wire Deformed, for Concrete Reinforcement
ASTM A 497	1990 (Rev B) Steel Welded Wire Fabric Deformed for Concrete Reinforcement
ASTM A 615/A 615M	1992 (Rev A) Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM C 31	1991 Making and Curing Concrete Test Specimens in the Field
ASTM C 33	1992 Concrete Aggregates
ASTM C 39	1986 Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	1990 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	1992 Ready Mixed Concrete
ASTM C 143	1990 (Rev A) Slump of Hydraulic Cement Concrete
ASTM C 150	1992 Portland Cement
ASTM C 171	1992 Sheet Materials for Curing Concrete
ASTM C 172	1990 Sampling Freshly Mixed Concrete
ASTM C 173	1978 Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	1991 (Rev B) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	1986 Air Entraining Admixtures for Concrete
ASTM C 309	1991 Liquid Membrane Forming Compounds for Curing Concrete

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ASTM C 494	1992 Chemical Admixtures for Concrete
ASTM C 567	1991 Unit Weight of Structural Concrete
ASTM C 881	1990 Epoxy Resin Base Bonding Systems for Concrete
ASTM C 920	1987 Elastomeric Joint Sealants
ASTM D 1752	1984 (R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 4397	1991 Polyethylene Sheeting for Construction Industrial and Agricultural Applications

AMERICAN WELDING SOCIETY INC (AWS)

AWS D1 4	1992 Structural Welding Code Reinforcing Steel

CORPS OF ENGINEERS (COE)

COE CRDC572	1974 Polyvinylchloride Waterstop

FEDERAL SPECIFICATIONS (FS)

FS SSS200	(Rev E) (Am 1) Sealants Joint Two Component Jet Blast Resistant Cold Applied For Portland Cement Concrete Pavement

U S DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS1	1983 Construction and Industrial Plywood

1 02 DEFINITIONS

A Cementitious material as used herein shall include all portland cement, pozzolan, fly ash, ground iron blast furnace slag and silica fume

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B Exposed to public view' means situated so that it can be seen from eye level from a public location after completion of the building A public location is accessible to persons not responsible for operation or maintenance of the building

1 03 SUBMITTALS

Bidder to submit the following

A Manufacturer s Catalog Data (4 copies each with quote)

1 Waterstops

2 Materials for curing concrete

3 Joint sealants

4 Joint filler

5 Vapor barrier

B Drawings (4 copies each 3 weeks after order)

1 Reinforcing steel

Reproductions of contract drawings are unacceptable

a Reinforcing Steel

ACI 315 Indicate bending diagrams assembly diagrams splicing and laps of bars shapes dimensions and details of bar reinforcing accessories and concrete cover Do not scale dimensions from structural drawings to determine lengths of reinforcing bars

C Design Data (4 copies each)

1 Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete Submit a complete list of materials including type brand source and amount of cement, silica fume and admixtures and applicable reference specifications Submit additional data regarding concrete aggregates if the source of aggregate changes Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted Obtain acknowledgement of receipt prior to concrete placement

D Test Reports (4 copies each 3 weeks after order)

1 Concrete Mix Design

Submit copies of test report showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions Test reports shall be submitted along with the concrete mix design Obtain approval before concrete placement

1 04 DELIVERY STORAGE AND HANDLING

Do not deliver concrete until vapor barrier forms reinforcement embedded items and chamfer strips are in place and ready for concrete placement ACI 301 for job site storage of materials Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting Protect materials from contaminants such as grease oil and dirt Ensure materials can be accurately identified after bundles are broken and tags removed

PART 2 – PRODUCTS

2 01 CONCRETE

A Contractor Furnished Mix Design

ACI 211 1 ACI 301 and ACI 318 [and ACI 211 2] [ACI 304 2R] [and] [ACI 213R] except as otherwise specified The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated as specified below

Location	f'c (Min 28 day comp strength) (psi)	ASTM C 33 Aggregate (Size No)	Range of Slump (inches)	Water/ Cement Ratio (by weight)	Air Entr (percent)
Concrete exposed to weather	4000	57	1 4	0 50	6%
All other areas	4000	57	1 3	0 35	6%

Maximum slump shown above may be increased one inch for methods of consolidation other than vibration Provide air entrainment using air entraining admixture

1 Required Average Strength of Mix Design

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The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301 When a concrete production facility has a record of at least 15 consecutive tests the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301 When a concrete production facility does not have a suitable record of tests to establish a standard deviation the required average strength shall be as follows

a For f'c less than 3000 psi 1000 psi plus f'c

b For f'c between 3000 and 5000 psi 1200 psi plus f'c

c For f'c over 5000 psi 1400 psi plus f'c

2 02 MATERIALS

A Cement

ASTM C 150 Type I blended cement

B Water

Water shall be fresh clean and potable

C Aggregates

ASTM C 33 except as modified herein Furnish aggregates for exposed concrete surfaces from one source Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement

D Nonshrink Grout

ASTM C 1107

E Admixtures

1 Air Entraining

ASTM C 260

2 Accelerating

ASTM C 494 Type C

3 Retarding

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ASTM C 494 Type B D or G

4 Water Reducing

ASTM C 494 Type A E or F

5 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494 Type F and ASTM C 1017

F Materials for Forms

Provide wood plywood or steel Use plywood or steel forms where a smooth form finish is required Lumber shall be square edged or tongue and groove boards free of raised grain knotholes or other surface defects Plywood PS1 BB concrete form panels or better Steel form surfaces shall not contain irregularities dents or sags

1 Form Ties and Accessories

The use of wire alone is prohibited Form ties and accessories shall not reduce the effective cover of the reinforcement

G Reinforcement

1 Reinforcing Bars

ACI 301 unless otherwise specified ASTM A 615/A with the bars marked A Grade 60

2 Welded Wire Fabric

ASTM A 185 Provide flat sheets of welded wire fabric for slabs and toppings where called for on drawings

3 Wire

ASTM A 82 or ASTM A 496

H Vapor Barrier

ASTM D 4397 polyethylene sheeting minimum 6 mil thickness

1 Waterproof Paper

Kraft paper glass reinforming fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UUB790 Type I Grade A Style 4 or waterproof paper regular conforming to ASTM C 171 consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 1 1/4 inch apart

2 Polyethylene Sheeting

ASTM D 4397 minimum 6 mil thickness

I Polyvinyl Chloride Waterstops

COE CRDC 572

J Materials for Curing Concrete

1 Impervious Sheeting

ASTM C 171 waterproof paper clear or white polyethylene sheeting or polyethylene coated burlap

2 Pervious Sheeting

AASHTO M182

3 Liquid Membrane Forming Compound

ASTM C 309 white pigmented Type 2 Class B

K Liquid Chemical Sealer Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete Do not use on exterior slabs exposed to freezing conditions Compound shall not reduce the adhesion of resilient flooring tile paint, roofing waterproofing or other material applied to concrete

L Expansion/Contraction Joint Filler

ASTM D 1751 or ASTM D 1752 1/2 inch thick, unless otherwise indicated

M Joint Sealants

1 Horizontal Surfaces 3 Percent Slope Maximum

ASTM C 920 Type M Class 25

2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920 Type M Grade NS Class 25

N Epoxy Bonding Compound

ASTM C 881 Provide Type I for bonding hardened concrete to hardened concrete Type II for bonding freshly mixed concrete to hardened concrete and Type III as a binder in epoxy mortar or concrete or for use in bonding skid resistant materials to hardened concrete Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces Provide Class A if placement temperature is below 40 degrees F Class B if placement temperature is between 40 and 60 degrees F or Class C if placement temperature is above 60 degrees F

O Dovetail Anchor Slot

Preformed metal slot approximately one inch by one inch of not less than 22 gauge galvanized steel cast in concrete Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material

PART 3 EXECUTION

3 01 FORMS

ACI 301 Provide forms shoring and scaffolding for concrete placement unless indicated or specified otherwise Concrete for footings may be placed in excavations without forms upon inspection and approval by the NTR Contracting Officer Excavation width shall be a minimum of 4 inches greater than indicated Set forms mortar tight and true to line and grade Chamfer above grade exposed joints edges and external corners of concrete 0 75 inch unless otherwise indicated Provide formwork with cleanout openings to permit inspection and removal of debris Forms submerged in water shall be watertight

A Coating

Before concrete placement coat the contact surfaces of forms with a nonstaining mineral oil nonstaining form coating compound, or two coats of nitrocellulose lacquer Do not use mineral oil on forms for surfaces to which adhesive paint, or other finish material is to be applied

B Removal of Forms and Supports

After placing concrete forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal

1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength

C Reshoring

Reshore concrete elements where forms are removed prior to the specified time period Do not permit elements to deflect or accept loads during form stripping or reshoring Forms on columns walls or other load bearing members may be stripped after 2 days if loads are not applied to the members After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with paragraph entitled Removal of Forms Perform reshoring operations to prevent subjecting concrete members to overloads eccentric loading or reverse bending Reshoring elements shall have the same load carrying capabilities as original shoring and shall be spaced similar to original shoring Firmly secure and brace reshoring elements to provide solid bearing and support

3 02 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301 Provide bars wire fabric wire ties supports and other devices necessary to install and secure reinforcement Reinforcement shall not contain rust scale oil grease clay or foreign substances that would reduce the bond Rusting of reinforcement is a basis of rejection if the effective cross sectional area or the nominal weight per foot of the reinforcement has been reduced to less than that specified in paragraph entitled Reinforcing Bars Remove loose rust prior to placing steel Tack welding is prohibited

A Vapor Barrier

Provide beneath the ongrade concrete floor slab Use the greatest widths and lengths practicable to eliminate joints wherever possible Lap joints a minimum of 12 inches [and tape or cement joints] Remove torn punctured or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete Concrete placement shall not damage vapor barrier material Place a 2 inch layer of clean concrete sand on vapor barrier before placing concrete

B Tolerances

Place reinforcement and secure with galvanized or noncorrodible chairs spacers or metal hangers Use concrete or other noncorrodible material for supporting reinforcement on the ground

C Splicing

ORIGINAL 4-01

As indicated For splices not indicated ACI 301 Do not splice at points of maximum stress Overlap welded wire fabric the spacing of the cross wires plus 2 inches

D Future Bonding

Plug exposed threaded mechanical reinforcement bar connectors with a greased bolt Bolt threads shall match the connector Countersink the connector in the concrete Caulk the depression after the bolt is installed

E Cover

ACI 301 for minimum coverage unless otherwise indicated

F Construction Joints

Locate joints to least impair strength Continue reinforcement across joints unless otherwise indicated

G Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces and as indicated Make expansion joints 1/2 inch wide unless indicated otherwise Fill expansion joints not exposed to weather with preformed joint filler material Completely fill joints exposed to weather with joint filler material and joint sealant Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used Provide contraction joints either formed or saw cut or cut with a jointing tool to the indicated depth after the surface has been finished Sawed joints shall be completed within 4 to 12 hours after concrete placement Protect joints from intrusion of foreign matter

H Waterstop Splices

Fusion weld in the field

3 03 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94 ACI 301 ACI 302 1R, and ACI 304R, except as modified herein Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances 1 percent for cement and water 2 percent for aggregate and 3 percent for admixtures Furnish mandatory batch ticket information for each load of ready mix concrete

A Measuring

Make measurements at intervals as specified in paragraphs entitled 'Sampling and Testing

B Mixing

ASTM C 94 and ACI 301 Machine mix concrete Begin mixing within 30 minutes after the cement has been added to the aggregates Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows if set retarding admixture is used and slump requirements can met limit for placing concrete may remain at 90 minutes Additional water may be added provided that both the specified maximum slump and water cement ratio are not exceeded When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required If the entrained air content falls below the specified limit add a sufficient quantity of admixture to bring the entrained air content within the specified limits Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch

C Transporting

Transport concrete from the mixer to the forms as rapidly as practicable Prevent segregation or loss of ingredients Clean transporting equipment thoroughly before each batch Do not use aluminum pipe or chutes Remove concrete which has segregated in transporting and dispose of as directed

3 04 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved Do not place concrete when weather conditions prevent proper placement and consolidation in uncovered areas during periods of precipitation or in standing water Prior to placing concrete remove dirt construction debris water snow and ice from within the forms Deposit concrete as close as practicable to the final position in the forms Do not exceed a free vertical drop of 3 feet from the point of discharge Place concrete in one continuous operation from one end of the structure towards the other Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs

A *Vibration*

ACI 301 Furnish a spare vibrator on the job site whenever concrete is placed Consolidate concrete slabs greater than 4 inches in depth with high frequency internal mechanical vibrating equipment supplemented by hand spading and tamping Consolidate concrete slabs 4 inches or less in depth by wood tampers spading and settling with a heavy leveling straightedge Operate vibrators with vibratory element submerged in the concrete with a minimum frequency of not less than 6000 impulses per minute when submerged Do not use vibrators to transport the concrete in the forms Insert and withdraw vibrators approximately 18 inches apart Penetrate the

reviously placed lift with the vibrator when more than one lift is required Place concrete in 18 inch maximum vertical lifts External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete

B Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry clean surfaces Scrub compound into the surface with a stiff bristle brush Place concrete while compound is stringy Do not permit compound to harden prior to concrete placement Follow manufacturer s instructions regarding safety and health precautions when working with epoxy resins

C Cold Weather

ACI 306 1 Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing Limit the rate of cooling to 5 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application

D Hot Weather

ACI 305R Maintain required concrete temperature using Figure 2 1 5 in ACI 305R to prevent the evaporation rate from exceeding 0 2 pound of water per square foot of exposed concrete per hour Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete Shade the fresh concrete as soon as possible after placing Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage Provide water hoses pipes spraying equipment and water hauling equipment where job site is remote to water source to maintain a moist concrete surface throughout the curing period Provide burlap cover or other suitable permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets For vertical surfaces protect forms from direct sunlight and add water to top of structure once concrete is set

3 5 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

A Defects

Repair formed surfaces by removing minor honeycombs pits greater than 1 square inch surface area or 0 25 inch maximum depth or otherwise defective areas Provide edges perpendicular to the surface and patch with nonshrink grout Patch tie holes and defects when the forms are removed Concrete with extensive honeycomb including

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exposed steel reinforcement cold joints entrapped debris separated aggregate or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved Obtain approval of corrective action prior to repair The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified

B Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces Finish shall match adjacent finishes

C Formed Surfaces

1 As Cast Rough Form for Surfaces Not Exposed to Public View

Remove fins and other projections exceeding 0 25 inch in height level abrupt irregularities

2 As Cast Smooth Form for Surfaces Exposed to Public View

Form facing material shall produce a smooth hard uniform texture on the concrete Remove fins and other projections

3 06 FLOOR, SLAB AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302 1R, unless otherwise specified Slope floors uniformly to drains where drains are provided Minimum thickness of slabs high point and low point elevations and floor drains are shown on drawings Depress the concrete base slab where quarry tile ceramic tile are indicated Where straightedge measurements are specified Contractor shall provide straightedge

A Finish

Place consolidate and immediately strike off concrete to obtain proper contour grade and elevation before bleed water appears Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment If bleed water is present prior to floating the surface drag the excess water off or remove by absorption with porous materials Do not use dry cement to absorb bleed water

1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications After the concrete has been placed consolidated struck off and leveled to a

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Class C tolerance as defined below the surface shall be roughened with stiff brushes of rakes before final set

2 Floated

Use for exterior slabs where not otherwise specified After the concrete has been placed consolidated struck off and leveled, do not work the concrete further until ready for floating Whether floating with a wood, magnesium, or composite hand float with a bladed power trowel equipped with float shoes or with a powered disc float shall begin when the surface has stiffened sufficiently to permit the operation During or after the first floating surface shall be checked with a 10foot straightedge applied at no less than two different angles one of which is perpendicular to the direction of strike off High spots shall be cut down and low spots filled during this procedure to produce a surface level within 1/4 inch in 10 feet

3 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings First provide a floated finish The finish shall next be power troweled two three times and finally hand troweled The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks Additional trowelings shall be done by hand after the surface has hardened sufficiently The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface The surface shall be thoroughly consolidated by the hand troweling operations The finished surface shall be essentially free of trowel marks and uniform in texture and appearance The finished surface shall produce a surface level [to within 1/4 inch in 10 feet

4 Nonslip Finish

Use on surfaces of exterior platforms steps and landings and on exterior and interior pedestrian ramps Apply dry shake aggregate of ceramically bonded aluminum oxide to the surface at a minimum rate of 25 pounds per 100 square feet Blend approximately two thirds of the aggregate with Portland cement as recommended by the manufacturer and apply to the surface evenly and without segregation After blended material has been embedded by floating apply the remainder of the blended material to the surface at right angles to the previous application Apply blended material heavier in any areas not sufficiently covered by the first application Perform a second floating immediately following the first After the selected material has been embedded by the two floatings complete the operation with a broomed finish

5 Broomed

Use on surfaces of exterior walks platforms patios and ramps unless otherwise indicated Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture Permit surface to harden sufficiently to retain the scoring or ridges Broom transverse to traffic or at right angles to the slope of the slab

6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion Maintain a slight surplus of concrete ahead of the template After screeding float the concrete longitudinally Use a straightedge to check slope and flatness correct and refloat as necessary Obtain final finish by belting Lay belt flat on the concrete surface and advance with a sawing motion continue until a uniform but gritty nonslip surface is obtained a burlap drag Drag a strip of clean wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab Produce a fine granular sandy textured surface without disfiguring marks Round edges and joints with an edger having a radius of 1/8 inch

C Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys

D Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated Perform pavement finish

E Splash Blocks

Provide at outlets of downspouts emptying at grade Splash blocks may be precast concrete and shall be 24 inches long 12 inches wide and 4 inches thick, unless otherwise indicated with smooth finished countersunk dishes sloped to drain away from the building

3 07 CURING AND PROTECTION

ACI 301 unless otherwise specified Begin curing immediately following form removal Protect concrete from injurious action by sun rain, flowing water frost, mechanical injury tire marks and oil stains Do not allow concrete to dry out from time of placement until the expiration of the specified curing period Do not use membrane forming compound on surfaces where appearance would be objectionable on any surface to be painted, where coverings are to be bonded to the concrete or on concrete to which other concrete is to be bonded If forms are

removed prior to the expiration of the curing period provide another curing procedure specified herein for the remaining portion of the curing period Provide moist curing for those areas receiving liquid chemical sealer hardener or epoxy coating

A Moist Curing

Remove water without erosion or damage to the structure

1 Ponding or Immersion

Continually immerse the concrete throughout the curing period Water shall not be more than 20 degrees F less than the temperature of the concrete For temperatures between 40 and 50 degrees F increase the curing period by 50 percent

2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period For temperatures between 40 and 50 degrees F increase the curing period by 50 percent

3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting Overlap sheeting 6 inches over adjacent sheeting Sheeting shall be at least as long as the width of the surface to be cured During application, do not drag the sheeting over the finished concrete nor over sheeting already placed Wet sheeting thoroughly and keep continuously wet throughout the curing period

4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum Provide sheeting not less than 18 inches wider than the concrete surface to be cured Secure edges and transverse laps to form closed joints Repair torn or damaged sheeting or provide new sheeting Cover or wrap columns walls and other vertical structural elements from the top down with impervious sheeting overlap and continuously tape sheeting joints and introduce sufficient water to soak the entire surface prior to completely enclosing

B Liquid Membrane Forming Curing Compound

Seal or cover joint openings prior to application of curing compound Prevent curing compound from entering the joint Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface Provide and maintain compound on the concrete surface throughout the curing period Do not use this method of curing where the use of Figure 2 1 5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0 2 pound of water per square foot per hour

1 Application

Unless the manufacturer recommends otherwise apply compound immediately after the surface loses its water sheen and has a dull appearance and before joints are sawed Mechanically agitate curing compound thoroughly during use Use approved power spraying equipment to uniformly apply two coats of compound in a continuous operation The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions The compound shall form a uniform continuous coherent film that will not check, crack or peel Immediately apply an additional coat of compound to areas where the film is defective Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application

2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application Maintain continuity of the coating for the entire curing period and immediately repair any damage

C Liquid Chemical Sealer Hardener

Apply sealer hardener to interior floors not receiving floor covering and floors located under access flooring Apply the sealer hardener in accordance with manufacturer s recommendations Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer The sealer hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days Apply a minimum of two coats of sealer hardener

D Curing Periods

ACI 301 except 10 days for retaining walls pavement or chimneys 21 days for concrete that will be in full time or intermittent contact with seawater salt spray alkali soil or waters Begin curing immediately after placement Protect concrete from premature drying excessively hot temperatures and mechanical injury and maintain minimal moisture loss at a relatively constant temperature for the period necessary for

hydration of the cement and hardening of the concrete The materials and methods of curing shall be subject to approval by the CONTRACTING OFFICER.

3 08 FIELD QUALITY CONTROL

A Sampling

ASTM C 172 Collect samples of fresh concrete to perform tests specified ASTM C 31 for making test specimens

B Testing

1 Slump Tests

ASTM C 143 Take concrete samples during concrete placement The maximum slump may be increased as specified with the addition of an approved admixture provided that the water cement ratio is not exceeded Perform tests at commencement of concrete placement when test cylinders are made and for each batch (minimum) or every 10 cubic yards (maximum) of concrete

2 Temperature Tests

Test the concrete delivered and the concrete in the forms Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 10 cubic yards (maximum) of concrete until the specified temperature is obtained and whenever test cylinders and slump tests are made

3 Compressive Strength Tests

ASTM C 39 Make five test cylinders for each set of tests in accordance with ASTM C 31 Precautions shall be taken to prevent evaporation and loss of water from the specimen Test two cylinders at 7 days two cylinders at 28 days and hold one cylinder in reserve Samples for strength tests of each concrete placed each day shall be taken not less than once a day nor less than once for each 100 cubic yards of concrete nor less than once for each 5000 square feet of surface area for slabs or walls For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 500 psi take a minimum of three ASTM C 42 core samples from the inplace work represented by the low test cylinder results and test Concrete represented by core test shall be considered structurally

adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c Locations represented by erratic core strengths shall be retested Remove concrete not meeting strength criteria and provide new acceptable concrete Repair core holes with nonshrink grout Match color and finish of adjacent concrete

4 Air Content

ASTM C 173 or ASTM C 231 for normal weight concrete Test air entrained concrete for air content at the same frequency as specified for slump tests

END OF SECTION

SECTION 03600
GROUT

PART 1 GENERAL

1 01 DESCRIPTION

A Scope
- 1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install grout
- 2 Grout shall be placed at the following locations
  - a Column and beam bearing
  - b Equipment bases
  - c Handrails and railings
  - d Construction joints
- 3 The types of grout include the following
  - a Non shrink epoxy type
  - b Non shrink non metallic type
  - c Ordinary cement sand

B Class of ordinary Cement Type Grout
- 1 Class A ordinary cement type grout shall have a compression strength of 4000 PSI and include the following
  - a Foundation grout
  - b Construction joint grout
- 2 Class B ordinary cement type grout shall have a compression strength of 3000 PSI and include the following
  - a Bonded topping grout for concrete tank
  - b Masonry lintels bond beams and pilasters grout fill

C Related Sections
- 1 Section 03251 Concrete Joints
- 2 Section 03300 Cast In Place Concrete
- 3 Section 04100 Mortar (grout for masonry work)

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
- 1 ASTM C 144 Standard Specification for Aggregate for Masonry Mortar
- 2 ASTM C 150 Standard Specification for Portland Cement
- 3 ASTM C 109 Standard Test Method for Compiessive Strength of Hydraulic Cement Mortars (using 2 in or 50 mm Cube Specimens)
- 4 CRD C 619 Specification for Grout Fluidifier
- 5 CRD C 621 Specification for Non Shrink Grout

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1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s specifications and installation instructions for all proprietary materials
2 For ordinary cement grout copies of grout design mix and laboratory test reports for grout strength tests

B Reports and Certificates
1 For proprietary materials submit copies of reports on quality control tests
2 Submit certification that materials meet specification requirements for nonproprietary materials

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

A Delivery of Materials Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer s labels

B Storage of Materials Grout materials shall be stored in a dry shelter and shall be protected from moisture

PART 2 PRODUCTS

2 01 MATERIALS

A Nonmetallic 100 percent solids high strength epoxy grout
1 Use prepackaged solvent free moisture insensitive high strength epoxy grout
2 Product and Manufacturer Provide one of the following
a Euco High Strength Grout as manufactured by The Euclid Chemical Company
b Sikadur 42 Grout Pak as manufactured by Sika Corporation
c Five Star Epoxy Grout by Five Star Products Incorporated
d Or approved equal

B Nonshrink Nonmetallic Grout
1 Prepackaged non staining cementious grout which shall meet the minimum requirements of CRD C 621 and requiring only the addition of water at the jobsite
2 Product and Manufacturer Provide one of the following
a Euco N S as manufactured by The Euclid Chemical Company
b Masterflow 928 as manufactured by Master Builders Incorporated
c Sika Grout 212 as manufactured by Sika Corporation
d Or approved equal

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C Ordinary Cement Sand Grout Prepare design mixes of ordinary cement grout Mixes subject to the following limitations

1 Cement

a Portland cement ASTM C150 Type II or blended hydraulic cement ASTM C595 Type IP

2 Aggregates ASTM C33 and as herein specified

a Do not use aggregates containing soluble salts or other substances such as iron sulfides pyrite marcasite ochre or other materials that can cause stains on exposed concrete surfaces

b Fine Aggregate Clean sharp natural sand free from loam clay lumps or other deleterious substances

1) Dune sand bank run sand and manufactured sand are not acceptable

c Coarse Aggregate Clean uncoated processed aggregate containing no clay mud loam or foreign matter as follows

1) Crushed stone processed from natural rock or stone

2) Washed gravel either natural or crushed Use of slag and pit or bank run gravel is not permitted

3) Coarse Aggregate Size Size to be ASTM C33 No 7 for Class B grout Coarse aggregate <u>not</u> permitted in Class A grout

3 Admixtures Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer s printed instruction Do not use admixtures which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by CONTRACTING OFFICER Refer to Section 03300 for additional admixtures requirements

4 Proportioning and Design of Mixes Prepare design mixes for each class of grout Mixes subject to the following limitations

a Class A Grout

1) Specified 28 day Compressive Strength 4 000 psi

2) Maximum Water Cement Ratio by Weight 0 45

3) Fine Aggregate meeting ASTM C33

4) Air Content Percentage 9+1%

5) Minimum Cement Content in Pounds per Cubic Yard 658

b Class B Grout

1) Specified 28 day Compressive Strength 3 000 psi

2) Maximum Water Cement Ratio by Weight 0 50

3) Fine and Coarse Aggregate (No 7) meeting ASTM C33

4) Air Content Percentage 7+1%

5) Minimum Cement Content in Pounds per Cubic Yard 611

5 Use an independent testing company acceptable to CONTRACTING OFFICER for preparing and reporting proposed mix designs

a The testing company shall not be the same as used for field quality control testing unless approved by CONTRACTING OFFICER

6 Proportion mixes by either laboratory trial batch or field experience methods using materials to be employed on the Project for grout required Comply with ACI211 1 and report CONTRACTING OFFICER the following data

a Complete identification of aggregate source of supply

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b Tests of aggregates for compliance with specified requirements
c Scale weight of each aggregate
d Absorbed water in each aggregate
e Brand type and composition of cement
f Brand type and amount of each admixture
g Amounts of water used in trial mixes
h Proportions of each material per cubic yard
i Gross weight and yield per cubic yard of trial mixtures
j Measured slump
k Measured air content
l Compressive strength developed at 7 days and 28 days from not less than 3 test specimens cast for each 7 day and 28 day test and for each design mix

7 Submit written reports to CONTRACTING OFFICER of proposed mix of grout at least 30 days prior to start of Work Do not begin grout production until mixes have been approved by CONTRACTING OFFICER

8 Laboratory Trial Batches When laboratory trial batches are used to select grout proportions prepare test specimens and conduct strength tests as specified in ACI 301 Chapter 3 Proportioning However 4 000 psi mixes need not be designed for greater than 4 600 psi and 3 000 psi mixes need not be designed for greater than 3 400 psi regardless of the production facilities standard deviation

9 Field Experience Method When field experience methods are used to select grout proportions establish proportions as specified in ACI 301 Chapter 3

10 Admixtures Use air entraining admixture in all grout Provide not less than 4 1/2 percent nor more than 7 1/2 percent entrained air Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing Adjust quantities and types of admixtures as required to maintain quality control Do not use admixtures which have not been incorporated and tested in the accepted design mix unless otherwise authorized in writing by CONTRACTING OFFICER

11 Slump Limits Proportion and design mixes to result in grout slump at the point of placement of not more than 5 inches

D Water

1 Use clean fresh potable water free from injurious amounts of oils acids alkalies or organic matter

PART 3 EXECUTION

3 01 INSPECTION

A Contractor and his installer shall examine the substrate and conditions under which grout is to be placed and notify CONTRACTING OFFICER in writing of unsatisfactory conditions Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

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3 02 INSTALLATION

A General

1 Place grout as shown and in accordance with manufacturer s instructions If manufacturer s instructions conflict with the Specifications do not proceed until CONTRACTING OFFICER provides clarification

2 Drypacking will not be permitted

3 Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified full time employee to aid in assuring proper use of the product under job conditions

B Columns Beams and Equipment Bases

1 After shimming equipment to proper grade securely tighten anchor bolts Properly form around the base plates allowing sufficient room around the edges for placing the grout Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the epoxy grout

2 After shimming columns beams and equipment to proper grade securely tighten anchor bolts Properly form around the base plates allowing sufficient room around the edges for placing the grout Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the non shrink non metallic grout

C Handrails and Railings

1 After posts have been properly inserted into the holes or sleeves fill the annular space between posts and sleeve with the non shrink non metallic grout Bevel grout at juncture with post so that moisture flows away from post

D Construction Joints

1 Place a 2 inch thick coat of ordinary cement grout over the contact surface of the old concrete at the interface of horizontal construction joints as outlined in Section 03251

E Grout Fill Around Reinforcement in Masonry Work

1 Provide ordinary Class B cement grout for grout fill in masonry lintels bond beams and pilasters Site mixing of grout is acceptable Use of water reducing admixture not required

++ END OF SECTION ++

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DIVISION 5

METALS

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1 1 DESCRIPTION

A Scope
- 1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install structural steel including surface preparation and shop priming
- 2 Structural steel is that work defined in AISC Code of Standard Practice Section 2 and as shown The work also includes
  - a Providing openings in and attachments to structural steel to accommodate the Work under this and other Sections and providing for the structural steel all items such as anchor bolts studs and all items required for which provision is not specifically included under other Sections

B Coordination Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the structural steel

C Related Sections
- 1 Section 03252 Concrete Anchors
- 2 Section 03600 Grout
- 3 Section 05504 Miscellaneous Metal Fabrication
- 4 Section 09900 Painting (surface preparation and shop priming is under Section 09900)

1 2 QUALITY ASSURANCE

A Reference Standards and Codes Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
- 1 ASTM A 36 Standard Specification for Structural Steel
- 2 ASTM A 108 Standard Specification for Steel Bars Carbon Cold finished Standard Quality
- 3 ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs 60 000 psi Tensile Strength
- 4 ASTM A 325 Standard Specification for High Strength Bolts for Structural Steel Joints
- 5 ASTM A 490 Standard Specification for Heat Treated Steel Structural Bolts 150 ksi Tensile Strength
- 6 AWS American Welding Society D1 1 Structural Welding Code
- 7 AREA Manual of Railway Engineering
- 8 AISC Manual of Steel Construction
- 9 AISC Code of Standard Practice for Steel Buildings and Bridges
- 10 AISC Specifications for Structural Steel Buildings including the Commentary and Supplements thereto as issued

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11 AISC Specifications for Structural Joints using ASTM A 325 or A 490 Bolts approved by the Research Council on Structural Connections (RCSC) of the Engineering Foundation

B Design of Members and Connections

1 All details shown are typical similar details apply to similar conditions unless otherwise shown or specified Verify dimensions at the site without causing delay in the Work

2 CONTRACTOR shall examine conditions under which structural steel is to be provided and notify CONTRACTING OFFICER in writing of unsatisfactory conditions existing or whenever design of members and connections may not be clearly indicated Do not proceed with the Work until unsatisfactory conditions or deficiencies have been corrected in a manner acceptable to CONTRACTING OFFICER

C Source Quality Control

1 Materials and fabrication procedures shall be subject to inspection and tests in the mill shop and field conducted by a qualified inspection agency Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements

2 Fabrication shall be performed by a structural steel fabricating plant possessing a current certificate from AISC stating that the plant satisfies the requirements for certification for Category II of the AISC Quality Certification Program The plant shall maintain this certification for the entire time fabrication for this project is being performed

D Qualifications for Welding Work

1 Qualify welding processes and welding operators in accordance with AWS Structural Welding Code D1 1 Section 5 Qualification

2 Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months CONTRACTOR shall ensure that all certifications are kept current

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Complete details and schedules for fabrication and shop assembly of members and details schedules procedures and diagrams showing the sequence of erection

a Include details of cuts connections camber holes and other pertinent data Indicate welds by standard AWS symbols and show size length and type of each weld

b Provide setting drawings templates and directions for the installation of anchor bolts and other anchorages

2 Copies of manufacturer s specifications and installation instructions for products listed below Include laboratory test reports and other data as required to show compliance with these specifications

a Structural steel of each type including certified copies of mill reports covering the chemical and physical properties
b High strength bolts of each type including nuts and washers
c Unfinished bolts and nuts
d Touch up field primer paint in accordance with Section 09900

1 4 PRODUCT DELIVERY, STORAGE AND HANDLING

A Deliver materials to the site at such intervals to insure uninterrupted progress of the Work
1 Deliver anchor bolts and anchorage devices which are to be embedded in cast in place concrete or masonry in ample time to not delay that Work

B Store materials to permit easy access for inspection and identification Keep steel members off the ground using pallets platforms or other supports Protect steel members and packaged materials from corrosion and deterioration
1 Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures Repair or replace damaged materials or structures as directed

PART 2 PRODUCTS

2 1 MATERIALS

A Rolled Steel Plates Shapes and Bars ASTM A 36 except where other type steel is shown

B Anchor Bolts ASTM A 307 nonheaded type unless otherwise shown or specified

C Unfinished Threaded Fasteners ASTM A 307 Grade A regular low carbon steel bolts and nuts
1 Provide hexagonal heads and nuts for all connections

D High Strength Threaded Fasteners Heavy hexagonal structural bolts heavy hexagon nuts and hardened washers as follows
1 Quenched and tempered medium carbon steel bolts nuts and washers complying with ASTM A 325 or
2 Quenched and tempered alloy steel bolts nuts and washers complying with ASTM A 490

E Headed Stud Type Shear Connectors ASTM 108 Grades 1010 1020 with dimensions complying with AISC specifications or approved equal

F Electrodes for Welding E70XX complying with AWS D1 1 Design of New Buildings Section 8 AWS D1 1

G Surface Preparation and Shop Priming All structural steel shall be primed in the shop Surface preparation and shop priming are included herein but are specified in Section 09900 Painting

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2 2 FABRICATION

A Shop Fabrication and Assembly

1 General

a Fabricate and assemble structural assemblies in the shop to the greatest extent possible Fabricate items of structural steel in accordance with AISC Manual of Steel Construction and as shown on the Shop Drawings Provide camber in structural members as shown

b Properly mark and match mark materials for field assembly Fabricate for delivery sequence which will expedite erection and minimize field handling of materials

c Where finishing is required complete the assembly including welding or units before start of finishing operations Provide finish surfaces of members exposed in the final structure free of markings burrs and other defects

B Connections

1 Shop Connections

a Unless otherwise shown shop connections may be welded or high strength bolted and all welds shall be 1/4 inch minimum

b Wherever reaction values of a beam are not shown the connections shall be designed to support the total uniform load capacity tabulated in the AISC tables for allowable loads on beams for the given shape span and steel specified for the beam in question

c Shop welded connections shall be designed to eliminate or minimize eccentricity The size extent location and type of all shop welds shall be clearly shown on the Shop Drawings by use of AWS standard notations and symbols

d End connection angles fastened to the webs of beams and girders and the thickness of the angles size and extent of fasteners or shop welds shall conform to tables of Framed Beam Connections in the AISC Manual All connections shall be two sided unless otherwise shown

2 Field Connections

a All field connections unless otherwise specified below or noted shall be made with high strength bolts and shall be bearing type connections

b Common bolts may be used for beam to beam and beam to girder connections

c Field welding may be used only where noted or approved by CONTRACTING OFFICER

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3 High Strength Bolted Construction

a Install high strength threaded fasteners in accordance with AISC Specifications for Structural Joints using ASTM A 325 or A 490 Bolts (RCSC)

b High strength bolt design shear values shall be as specified in the AISC Manual for bolts with threads in the shear plane

c The minimum size of bolts shall be 3/4 inch diameter unless otherwise noted

4 Welded Construction Comply with AWS Code for procedures appearance and quality of welds and methods used in correcting welding work

a Assemble and weld built up sections by methods which will produce true alignment of axes without warp

5 Where rigid connections are required by the stresses shown web shear reinforcement and stiffeners per AISC Specifications shall be provided

6 All moment connections shall be designed for bending moments shown and shall conform to the details shown

7 Shear Connectors Install stud shear connectors in accordance with AWS D1 1 Section 4 and as recommended by the manufacturer

C Bracing

1 Bracing for which a calculated stress is not shown shall have a minimum two bolt connection or a shop welded connection of equivalent strength

2 Vertical bracing and knee braces connecting to columns shall be on the centerline of the columns unless otherwise noted

3 Knee braces shall be at 45 degree angle unless shown or noted

4 All gussets shall be minimum 3/8 inch thick unless otherwise shown

D Columns Column shafts shall have finished bearing surfaces at the base and at all splice lines

E Structural Tubing Structural tubing shall be properly sealed to protect the internal surfaces

F Monorails

1 All hoist beam splices shall be smooth and positive and keep the track in perfect alignment both horizontally and vertically The top joint plate shall keep the splice from spreading and develop full strength at the splice The splice shall be located as close as possible to the track support

2 Clamps for connecting hoist beams to support beams shall be of the flush type and suitable for the loads shown

G Holes and Appurtenances for Other Work

1 Provide holes required for securing other work to structural steel framing and for the passage of other work through steel framing members as shown on the Shop Drawings If large block outs are required and approved the webs shall be reinforced to develop specified shears Provide threaded nuts welded to framing and other specialty items as shown to receive other work

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2 Cut drill or punch holes perpendicular to metal surfaces Do not flame cut holes or enlarge holes by burning Drill holes in bearing plates

3 Coordinate as specified in Paragraph 1 1 B

PART 3 EXECUTION

3 1 INSPECTION

A Examine areas and conditions under which structural steel framing is to be installed Notify CONTRACTING OFFICER in writing of conditions detrimental to proper and timely completion of Work Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 2 ERECTION

A General Comply with the AISC Specifications and Code of Standard Practice and as herein specified

B Temporary Shoring and Bracing Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads Remove temporary members and connections when permanent members are in place and final connections are made Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds

C Temporary Planking Provide temporary planking and working platforms as necessary to effectively complete the Work CONTRACTOR shall provide sufficient planking to meet OSHA requirement of a tightly planked substantial floor within 2 stories or 30 feet whichever is less below each tier of steel beams on which Work is performed

D Anchor Bolts Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in place Work

1 Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations

a Refer to Section 03252 of these Specifications for anchor bolt installation requirements

E Setting Bases and Bearing Plates Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces Clean the bottom surface of base and bearing plates

1 Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices

2 Tighten the anchor bolts after the supported members have been positioned and plumbed Do not remove wedges or shims but if protruding cut off flush with the edge of the base or bearing plate prior to packing with grout

3 Place grout between bearing surfaces and bases or plates as specified in Section 03300 Article 3 17 Finish exposed surfaces protect installed materials and allow to cure in strict compliance with the manufacturer s instructions or as otherwise required

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4 Leveling plates and wood wedges will not be permitted

F Field Assembly Set structural frames accurately to the lines and elevations indicated Align and adjust the various members forming a part of a complete frame or structure before permanently fastening Clean bearing surfaces and other surfaces which will be in permanent contact before assembly Perform necessary adjustments to compensate for discrepancies in elevations and alignment

1 Level and plumb individual members of the structure within tolerances as specified in AISC Manual For members requiring accurate alignment clip angles lintels and other members shall be provided with slotted holes for horizontal adjustment at least 3/8 inch in each direction or more when required

2 Splice members only where shown or specified

G Erection Bolts On exposed welded construction remove erection bolts fill holes with plug welds and grind smooth at exposed surfaces

H Comply with AISC Manual for bearing adequacy of temporary connections alignment and the removal of paint on surfaces adjacent to field welds

1 Do not enlarge unfair holes in members by burning or by the use of drift pins except in secondary bracing members Ream holes that must be enlarged to admit bolts

I Gas Cutting Do not use gas cutting torches for correcting fabrication errors in the structural framing Cutting will be permitted only on secondary members which are not under stress as acceptable to the CONTRACTING OFFICER Finish gas cut sections equal to a sheared appearance when permitted

J Touch Up Painting

1 Unless otherwise specified below comply with all requirements of touch up painting in Section 09900

2 Immediately after erection clean field welds bolted connections and all damaged and abraded areas of the shop paint Apply paint to exposed areas with the same material as used for shop painting Apply by brush or spray to provide a minimum dry film thickness of 2 0 mils

3 3 FIELD QUALITY CONTROL

A Engage an independent testing and inspection agency to inspect high strength bolted connections and welded connections and to perform tests and prepare test reports

1 Test 10 percent of the installed high strength bolts but not less than two bolts at each connection

2 Visually inspect all welds and test 10 percent of all welds using procedures as outlined in AWS D1 1 Structural Welding Code

3 The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements and specifically state all deviations therefrom

4 Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished

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5 The testing agency may inspect structural steel at the plant before shipment however the CONTRACTING OFFICER reserves the right at any time before Final Acceptance to reject material not complying with specified requirements

B Correct deficiencies in structural steel Work which inspection and laboratory test reports have indicated to be not in compliance with requirements Perform additional tests at CONTRACTOR s expense as may be necessary to reconfirm any non compliance of the original Work and as may be necessary to show compliance of corrected Work

++ END OF SECTION ++

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SECTION 05504
MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install all miscellaneous metal fabrications Work including surface preparation and shop priming

2 Extent of miscellaneous metal fabrications is shown or scheduled and includes items fabricated from iron steel and aluminum shapes plates bars casings and extrusions which are not a part of other metal systems covered by other Sections of these Specifications

3 Types of miscellaneous metal fabrications work required include but are not necessarily limited to the following

a Ladders
b Ladder safety cages
c Fall prevention system
d Loose stainless steel lintels
e Cast aluminum stair nosing
f Cast in place continuous channel inserts
g Expansion shield fasteners
h Miscellaneous framing and supports
I Truck bollards
j Miscellaneous accessories and fasteners
k Cast iron manhole steps

B Related Sections

1 Section 09900 Painting (Surface preparation and shop priming are under section 05504)

2 Section 15094 Pipe Hangers Supports and Restraints

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ASTM A 36 Structural Steel

2 ASTM A 123 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled Pressed and Forged Steel Shapes Plates Bars and Strip

3 ASTM A 153 Zinc Coating (Hot Dip) on Iron and Steel Hardware

4 ASTM A 240 Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate Sheet and Strip for Fusion Welded Unfired Pressure Vessels

5 ASTM A 320 Alloy Steel Bolting Material for Low Temperature Service

6 ASTM A 386 Zinc Coating (Hot Dip) on Assembled Steel Products

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7 ASTM B 209 Aluminum Alloy Sheet and Plate
8 ASTM B 211 Aluminum Alloy Bars Rods and Wire
9 ASTM B 221 Aluminum Alloy Extruded Bars Rods Wire Shapes and Tubes
10 ANSI A14 3 Safety Requirements for Fixed Ladders
11 AWS D1 1 Structural Welding Code
12 AISI Standards for Stainless Steel

B Design Criteria The size and spacing of expansion bolts anchor bolts cast in place inserts and similar items shown or specified shall be considered the minimum acceptable size Final selection of these items shall be based upon the actual design load times a minimum safety factor of four Where the size and spacing of expansion bolts anchor bolts cast in place inserts and similar items are not shown or are not specified CONTRACTOR shall provide such items of sufficient size length load carrying capacity and spacing required to carry the design load times a minimum safety factor of four Provide non corrodible materials for all such items

C Field Measurements Take field measurements where required prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work

D Shop Assembly Preassemble items in the shop to the greatest extent possible so as to minimize field splicing and assembly of units at the project site Disassemble units only to the extent necessary for shipping and handling limitations Clearly mark units for reassembly and coordinated installation

1 3 SUBMITTALS

A Samples Submit for approval sets of representative samples of materials including nosings rungs and other finished products as may be requested by CONTRACTING OFFICER Review will be for color texture style and finish only Compliance with all other requirements is exclusive responsibility of CONTRACTOR

B Shop Drawings Submit for approval the following
1 Shop Drawings for the fabrication and erection of all assemblies of miscellaneous metal fabrications Work Include plans elevations and details of sections and connections Show anchorage and accessory items Include setting drawings and templates for location and installation of miscellaneous metal fabrications items and anchorage devices
2 Copies of manufacturer s specifications load tables dimension diagrams anchor details and installation instructions for products to be used in miscellaneous metal fabrications Work

PART 2 PRODUCTS

2 1 MATERIALS

A Stainless Steel Sheet and Plate ASTM A 240

B Steel Plates Shapes and Bars ASTM A 36

C Aluminum
1 Alloy and Temper Provide alloy and temper as shown or specified or as otherwise recommended by the aluminum producer or finisher
2 Extruded Shapes and Tubes ASTM B 221
3 Plate and Sheet ASTM B 209
4 Bars Rods and Wire ASTM B 211
5 Finish Provide Architectural Class I anodized finish AA M32C22A41 Clear as specified in the NAAMM Manual

D Stainless Steel Fasteners and Fittings ASTM A 320

E Zinc Coated Hardware ASTM A 153

2 2 MISCELLANEOUS METAL ITEMS

A Aluminum Ladders
1 Fabricate ladders for the locations shown with dimensions spacings details and anchorages as shown and specified Comply with the requirements of ANSI A14 3 except as otherwise shown or specified
a Unless otherwise shown provide aluminum pipe ASTM B 429 554 1 90 inch outside diameter Schedule 80 side rails spaced 18 inches apart minimum
b Provide solid aluminum square rungs spaced 12 inches on centers maximum with non slip surface on the top of each rung
2 Fit rungs in centerline of side rails plug weld and grind smooth on outer rail faces
3 Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet on centers Use welded or bolted brackets designed for adequate support and anchorage and to hold the ladder clear of the wall surface with a minimum of 8 inches clearance from wall to centerline of rungs Extend rails 42 inches above top rung and return rails to wall or structure unless other secure handholds are provided If the adjacent structure does not extend above the top rung gooseneck the extended rails back to the structure to provide secure ladder access

B Aluminum Ladder Safety Cages
1 Fabricate ladder safety cages from flat bars assembled by welding Unless otherwise shown provide ½ inch by 3 inch top bottom and intermediate hoops spaced not more than 5 feet on centers and 3/8 inch by 2 inch vertical bars secured to each hoop Space vertical bars approximately 9 inches on centers Fasten assembled safety

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cage to ladder rails and adjacent construction Grind all welds sharp edges and projections smooth

2 Comply with the requirements of ANSI A14 3

C Fall Prevention System All ladders shall be provided with a fall prevention system The system shall meet OSHA standards

1 The system shall consist of a rail permanently attached to the ladder to which a harness belt is attached The rail shall be notched and constructed of aluminum Ladder attachments shall be provided as required by the manufacturer A removable extension section shall be provided at the top of the ladder

D NOT USED

E Cast Aluminum Safety Nosings for Concrete Stairs

1 Provide heavy duty curb bar type cast aluminum abrasive No 24 virgin grain silicon carbide embedded while matrix is in a molten state cross hatched non skid type nosings 2 1/2 inches wide by 2 1/2 inches deep by ½ inch thick with integral cast on anchors for embedding in concrete and Portland cement setting beds space anchors not more than 4 inches from each end and not more than 12 inches on centers

F Cast In Place Continuous Channel Inserts

1 Provide hot dipped galvanized steel continuous channel inserts with integral anchors (spaced at 9 inches maximum) spring loaded stainless steel serrated grooved nuts washers and shims capable of accommodating threaded stainless steel eyebolt rods (up to 3/4 inch in diameter) as shown Maximum depth of insert shall be 1 50 inches

2 In corrosive areas stainless steel channel inserts shall be provided

3 Minimum working capacity shall be 6 500 pounds per linear foot when determined for 3 000 psi compressive strength concrete with a 2 to 1 factor of safety

G Miscellaneous Framing and Supports

1 Provide miscellaneous metal framing supports and other metal items required which are not a part of the structural steel framework and are required to complete the Work

2 Fabricate miscellaneous units to the sizes shapes and profiles shown or if not shown of the required dimensions to receive adjacent grating plates tanks doors or other work to be retained by the framing Except as otherwise shown fabricate from structural shapes plates and bars of all welded construction using mitered corners welded brackets and splice plates and a minimum number of joints for field connection Cut drill and tap units to receive hardware and similar items to be anchored to the Work

3 Equip units with integrally welded anchors for casting into concrete or building into masonry Furnish inserts if units must be installed after concrete is placed

a Except as otherwise shown space anchors 24 inches on centers and provide units the equivalent of 1 1/4 inch by 1/4 inch by 8 inch strips

b Galvanize all exterior miscellaneous framing and supports

c Galvanize interior miscellaneous framing and supports where shown

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H Truck Bollards Provide 8 inch diameter double extra strong galvanized steel pipe 4 feet above grade 3 feet 6 inches below grade Fill with concrete and mound top

I Primer Paint Unless otherwise shown or specified prepare surfaces and prime steel items as required under Section 09900 Painting

J Galvanizing All galvanizing of fabricated steel items shall comply with the requirements of ASTM A 123

K Aluminum Finish Provide a natural mill finish for all aluminum Work unless otherwise shown or specified

L Standard Cast Iron Manhole Steps ½ inch diameter Grade 60 Steel surrounded by Copolymer Polypropylene Plastic

2 3 SURFACE PREPARATION AND SHOP PAINTING

A Surface preparation and shop painting is required for all ferrous metals equipment and accessories Stainless steel shall not be painted

B All ferrous metal surfaces shall be cleaned and provided with surface preparation and two coats of priming paint in accordance with the applicable requirements of Section 09900 Painting All prime coat materials shall be compatible with the finish coat materials to be furnished under Section 09900 Painting

PART 3 EXECUTION

3 1 FABRICATION, GENERAL

A Use materials of the size and thicknesses shown or if not shown of the required size and thickness to produce adequate strength and durability In the finished product for the intended use Work to the dimensions shown or accepted on Shop Drawings using proven details of fabrication and support Use the type of materials shown or specified for the various components of Work

B Form exposed Work true to line and level with accurate angles and surfaces and straight sharp edges Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown or specified Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work

C Weld corners and seams continuously and in accordance with the recommendation of AWS Grind exposed welds smooth and flush to match and blend with adjoining surfaces Discoloration of finished surfaces of materials not to be painted will not be acceptable

D Form exposed connections with hairline joints which are flush and smooth using concealed fasteners wherever possible Use exposed fasteners of the type shown or if not shown use flathead (counter sunk) screws or bolts

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E Cut reinforce drill and tap miscellaneous metal fabrications Work as may be required to receive finish hardware and similar items of Work

F Use hot rolled steel bars for Work fabricated from bar stock unless Work is otherwise shown or specified to be fabricated from cold finished or cold rolled stock

3 2 INSTALLATION

A Set miscellaneous metal fabrications accurately in location alignment and elevation plumb level true and free of rack measured from established lines and levels Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete masonry or similar construction

B Anchor securely as shown or as required for the intended use using concealed anchors wherever possible Comply with the following

1 Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer s instructions

2 Assure that embedded items are protected from damage and are not filled in with concrete

3 Expansion anchors may be used for hanging or supporting 2 inch diameter pipes and smaller Expansion anchors shall not be used for larger pipe unless otherwise shown or approved by CONTRACTING OFFICER

4 Use concrete inserts for pipe hangers and supports for the pipe size and loading recommended by the insert manufacturer

a Minimum embedment depth in concrete 5 diameters

b Minimum anchor spacing on centers 10 diameters

c Minimum distance to edge of concrete 5 diameters

d Increase dimensions above if required to develop the required anchor load capacity

C Fit exposed connections accurately together to form tight hairline joints Weld steel connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations Grind steel joints smooth and touch up shop paint coat Do not weld cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication and are intended for bolted or screwed field connections

D Follow manufacturer s recommendations for installation of reglets inserts and cast in place shelf angle supports Lap ends of reglets as recommended by flashing manufacturer

E Protection of Aluminum from Dissimilar Materials Using approved washers strips or sheets of felt and coating specified in Section 09900 Painting protect all surfaces of aluminum from contact with dissimilar materials such as concrete masonry steel nonferrous metals etc

++ END OF SECTION ++

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DIVISION 6

WOOD & PLASTIC
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DIVISION 7

THERMAL & MOISTURE PROTECTION

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SECTION 07110
LIQUID APPLIED MEMBRANE WATERPROOFING

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install membrane waterproofing

2 The extent of membrane waterproofing includes coating all below grade concrete walls roofs or slabs of all structures covered with earth and not intended to contain liquids and all other locations shown on the Contract Drawings

3 The types of membrane waterproofing required include the following

a Liquid applied urethane rubber waterproofing membranes

1 2 QUALITY ASSURANCE

A Installer Qualifications An applicator with 5 years successful experience installing this type of work on like projects of similar size acceptable to the manufacturer

B Job Mock Up

1 Prior to installation of waterproofing Work but after CONTRACTING OFFICER S approval of submittals erect job mock up using materials and application techniques specified for final Work Provide special features as directed including corners finished end and expansion joint Build mock up at the site in location approved by the CONTRACTING OFFICER of full thickness and approximately 6 feet long by 4 feet high Indicate the proposed texture and Workmanship to be expected in the completed work Obtain the representative of the manufacturer s and CONTRACTING OFFICER S acceptance of visual qualities of the mock up before start of Work Retain and protect mock up during construction as a standard for judging completed work Do not alter or destroy mock up until given written permission by CONTRACTING OFFICER Waterproofing that does not meet the standards approved on the sample panel shall be removed and recoated as required by CONTRACTING OFFICER

C Requirements of Regulatory Agencies Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 ASTM D 412 Tension Testing for Vulcanized Rubber

2 ASTM D 471 Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids

3 ASTM D 573 Test for Accelerated Aging of Vulcanized Rubber by the Oven Method

4 ASTM D 624 Tests for Tear Resistance of Vulcanized Rubber

5 ASTM D 746 Test for Brittleness Temperature of Plastics and Elastomers by Impact

6 ASTM D 1149 Test for Accelerated Ozone Cracking of Vulcanized Rubber

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1 3 SUBMITTALS

A Manufacturer s Data Submit for approval the following
1 Copies of specifications installation instructions maintenance instructions and general recommendations by the manufacturer covering each material required for the waterproofing Work Include data substantiating that the materials comply with the requirements

B Certificates Submit for approval the following
1 Evidence of acceptance of installer by manufacturer
2 Evidence of installer s experience
3 Evidence prior to delivery
a That materials and components furnished conform with the requirements of the Specifications
4 Evidence of acceptance of the substrate by the waterproofing manufacturer

C Manufacturer s Warranty
1 Provide written warranty signed by CONTRACTOR installer and manufacturer for primary waterproofing materials agreeing to replace/repair defective materials including significant leakage of water abnormal aging or deterioration of materials and other failures of sheet waterproofing to perform as required

1 4 PRODUCT HANDLING, STORAGE AND DELIVERY

A Deliver materials in manufacturers original unopened containers and rolls with labels intact and legible Materials requiring fire resistance classification shall be delivered to the job with labels attached and packaged as required by labeling service Deliver materials in sufficient quantity to allow continuity of Work

B Handle rolled goods so as to prevent damage to edge or ends Select and operate material handling equipment so as not to damage existing construction or applied roofing

C Store materials on clean raised platforms with weather protective covering when stored outdoors Store rolled goods on end

D Provide continuous protection of materials against wetting moisture absorption and damage by construction traffic Remove wet materials from project site Comply with fire and safety regulations Store liquid materials in temperature above 60 F

1 5 JOB CONDITIONS

A Environmental Requirements
1 Apply waterproofing in dry weather
2 Apply waterproofing when material temperature is above 60 F

B Pre Installation Conference

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1 Prior to the installation of the waterproofing and associated Work meet at the project site with the installer and manufacturer of each component of associated Work the installers of deck or substrate construction to receive waterproofing Work the installers of other Work in and around waterproofing which shall follow the waterproofing Work (including mechanical Work if any) CONTRACTING OFFICER and other representatives directly concerned with performance of the Work including where applicable insurers test agencies product manufacturers and governing authorities Record the discussions of the conference and the decisions and agreements or disagreements reached and furnish a copy of the record to each party attending Review foreseeable methods and procedures related to the waterproofing Work including but not necessarily limited to the following

a Review project requirements (Drawings Specifications and other Contract Documents)
b Review required submittals both completed and yet to be completed
c Review status of substrate Work including drying structural loading limitations and similar considerations
d Review availability of materials tradesmen equipment and facilities needed to make progress and avoid delays
e Review required inspection testing and certifying
f Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions including the possibility of temporary water proofing
g Review regulations concerning code compliance environmental protection health safety fire and similar considerations
h Review procedures needed for protection of waterproofing during the remainder of the construction period

2 Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration

3 Record any revisions or changes agreed upon reasons therefore and parties agreeing or disagreeing with them

C Weather Condition Limitations

1 Proceed with waterproofing and associated Work only when weather conditions will permit unrestricted use of materials and quality control of the Work being installed complying with the requirements and with the recommendations of the waterproofing materials manufacturers

a Proceed only when the installer is willing to guarantee the Work as required and without additional reservations and restrictions

PART 2 PRODUCTS

2 1 MATERIALS

A Liquid Membrane Waterproofing

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1 Liquid Urethane Rubber Provide materials that comply with the following physical properties
   a Tensile Strength 150 pounds per square inch ASTM 412
   b Elongation at Break 215 percent at 75 F ASTM 412
   c Hardness Shore A 30 ASTM D 2240
   d Low Temperature Brittleness Minus 50 F ASTM D 746
   e Water Vapor Transmission 015 perm inches ASTM E 96

B Elastic Membrane Flashing
1 Synthetic rubber sheet not less than 60 mils thick textured as required for bonding to the substrate in widths of not less than 10 feet complying with the following
   a Tensile Strength 1400 pounds per square inch ASTM D 412
   b Elongation at Break 300 percent at 75 F ASTM D 412
   c Hardness Shore A 50 to 70 ASTM D 2240
   d Low Temperature Brittleness Minus 75 F ASTM D 746
   e Tear Resistance Die C 125 pounds per linear inch ASTM D 624
   f Water Absorption 0 5 percent maximum by weight 72 hours at 104 F ASTM D 1149
   g Resistance to Heat Aging 15 points maximum increase in hardness 30 percent maximum loss of elongation and 15 percent maximum loss of tensile strength for 168 hours at 240 F ASTM D 573

D Miscellaneous Waterproofing Materials
1 Deck Joint Treatment Materials Types recommended by manufacturer
2 Bonding Adhesive Types recommended by manufacturer for the type and condition of the substrate
3 Cant Strips Protection Board Expansion Joints and Flashing Accessories Types recommended by the manufacturer for the specific installation provided at locations shown or specified and at locations recommended by manufacturer and including adhesive tapes flashing cements and sealants
4 Protection Board Type recommended in writing by the manufacturer

PART 3 EXECUTION

3 1 SUBSTRATE PREPARATION

A CONTRACTOR his installer and the representative of the manufacturer shall examine the surface condition of the substrates to receive waterproofing and associated Work and ascertain the conditions under which the Work will be performed and notify CONTRACTING OFFICER in writing of unsatisfactory conditions Do not proceed with waterproofing and associated Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

B General Comply with the manufacturer s instructions for the preparation of the substrate to receive the waterproofing system

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C Clean the substrate of dust debris and other substances detrimental to the Work Where necessary to remove sharp projections grind concrete surfaces

D Install cant strips expansion joints flashing accessories and other items as shown and as recommended by the manufacturer

E Prime the substrate with a seal coat as recommended by the manufacturer

3 2 INSTALLATION

A General Comply with manufacturer s instructions for the installation of liquid waterproofing including priming flashing and curing

1 Start the installation only in the presence of the manufacturer s technical representative

B Apply waterproofing to walls and decks in accordance with manufacturer s written instructions Apply in two coats to obtain total thickness of 60 mils

C Protect other Work from spillage of waterproofing materials and prevent materials from entering and clogging drains and conductors Replace or restore other Work which is soiled or otherwise damaged by the performance of the waterproofing and associated Work

D Install protection course of the type recommended by the manufacturer for the type of installation shown

E In place Testing Before completed membranes on horizontal surfaces are covered by protection course or other work test for leaks with 2 inch depth of water maintained for 24 hours Repair any leaks revealed by examination of substructure and repeat test until no leakage is observed

F Elastic Membrane Flashing Install with liquid membrane flashing and elsewhere as shown

3 3 PROTECTION OF WATERPROOFING

A Waterproofing shall be kept free of all unnecessary traffic

B Only the installer shall repair or replace deteriorated or defective Work found at the time of final inspection Only the installer shall be engaged by CONTRACTOR to repair damages to the waterproofing which occurred subsequent to waterproofing installation and prior to final inspection Repair or replace the Work so that there will be no question as to the condition of waterproofing and associated Work at the time of final acceptance

++ END OF SECTION ++

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SECTION 07920
CAULKING AND SEALANTS

PART 1 GENERAL

1 01 Summary

A The Contractor shall supply and provide materials application and delivery of services as specified in this section and as included in the contract documents for caulking and sealants

B This section covers the requirements for the material quality and application of the caulking and sealants described herein

1 02 Description

A Caulking and sealants shall be provided in joints as indicated or specified The joint design shape and spacing shall be as indicated Mixing shall be in accordance with instructions provided by the manufacturer of the sealants

1 03 Applicable Codes and References

A The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by basic designation only

FEDERAL SPECIFICATION (FS)

FS TT S 00227	(Rev E Am 3) Sealing Compound Elastomeric Type Multi Component for Caulking Sealing and Glazing (for Buildings and Other Structures)
FS TT S 00230	(Rev C Am 2) Sealing Compound Elastomeric Type Single Component for Caulking Sealing and Glazing (in Buildings and Other Structures)
FS TT S 001543	(Rev A) Sealing Compound Silicone Rubber Base (for Caulking Sealing and Glazing in Buildings and Other Structures)

1 04 Submittals

A The following shall be submitted in accordance with Section 01300 Submittals

1 Manufacturer s descriptive data for materials including backstop material primer and sealer Descriptive data for elastomeric sealants shall include shelf life curing time and mixing instructions for two component sealants

2 Certificates of compliance stating that the caulking and sealants conform to the

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specified requirements Certificates shall include laboratory test reports showing that the caulking and sealants have been tested within the last 12 months

1 05 **Environmental Conditions**

A The ambient temperature shall be within the limits of 40 to 90 degrees F when the caulking and sealants are applied

1 06 **Shipping Delivery, and Storage**

A Materials shall be delivered to the job site in the manufacturer s original unopened containers The containers shall include the following information on the label manufacturer name of material formula or specification number lot number color date of manufacture mixing instructions shelf life and curing time when applicable at the standard conditions for laboratory tests Caulking compound or components outdated as indicated by shelf life shall not be used Materials shall be carefully handled and stored to prevent inclusion of foreign materials or exposure to temperatures exceeding 90 degrees F Sealant tape shall be handled and stored in a manner that will not deform the tape

PART 2 PRODUCTS

A Materials shall conform to the respective specifications and other requirements specified Each container brought to the jobsite with a different sealant formulation shall be marked for the intended use For each intended use the color shall be one of the manufacturer s standard colors as selected by the Engineer

B No 1 sealant shall be a two component elastomeric type compound conforming to FS TT S 00227 type I (self leveling) or Type ll (non sag) as determined by Contractor and approved for particular locations Class A The compound shall be supplied in pre measured kit form for on the job mixing

C No 2 sealant shall be a one component elastomeric type compound conforming to FS TT S 00230 Type ll Class A or FS TT S 001543 Class A

D Primer for each sealant specified shall be as recommended by the sealant manufacturer Primer shall have been tested for durability with the sealant to be used and on samples of the surfaces to be sealed

E Backstop materials shall be resilient closed cell polyethylene foam Backstop materials shall be nonabsorbent nonstaining and compatible with the sealant used Tube or rod stock shall be rolled into the joint cavity

F Bond preventive materials shall be pressure sensitive adhesive polyethylene tape aluminum foil or wax paper At the option of the Contractor backstop material with bond breaking characteristics may be installed in lieu of bondpreventive materials specified

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PART 3 EXECUTION

3 01 Surface Preparation

A The surfaces of joints to be sealed shall be dry Oil grease dirt chalk particles of mortar dust loose rust loose mill scale and other foreign substances shall be removed from all joint surfaces to be sealed Oil and grease shall be removed with solvent and surfaces shall be wiped with clean cloths

B Where concrete and masonry surfaces have been treated with curing compounds oil or other such materials the materials shall be removed by sandblasting or wire brushing Laitance efflorescence and loose mortar shall be removed from the joint cavity

C Galvanized steel shall be cleaned of all bond inhibiting compounds by solvent cleaning and leave no residue

D Painted steel shall have all required paint coats applied and paint shall be allowed to cure as required before application of sealants Solvent clean immediately prior to caulking with compound which leaves no residue

E Aluminum surfaces of frames in contact with sealants shall be cleaned of temporary protective coatings When masking tape is used for a protective cover the tape and any residual adhesive shall be removed just prior to applying the sealant Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be nonstaining

3 02 Sealant Uses

A The sealants to be used in the various joints shall be provided by the Contractor as part of the building design

3 03 Application

A Paper masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or compound smears Masking tape shall be removed within 10 minutes after joint has been filled and tooled

B Bond preventive materials for sealant shall be installed on the bottom of the joint cavity and other surfaces indicated to prevent the sealant from adhering to the surfaces covered by the bond preventive materials The materials shall be carefully applied to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond preventive materials

C The back or bottom of joints constructed deeper than indicated shall be packed tightly with backstop material to provide a joint of the depth indicated Where necessary to provide a backstop for caulking compound the joint shall be packed tightly with rope yarn

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D Primer shall be used on concrete masonry units wood or other porous surfaces in accordance with instructions furnished with the sealant Primer shall be applied to the joint surfaces to be sealed Surfaces adjacent to joints shall not receive primer

E Sealant shall be gun applied with a nozzle of proper size to fit the width of the joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly Sealant shall be uniformly smooth and free of wrinkles Joints shall be tooled slightly concave after sealant is installed When tooling white or light color sealant dry or water wet tool shall be used

3 04 Cleaning

A The surfaces adjoining the caulked and sealed joints shall be cleaned of smears and other soiling resulting from the caulking and sealing application as work progresses

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END OF SECTION

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DIVISION 8

DOORS & WINDOWS

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SECTION 08116
STEEL DOORS AND FRAMES
PART 1 GENERAL

1 01 REFERENCES

A The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/DHI A115	1991 Steel Door Preparation Standards
ANSI A151 1	1987 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 526/A 526M	1990 Steel sheet Zinc Coated (Galvanized) by the Hot Dip Process commercial Quality
ASTM A 591/A 591M	1989 Steel Sheet Electrolytic Zinc Coated for Light Coating Mass Applications
ASTM C 578	1992 Rigid Cellular Polystyrene Thermal Insulation
ASTM C 591	1985 Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
ASTM D 2863	1991 Measuring the Minimum Oxygen concentration to Support Candle Like Combustion of Plastics (Oxygen Index)
ASTM E 283	1991 Rate of Air Leakage Through Exterior Windows Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DNI)

ANSI/DHI A115	(1991) Steel Door Preparation Standards

HOLLOW METAL MANUFACTURER S ASSOCIATION (HMMA)

HMMA HMM	(1992) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NAPA)

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NAPA 80	(1992) Fire Doors and Fire Windows
NAPA 105	(1993) Smoke Control Door Assemblies
NAPA 252	(1995) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100	(1991) Standard Steel Doors and Frames
SDI 105	(1992) Recommended Erection Instructions for Steel Frames
SDI 107	(1984) Hardware on Steel Doors (Reinforcement Application)
SDI 111B	Recommended Standard Details for Dutch Doors
SDI 111F	Recommended Completed Opening Anchors for Standard Steel Doors and Frames
SDI 113	(1979) Apparent Thermal Performance for Steel Door and Frame Assemblies
SDI 114	(1979) Acoustical Performance for Steel Door and Frame Assemblies

UNDERWRITERS LABORATORIES INC (UL)

UL 10B	(1993) Fire Tests of Door Assemblies

1 02 SUBMITTALS

Submit the following in accordance with Section 01300

A Manufacturer s Catalog Data

1 Doors

2 Frames

3 Accessories

4 Weatherstripping

Submit manufacturer s descriptive literature for doors frames and accessories Include data and details on door construction panel (internal) reinforcement insulation and door edge construction When custom

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hollow metal doors are provided in lieu of standard steel doors provide additional details and data sufficient for comparison to ANSI/SDI 100 requirements

B Manufacturer s Standard color Charts

1 Factory applied enamel finish

Where colors are not indicated submit manufacturer s standard colors and patterns

C Drawings (4 copies each 4 weeks after order)

1 Doors

2 Frames

Show elevations construction details metal gages hardware provisions method of glazing and installation details

D Schedules

1 Doors

2 Frames

1 03 DELIVERY, STORAGE, AND HANDLING

Deliver doors frames and accessories undamaged and with protective wrappings or packaging Strap knock down frames in bundles Provide temporary steel spreaders securely fastened to the bottom of each welded frame Store doors and frames on platforms under cover in clean dry ventilated and accessible locations with 1/4 inch airspace between doors Remove damp or wet packaging immediately and wipe affected surfaces dry Replace damaged materials with new

PART 2 PRODUCTS

2 01 STANDARD STEEL DOORS

A ANSI/SDI 100 except as specified otherwise Prepare doors to receive hardware specified in Section 08710 Door Hardware Undercut where indicated Exterior doors shall have top edge closed flush and sealed to prevent water intrusion Doors shall be 1¾ inches thick unless otherwise indicated

2 02 INSULATED STEEL DOOR SYSTEMS

A Grade II Insulated steel doors and frames with non removable pin hinges threshold and vinyl door bottom Doors and frames shall receive phosphate treatment rust inhibitive primer

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2 03 WELDED FRAMES

A Form stops are into frame and are 16 gauge

2 04 STOPS AND BEADS

A Form stops are into frame and are 16 gauge

2 05 TERMINATED STOPS

A Terminated stops are 3 rubber silencers

2 06 CASED OPENINGS

A Fabricate frames for cased openings of same material gage and assembly as specified for metal door frames

2 07 ANCHORS

A Provide anchors to secure the frame to adjoining construction Screws in protective finish

B Provide floor anchors at least ½ thick and cad plated

2 08 LABELS

A Doors shall bear the label of Underwriters Laboratories Inc (UL)

2 09 WEATHERSTRIPPING

Weatherstripping shall be vinyl bulb type see Section 08710

2 10 HARDWARE PREPARATION

A Reinforce drill and tap doors and frames to receive finish hardware based on manufacturer s specifications

2 11 FINISHES

A Factory primed finish to satisfy 200 hour salt test

B Hot Dip galvanized shall be the method of protection

2 12 FABRICATION AND WORKMANSHIP

A Finished doors and frames shall be strong and rigid neat in appearance and free from defects waves scratches cuts dents ridges holes warp and buckle

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PART 3 EXECUTION

3 01 INSTALLATION

A Install per factory guidelines and data

3 02 PROTECTION

A Protect doors and frames from damage Repair damaged doors and frames prior to completion and acceptance of the project or replace with new as directed Wire brush rusted frames until rust is removed Clean thoroughly Apply an all over coat of rust inhibitive paint of the same type used for shop coat

3 03 CLEANING

A Upon completion clean exposed surfaces of doors and frames thoroughly Remove mastic smears and other unsightly marks

END OF SECTION

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SECTION 08710
DOOR HARDWARE
03/95

PART 1 GENERAL

1 01 REFERENCES

The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION INC (BHMA)

ANSI/BHMA A156 1	(1988) Butts and Hinges (BHMA 101)
ANSI/BHMA A156 2	(1989) Bored and Preassembled Locks and Latches (BHMA 601)
ANSI/BHMA A156 3	(1989) Exit Devices (BHMA 701)
ANSI/BHMA A156 4	(1992) Door Controls Closers
ANSI/BHMA A156 5	(1992) Auxiliary Locks & Associated Products
ANSI/BHMA A156 6	(1994) Architectural Door Trim (BHMA 1001)
ANSI/BHMA A156 7	(1988) Template Hinge Dimensions
ANSI/BHMA A156 8	(1988) Door Controls Overhead Holders (BHMA 311)
ANSI/BHMA A156 12	(1992) Interconnected Locks & Latches (BHMA 611)
ANSI/BHMA A156 13	(1987) Mortise Locks & Latches (BHMA 621)
ANSI/BHMA A156 15	(1986) Closer Holder Release Devices (BHMA 321)
ANSI/BHMA A156 16	(1989) Auxiliary Hardware (BHMA 1201)
ANSI/BHMA A156 17	(1993) Self Closing Hinges & Pivots

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ANSI/BHMA A156 18	(1993) Materials and Finishes (BHMA 1301)
ANSI/BHMA A156 21	(1989) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Fire Windows
NFPA 101	(1994) Code for Safety to Life from Fire in Buildings and Structures

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100	(1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES INC (UL)

UL BMD	(1994) Building Materials Directory
UL 14C	(1993) Swinging Hardware for Standard Tin Clad Fire Doors Mounted Singly and in Pairs

1 02 SUBMITTALS

Submit the following in accordance with Section 01300

A Manufacturer s Catalog Data
- 1 Hardware items
- 2 Instructions
  - a Installation
- 3 Schedules
  - a Hardware schedule
  - b Keying system

1 03 QUALITY ASSURANCE

A Hardware Manufacturers and Modifications

Provide as far as feasible locks hinges and closers of one lock hinge or closer manufacturer s make Modify hardware as necessary to provide features indicated or specified

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PART 2 PRODUCTS

2 01 TEMPLATE HARDWARE

Hardware to be applied to metal shall be made to template

2 02 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors as well as to other requirements specified even if such hardware is not specifically mentioned under paragraph entitled Hardware Schedule Such hardware shall bear the label of Underwriters Laboratories Inc

2 03 EXIT DEVICES

Exit devices shall meet ANSI/BHMA A156 3 Grade 1 and NFDA 80

2 04 LOCK TRIM

Cast forged or heavy wrought construction and commercial plain design factory standard brushed finish

2 05 LEVER HANDLES

Lever handles meet criteria under ANSI and current ADA requirements and NFPA 80

2 06 DOOR STOPS AND SILENCERS

ANSI/BHMA A156 16 Silencers Type L03011 Provide three silencers for each single door

2 07 THRESHOLDS

Panic bar shall meet ANSI/BHMA A156 21 and ADA codes

2 08 WEATHER STRIPPING

A set shall include head and jamb Air leakage of weather stripped doors shall not exceed 1 25 cubic feet per minute of air per square meter foot of door area when tested in accordance with ASTM E 283 Weather stripping shall be one of the following

A Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1 25 mm 0 050 inch wall thickness with vinyl neoprene silicone rubber or polyurethane inserts Aluminum shall be natural anodized

2 09 SPECIAL TOOLS

Provide special tools such as spanner and socket wrenches and dogging keys required to service and adjust hardware items

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9 01

2 10 FASTENERS

Provide fasteners of proper type quality size quantity and finish with hardware Fasteners exposed to weather shall be of nonferrous metal or stainless steel Provide fasteners of type necessary to accomplish a permanent installation

2 11 FINISHES

A Hardware shall have brushed or satin finish

PART 3 EXECUTION

Not used

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END OF SECTION

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DIVISION 9

FINISHES

SECTION 09740
CONCRETE TOPPINGS

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install all concrete toppings Work The Work also includes

a Providing openings in the concrete toppings to accommodate the work under other Sections and building into the concrete toppings all items such as sleeves anchor bolts inserts and all other items to be embedded in concrete toppings for which placement is not specifically provided under other Sections

2 Extent of concrete toppings is shown and in addition include but are not necessarily limited to the following

a 8 inch high concrete topping cove bases for all walls in all areas receiving concrete toppings of same type and thickness as floor in that area

b Concrete topping completely covering top and sides of all concrete equipment pads tank and pump pads and curbs and similar concrete items using same type and thickness of concrete toppings as used for floor in that area

c Concrete topping on bottoms and sides of all trench drains sumps containment areas and pits and horizontal pipe chases of same type and thickness as floor in that area

3 Types of concrete topping Work required include but are not necessarily limited to the following

a Chemical resistant concrete topping

b Miscellaneous materials and accessories

c Sandblasting acid etching and other substrate preparations

B Coordination

1 Coordinate and schedule sandblasting of substrates before equipment and similar items are installed to avoid later difficulty or delay in performing the Work of this Section

2 Coordinate the protection of existing equipment to remain in place during substrate preparation

3 Review installation procedures under other Sections and coordinate the installation of items that must be installed with the concrete toppings

4 Coordinate the finishing and tolerances of substrates for acceptability of substrates to concrete toppings manufacturers

5 Coordinate floor drain mounting heights and types Provide floor drain type which accommodates 1/4 inch thick concrete floor toppings

6 Remove all chemicals compounds and other materials from substrates to receive the Work of this Section as may be required by the concrete toppings manufacturers at

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no additional expense to the CONTRACTING OFFICER even if chemicals compounds and other materials are permitted by other Sections of this Specification

1 2 QUALITY ASSURANCE

A Applicator Qualifications
1 Certified or licensed by the flooring materials manufacturer
2 Applicator must have not less than 5 years successful experience with concrete toppings systems of the type specified on projects of magnitude equivalent to the required Work

B Source Quality Control
1 Provide each component of concrete toppings produced by a single manufacturer including but not limited to recommended primers base coat aggregate and top coat materials

C Allowable Tolerances Provide the following
1 Finished toppings level to 1/8 inch in 10 feet 0 inches
2 Smooth continuous color with no color streaks or inconsistencies
3 Uniformly textured non slip finish
4 Thicknesses specified for finish Work are actual not nominal

D Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
1 ASTM C 109 Compressive Strength of Hydraulic Cement Mortars
2 ASTM C 150 Portland Cement
3 ASTM C 190 Tensile Strength of Hydraulic Cement Mortars
4 ASTM C 321 Bond Strength of Chemical Resistant Mortars
5 ASTM C 501 Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
6 ASTM D 696 Test for Coefficient of Linear Thermal Expansion of Plastics
7 ASTM D 790 Test of Flexural Properties of Plastics
8 ASTM D 1308 Effect of Household Chemicals on Clear and Pigmented Organic Finishes
9 ASTM D 2240 Rubber Property Durometer Hardness
10 ASTM E 84 Surface Burning Characteristics of Building Materials
11 Military Specification MIL 3134F

1 3 SUBMITTALS

A Samples Submit for approval the following
1 12 inch by 12 inch samples of each type of concrete toppings on plywood Show range of color and pattern variation Sample submittals will be reviewed for color texture and pattern only Compliance with all other requirements is the exclusive responsibility of CONTRACTOR
2 Complete selection of named manufacturer s standard and custom colors for preselection by CONTRACTING OFFICER CONTRACTING OFFICER will select

a maximum of six colors to be prepared as 24 inch by 24 inch boards for final selections by CONTRACTING OFFICER CONTRACTING OFFICER may request a variety of finishes on each sample board

3 After samples have been approved a sample of concrete toppings shall be applied to floor areas selected by CONTRACTING OFFICER Upon acceptance by CONTRACTING OFFICER the samples shall be the standard by which all Work shall be compared

B Shop Drawings Submit for approval the following

1 Applicator s proof of certification by manufacturer and list of successful installations as specified Include owner s name and telephone number of responsible person at each installation Arrange visits to each installation for Engineer if required

2 Floor plans indicating where concrete toppings occurs in each space Show interface details with other items occurring in the spaces such as thresholds floor drains coves equipment pads and trench drains or horizontal pipe chases Show recommended locations of all control and expansion joints in concrete toppings work

3 Copies of manufacturer s technical data and installation instructions for concrete topping required Include manufacturer s published data indicating that each material complies with the requirements and is recommended for application shown

4 Maintenance Manual Copies of manufacturer s written instructions for recommended maintenance practices

5 Test Reports Copies of test data from an independent testing laboratory for all the physical properties listed herein

1 4 PRODUCT DELIVERY, STORAGE AND HANDLING

A Delivery of Materials

1 Deliver material in manufacturer s original unopened and undamaged packages

2 Clearly identify manufacturer brand name contents color stock number and order number on each package

3 Packages showing indications of damage that may affect condition of contents are not acceptable

B Storage of Materials

1 Store in original packaging under protective cover and protect from damage

2 Stack containers in accordance with manufacturer s recommendations

C Handling of Materials

1 Handle materials in such a manner as to prevent damage to products or finishes

2 Do not open containers or mix components until necessary preparatory Work and priming has been completed

3 Manufacturers who do not offer premeasured kits of each component shall not be approved for the Work

1 5 JOB CONDITIONS

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A Environmental Requirements Maintain substrate temperature and room temperature before during and after installation above 50 F and rising in accordance with flooring material manufacturer s instructions Provide adequate ventilation during application and curing periods

B Scheduling

1 Schedule the installation of concrete topping Work in order to provide concrete topping on top of equipment pads within horizontal pipe chases and similar locations where installation of equipment piping and similar items would cause concrete topping installation difficulties before such equipment piping and similar items which would preclude later installation of concrete topping have been installed

2 Provide all temporary heat and shelters as may be required to schedule the installation of concrete topping Work at no additional expense to the CONTRACTING OFFICER

1 6 GUARANTEE

A Provide written guarantee signed by CONTRACTOR the installer and manufacturer agreeing to replace concrete toppings systems which fail under specified use for a period of three years starting on the date of the CONTRACTING OFFICER S acceptance of the completed construction Work Guarantee shall extend to all aspects of the Work including but not limited to substrate preparation materials and installation techniques Concrete toppings systems which fail due to abnormal use shall not be included under the guarantee

PART 2 PRODUCTS

2 1 MATERIALS

A Chemical Resistant Concrete Topping Provide the following chemical resistant topping all individual components of which shall be capable of and recommended by the manufacturer for immersion in the reagent specified for one year without loss of specified properties or color and which is capable of resisting heavy traffic

1 Acid Etch Provide manufacturer s recommended acid etching compound in addition to sandblast surface preparation

2 Bond Coat As recommended by the manufacturer

3 Reinforcement Provide a glass reinforced system using materials recommended for the system and chemical resistance specified Provide Type H glass cloth

4 Underlayment Fill As recommended by the manufacturer

5 Binder Troweled vinyl ester composition flooring

6 Top Coats Non slip with complete selection of manufacturer s top coats for maximum chemical resistant

7 Termination Strips White metal tapered bar type as recommended by the manufacturer

8 Physical Properties The complete installation when thoroughly cured shall have the following physical properties

a Tensile Strength ASTM D 638 2 800 pounds per square inch minimum

b Indentation MIL D 3134F PAR 4 7 3 0 062 inches maximum
c Bond Strength ASTM C 321 400 pounds per square inch minimum
d Flame Spread ASTM D 635 Self extinguishing
e Thermal Coefficient of Linear Expansion ASTM C 531 2 x 10^5 inches per inch per F maximum
f Abrasive Resistance ASTM D 4060 0 10 gram maximum weight loss
g Flexural Strength ASTM C 580 8 000 pounds per square inch minimum
h Compressive Strength ASTM C 109 11 000 pounds per square inch minimum
I Surface Hardness ASTM D 2240 Scale D 85 90
j Water Absorption MIL D 3134 4 78 0 12
k Chemical Resistance ASTM D 1308

Reagent	Film Integrity
35% Ferric Chloride	Unaffected
50% Sodium Hydroxide	Unaffected
50% Hydrogen Peroxide	Unaffected

9 Color Selected from complete range of manufacturer s standard and custom colors
10 Texture Non slip surface

PART 3 EXECUTION

3 1 INSPECTION

A CONTRACTOR and his installer shall examine the areas and conditions under which concrete toppings are to be placed and notify CONTRACTING OFFICER in writing of conditions detrimental to the proper and timely completion of the Work Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

B Subfloor shall have a wood float finish Concrete shall have cured for 28 days prior to initiation of this Work

3 2 PREPARATION

A Subfloors Prior to start of applying flooring broom clean or vacuum surfaces to be covered and inspect the subfloor Start of application operations will indicate acceptance of subfloor conditions and full responsibility for the completed Work

B Sandblasting and Acid Etching All areas to receive the Work of this Section shall be given a medium sandblast finish to insure maximum topping adhesion followed by concrete toppings manufacturer s recommended acid etching treatment

C Primer Apply primer as recommended by flooring manufacturer prior to application of the base coat Apply in accordance with manufacturer s directions

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D Fill or grind concrete substrate as may be required to achieve a smooth uniform level finished appearance on finished Work

3 3 APPLICATION

A Do not power trowel the heavy duty concrete topping unless manufacturer provides written certification to CONTRACTING OFFICER that material shall experience no loss in compressive strength or tensile strength

B Apply termination and expansion joint strips at the junction of the flooring with other materials and at expansion joints as recommended by the manufacturer

C Apply flooring only after finishing operations have been completed and permanent heating system is operating Moisture content of concrete slabs building air temperature and relative humidity must be within limits recommended by manufacturer

D Mix materials and apply bonding coat in accordance with manufacturer s instructions

E Apply epoxy mortar floor topping body coat to 1/4 inch dry cured minimum thickness or as specifically recommended to achieve the physical properties and dimensional tolerances specified

F Apply glass reinforcement as specified

G Apply grout coats to smooth body coat

H Apply vinyl ester floor topping coat to 1/4 inch dry cured minimum thickness or greater if specifically recommended to achieve the physical properties chemical resistances and dimensional tolerances specified

I Power sand to remove trowel marks

J Apply top coat sealer material for maximum chemical resistance and cleanability as recommended by the manufacturers

3 4 ADJUSTMENT AND CLEANING

A Finishing Apply a final top coat to match the texture of the approved samples

B Protect installed flooring from damage by use of heavy Kraft paper or other covering so that flooring is without damage or unusual or accelerated wear at time of Final Acceptance

C Flooring damaged in any manner shall be repaired or replaced at the discretion of CONTRACTING OFFICER at no additional cost to the CONTRACTING OFFICER

D The flooring at the time of Final Acceptance shall be clean and without damage other than for normal wear associated with normal foot traffic according to the manufacturer s published literature

++ END OF SECTION ++

SECTION 09900
PAINTING
PART I GENERAL

1 01 SUMMARY

A The Contractor shall supply and provide all materials application and delivery of services as specified in this section and/or on the drawings for completion and application of general painting as included in the contract documents

1 02 DESCRIPTION

A General painting shall consist of furnishing and applying coatings of various types to form an effective barrier and/or serve as a form of coding or marking for the various systems pipes etc mentioned here

1 03 APPLICABLE CODES AND REFERENCES

A The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by basic designation only

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI A 1301	(1981) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3273	1986 R 1991 Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM D 3274	1982 R 1988 Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation
ASTM D 4214	1989 Evaluating the Degree of Chalking of Exterior Paint Films

FEDERAL SPECIFICATIONS (FS)

FS TT C 535	(Rev B Am 2) Coating Epoxy Two Component for Interior Use on Metal Wood Wallboard Painted Surfaces Concrete and Masonry
FS TT C 542	(Rev E) Coating Polyurethane Oil Free Moisture Curing
FS TT E-489	(Rev H) Enamel Alkyd Gloss Low Voc Content
FS TT E 489	(Rev B Am 3) Enamel Heat Resisting (400 degrees F) Black

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FS TT F 1098	(Rev D) Filler Block Solvent Thinned for Porous Surfaces (Concrete Block Cinder Block Stucco etc)

FEDERAL STANDARDS (FED STD)

FED STD 313	(Rev C) Material Safety Data Transportation Data and Disposal Data for Hazardous Materials Furnished to Engineer Activities

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1982) White or Colored Silicone Alkyd Paint
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1989) Power Tool Cleaning
SSPC SP 6	(1989) Commercial Blast Cleaning
SSPC SP 7	(1989) Brush Off Blast Cleaning
SSPC SP 10	(1989) Near White Blast Cleaning

1 04 SUBMITTALS

A The following shall be submitted in accordance with Section 01300 Submittals

1 The names quantity represented and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular color is 50 gallons or less

2 Manufacturer s current printed product description material safety data sheets (MSDS) and technical data sheets for each coating system MSDS submittals shall meet the requirements of FED STD 313 Detailed mixing thinning and application instructions minimum and maximum application temperature and curing and drying times between coats for epoxy moisture curing polyurethane and liquid glaze coatings Detailed application instructions for textured coatings shall be provided

3 A statement as to the quantity of paint represented and the intended use

4 Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide Certificate stating that paints proposed for use contain not more than 0 06 percent lead Certificate stating that paints proposed for use meet the VOC regulations of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located

5 A complete sample of the moisture curing polyurethane system applied to a panel of the same material as that on which the coating will be applied in the work and for each color specified The sample panels will be used for quality control in applying the system

1 05 MATERIAL CRITERIA AND APPROVAL

A Unless otherwise recommended by the paint manufacturer the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water thinned epoxy and moisture curing polyurethane coatings Water thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F Epoxy and moisture curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer Moisture curing polyurethane shall not be applied when the relative humidity is below 30 percent

B When samples are tested approval of materials will be based on tests of the samples otherwise materials will be approved based on test reports furnished with them If materials are approved based on test reports furnished samples will be retained by the Engineer for testing should the materials appear defective during or after application In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor s expense

1 06 SHIPMENT, DELIVERY, AND STORAGE

A Paints shall be in sealed containers that legibly show the designated name formula or specification number batch number color quantity date of manufacture manufacturer s formulation number manufacturer s directions including any warnings and special precautions and name of manufacturer Pigmented paints shall be furnished in containers not larger than five gallons Paints and thinner shall be stored in accordance with the manufacturer s written directions and as a minimum stored off the ground under cover with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing

PART 2 PRODUCTS

2 01 PAINT

A The term paint as used herein includes emulsions enamels paints stains varnishes sealers cement emulsion filler and other coatings whether used as prime intermediate or finish coat Paint shall conform to the respective specifications listed for use in the painting schedules at the end of this section except when the required amount of a material of a particular color is 50 gallons or less an approved first line proprietary paint material with similar intended usage and color to that specified may be used

B Colors shall be as selected from manufacturer s standard colors as indicated Manufacturer s standard color is for identification of color only Tinting of epoxy and

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urethane paints shall be done by the manufacturer The color of the undercoats shall vary slightly from the color of the next coat

C Paint specified for all coats applied to fabrics and vapor barrier jackets over insulation shall contain a mildewcide that will not adversely affect the color texture or durability of the coating The mildewcide shall be incorporated into the paint by the manufacturer and shall attain a surface disfigurement rating of eight or greater when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274 Mercurial mildewcide shall not be used in interior paint Insecticides shall not be used in paint

D Paints containing lead in excess of 0 06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used

E Paints containing zinc chromate or strontium chromate pigments shall not be used

F Paints shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards Materials shall conform to the restrictions of the local air pollution control authority When the materials specified in the painting schedule do not meet the applicable VOC content limitations the Contractor shall notify the Contracting Officer prior to commencing the work

PART 3 EXECUTION

3 01 PROTECTION OF AREAS NOT TO BE PAINTED

A Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations Items removed prior to painting shall be replaced when painting is completed Following completion of painting workmen skilled in the trades involved shall reinstall removed items Surfaces contaminated by coating materials shall be restored to original condition

3 02 SURFACE PREPARATION

A Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F Cleaning shall be programmed so that dust and other contaminants will not fall on wet newly painted surfaces Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water thinned paints shall be spotprimed with a suitable corrosion inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas

B Masonry surfaces shall be allowed to dry at least 30 days before painting except concrete slab on grade which shall be allowed to cure 90 days before painting Glaze efflorescence laitance dirt grease oil asphalt surface deposits of free iron and other foreign matter shall be removed prior to painting Surfaces to receive epoxy coatings shall be acid etched or mechanically abraded as specified by the coating manufacturer rinsed

with water allowed to dry and treated with the manufacturer s recommended conditioner prior to application of the first coat

C Ferrous surfaces including those that have been shop coated shall be solvent cleaned Surfaces that contain loose rust loose mill scale and other foreign substances shall be cleaned mechanically with power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7 Shop coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection

D Galvanized aluminum and aluminum alloy copper and other nonferrous metal surfaces shall be solvent cleaned in accordance with SSPC SP 1

3 03 MIXING AND THINNING

A When thinning is approved as necessary to suit surface temperature weather conditions or application methods paints may be thinned in accordance with the manufacturer s directions When thinning is allowed paints shall be thinned immediately prior to application with no more than one pint of suitable thinner per gallon The use of thinner shall not relieve the Contractor from obtaining complete hiding full film thickness or required gloss Thinning shall not cause the paint to exceed local limits on volatile organic compounds Paints of different manufacturers shall not be mixed

B Two component systems shall be mixed in accordance with manufacturer s instructions Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate

3 04 APPLICATION

A Painting practices shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards Unless otherwise specified or recommended by the paint manufacturer paint may be applied by brush roller or spray At the time of application paint shall show no signs of deterioration Uniform suspension of pigments shall be maintained during application Each coat of paint shall be applied so that dry film shall be of uniform thickness and free from runs drops ridges waves pinholes or other voids laps brush marks and variations in color texture and finish Hiding shall be complete Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated Special attention shall be given to insure that all edges corners crevices welds and rivets receive a film thickness equal to that of adjacent painted surfaces Paints except water thinned types shall be applied only to surfaces that are completely free of moisture as determined by sight or touch

B Adequate ventilation shall be provided during paint application Respirators shall be worn by all persons engaged in spray painting Adjacent inhibited areas shall be protected by approved precautionary measures

C Surfaces that have been cleaned pretreated and otherwise prepared for painting shall be

given a coat of the specified first coat as soon as practical after such pretreatment has been completed but prior to any deterioration of the prepared surface Sufficient time shall elapse between successive coats to permit proper drying This period shall be modified as necessary to suit weather conditions Oil based or oleoresinous solvent type paints shall be considered dry for recoating when the paint feels firm does not deform or feel sticky under moderate pressure of the thumb and the application of another coat of paint does not cause the undercoat to lift or lose adhesion Manufacturer s instructions for application curing and drying time between coats of two component systems shall be followed

D Masonry surface voids shall be filled however surface irregularities need not be completely filled The filler dry film shall be uniform and free of pinholes Filler shall not be applied over caulking compound

E Solvent thinned filler FS TT F 1098 shall be applied to dry surfaces only and may be applied by brush or roller Filler shall be allowed to set for three to five minutes or until the filler becomes tacky and the excess material shall then be removed with a rubber squeegee Surface voids shall be filled however surface irregularities need not be completely filled Surfaces to which solvent thinned filler has been applied shall be given the specified topcoat as soon as practical but before the filler material starts to discolor or chalk

F Primer for ferrous metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat but shall be overcoated with the specified ferrous metal primer prior to application of finish coats

3 05 PIPE COLOR CODE MARKING

A Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves except those provided at plumbing fixtures at not more than 40 foot spacing on straight pipe runs adjacent to change in direction and on both sides where pipes pass through walls or floors Color code marking shall be of the color listed in Table I and the size listed in Table II The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe per ANSI A13 1 1981 The legends shall be printed in upper case letters as listed in Table 09900 1 Marking shall be painted or applied using colored pressure sensitive adhesive markers of standard manufacture or snap around markers Paint shall be as specified

The colors for banding in Table 09900 1 are given as a guide

3 06 MISCELLANEOUS PAINTING

A Lettering shall be provided as scheduled on the Contractor s approved drawings shall be block type and shall be black (or white for contrast) paint as scheduled for particular substrate Lettering for equipment shall be three inches in height Samples shall be approved before application

TABLE 09900 1 COLOR CODES FOR MARKING PIPE

LEGEND/WORDING	MARKER COLORS*	LEGEND/WORDING	MARKER COLORS*
CAUSTIC	Y	INDUSTRIAL WATER	GW
COLD WATER	GW	INSTRUMENT AIR	B
COLD WATER SUPPLY	GW	LO PRESSURE AIR +	B
COMPRESSED AIR	B	MAKE UP WATER	GW
DISCHARGE	GW	MEDIUM PRESSURE AIR +	B
DOMESTIC COLD WATER	GW	PLANT AIR	Y
DRAIN	GW	PLANT WATER	GW
EXHAUST AIR	B	PLUMBING VENT	GW
FRESH WATER	GW	POTABLE WATER	GW
HEATING RETURN	Y	PROCESS WATER	Y
HEATING SUPPLY	Y	TREATED WATER	GW
HI PRESSURE AIR +	Y	UNSAFE WATER	Y
		VENT	Y
		WASTE WATER	GW
		WELL WATER	GW

Y= Yellow with Black Letters GW=Green with White Letters R= Red with White Letters B=Blue with White Letters

+ For air with varying pressures use AIR (Yellow) For air pressures above 90 lbs use HI PRESSURE AIR (Yellow) For air pressures less than 30 lbs use LO PRESSURE AIR (Blue) For air pressure of 30 90 Lbs use MEDIUM PRESSURE AIR (Blue)

TABLE 09900 2 SIZE OF LEGEND LETTERS

Outside Diameter of Pipe or Covering (Inches)	Length of Color Field (Inches)	Size of Letters (Inches)
3/4 to 1 1/4	8	½
1 1/2 to 2	8	3/4
2 1/2 to 6	12	1 1/4
8 to 10	24	2 1/2
over 10	32	3 1/2

3 07 SURFACES TO BE PAINTED

A Surfaces listed in the painting schedules at the end of this section other than those listed in paragraph SURFACES NOT TO BE PAINTED shall be painted as scheduled

3 08 SURFACES NOT TO BE PAINTED

A Surfaces in the following areas are not to be painted concrete aluminum pipe insulation stainless steel copper and plastic components (except bands arrows and legends for pipe or where codes require full pipe painting) and metal building wall and roof panels and

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liners In addition surfaces of hardware fittings and other factory finished items shall not be painted

3 09 CLEANING

A Cloths cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day Upon completion of the work staging scaffolding and containers shall be removed from the site or destroyed in an approved manner Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable

3 10 PAINTING SCHEDULES

A The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats to be applied

EXTERIOR PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Ferrous including galvanized surface	MS MIL P 2441/GEN Formula 159	MS MIL C 83286 Formula 150	
	NOTE Near white blast cleaning SSPC SP 10 is required		
Metal subject to high temperature up to 400 degrees F	FS TT E 496 Type II	FS TT E 496 Type II	None
Concrete masonry units	FS TT F 1098	FS TT C 535 Type II	FS TT C 535 Type II
Ferrous including galvanized surfaces unless otherwise specified	FS TT C 535 Type II	FS TT C 535 Type II	None
Ferrous factory primed mechanical and electrical equipment	FS TT E 489 Class A	FS TT E 489 Class A	None
	or		
	SSPC Paint 21 Type I	SSPC Paint 21 Type I	None
Facing of vapor barrier jackets of presized or adhesive finished cloth over insulation on exposed ducts and equipment as shown on drawings	Two coats of exterior grade latex paint to match adjacent areas except where applicable codes dictate the appropriate color and as reflected in Spec 15400 FS TT P 1510A		

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10200
METAL LOUVERS
09/96

PART 1 GENERAL

1 01 REFERENCES

The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by the basic designation only

THE ALUMINUM ASSOCIATION INCORPORATED (AA)

AA 45	(1980) Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603 8	(1992 Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

AIR MOVEMENT AND CONTROL ASSOCIATION INC (AMCA)

AMCA 500	(1991) Louvers Dampers and Shutters
AMCA 511	(1986) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1994 Rev A) Stainless and Heat Resisting Chromium Nickel Steel Plate Sheet and Strip
ASTM A 366/A 366M	(1991 R 1993) Steel Sheet Carbon Cold Rolled Commercial Quality
ASTM A 653/A 653M	(1995) Steel Sheet Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
ASTM B 209M	(1995) Aluminum and Aluminum Alloy Sheet and Plate (Metric)
ASTM B 209	(1995) Aluminum and Aluminum Alloy Sheet and Plate
ASTM B 221M	(1995 Rev A) Aluminum and Aluminum Alloy Extruded Bars Rods Wire Shapes and Tubes (Metric)
ASTM B 221	(1995 Rev A) Aluminum and Aluminum Alloy Extruded Bars Rods Wire Shapes and Tubes

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1 02 SUBMITTALS

Submit the following in accordance with section entitled Submittal Procedures

A Manufacturer s Standard Color Charts

a Wall louvers

b Door louvers

Colors of finishes shall closely approximate colors indicated Where color is not indicated submit the manufacturer s standard colors to the CONTRACTING OFFICER for selection

B Drawings

a Wall louvers

Show all information necessary for fabrication and installation of louvers Indicate materials sizes thicknesses fastenings and profiles

PART 2 PRODUCTS

2 01 MATERIALS

A Prepainted steel shall be formed by the G90 process bearing the product name galvalume

2 02 METAL WALL LOUVERS

A Weather resistant type with bird screens and made to withstand a wind load of not less than 30 pounds per square foot Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500 and AMCA 511 The rating shall show a water penetration of 0 20 or less ounce per square foot of free area at a free velocity of 800 feet per minute

B Screens on louvers shall be fiberglass only

PART 3 EXECUTION

Not used

* * * * *

END OF SECTION

SECTION 10400
IDENTIFICATION DEVICES
PART 1 GENERAL

1 01 DESCRIPTION

A Scope
- 1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install all identification device Work
- 2 Extent of identification devices is specified herein and shown
- 3 Types of identification device Work include but are not necessarily limited to the following
  - a Fire extinguisher location signs
  - b Interior room identification signs
  - c Right to know labels and tags
  - d Miscellaneous mechanical fasteners and supports
  - e No smoking signs

1 02 QUALITY ASSURANCE

A Field Measurements Take field measurements prior to preparation of Shop Drawings and fabrication where possible to ensure proper fitting of the Work

B Inserts and Anchorages
- 1 Furnish inserts and mechanical anchoring devices for the installation of identification devices and related Work
- 2 Provide setting drawings templates instructions and directions for installation of anchorage devices Coordinate delivery with other work to avoid delay

C Shop Assembly Preassemble items in the shop to the greatest extent possible Disassemble units only to the extent necessary for shipping and handling limitations Clearly mark units for reassembly and coordinated installation

1 03 SUBMITTAL

A Samples Submit for approval samples of each color and finish of exposed materials and accessories required for identification devices CONTRACTING OFFICER S review of samples will be for color and texture only Compliance with all other requirements is the exclusive responsibility of Contractor

B Shop Drawings Submit for approval the following
- 1 Shop Drawings for fabrication and erection of identification devices Include plans elevations and full size graphic layout Show anchorages

and accessory items Furnish location template drawings for items supported or anchored to permanent construction

2 Copies of manufacturer s technical data and installation instructions for each type of device required
3 Complete selection of specified manufacturer s standard and custom colors

PART 2 PRODUCTS

2 01 FIRE EXTINGUISHER LOCATION SIGNS AND INTERIOR ROOM IDENTIFICATION

A Material Subsurface silkscreened graphics on a transparent acrylic sheet 0 08 inches thick with Helvetica Medium alphabet and matching arrows type face Provide 2 inch high upper case letters and 1 inch high lower case letters

B Fire Extinguisher Identification Sign Provide 15 inch by 15 inch with square corners unframed Provide one for each surface mounted fire extinguisher Background color red with white lettering Sign shall incorporate a directional arrow as located by CONTRACTING OFFICER

C Room Identification Signs Provide 15 inch by 15 inch with square corners unframed Background color brown with white lettering Provide one sign for each door shown Use room names shown to determine extent of graphics

D No Smoking Signs Provide 15 inch by 15 inch with square corners unframed Background color red with white lettering Provide one sign inside the buildings near all exterior doors shown

2 02 RIGHT TO KNOW LABELS AND TAGS

A Provide right to know target organ labels for each chemical storage tank Provide right to know tags along chemical pipelines and fill pipes as specified

B Right to know labels for storage tanks shall have adhesive backs and shall be provided with stick on numbers/symbols and legends Labels shall provide information such as chemical name and/or CAS number fire and health hazard reactivity personal protection and target organ legends

C Provide right to know tags for attaching to pipelines and fill lines Locate tags at 25 feet maximum center to center distance with one tag on each side of through wall pipe penetrations and as directed by CONTRACTING OFFICER Tags shall be constructed of laminated plastic and furnished with nylon tie fasteners

D Quantity
1 Right to know Labels 250 labels minimum
2 Right to Know Tags As required based on criteria specified and

installed lengths of pipelines and fill lines

PART 3 EXECUTION

3 01 INSPECTION

A Contractor and his installer must examine the substrates and condi tions under which the devices are to be installed and notify CONTRACTING OFFICER in writing of conditions detrimental to the proper and timely completion of the Work Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTING OFFICER

3 02 INSTALLATION

A Install identification devices and components at the locations shown or if not shown as directed by CONTRACTING OFFICER securely mounted with concealed theft resistant fasteners Attach signs to substrates in accordance with the manufacturer s instructions unless otherwise shown

B Use stainless steel fasteners

C Install level plumb and at the proper height Cooperate with other trades for installation of sign units to finish surfaces Repair or replace damaged units as directed by CONTRACTING OFFICER

++ END OF SECTION ++

SECTION 10520
PORTABLE FIRE PROTECTION EQUIPMENT
PART 1 GENERAL

1 01 SUMMARY

A Contractor shall provide extinguishers with brackets at locations required by the building code and as directed

1 02 REFERENCES

A The publications listed below form a part of this specification to the extent referenced The publications are referred to in the text by basic designation only

UNDERWRITERS LABORATORIES (UL)

1 03 SUBMITTALS

A Drawings showing details of extinguishing medium construction and installation of fire extinguishers and brackets shall be submitted in accordance with Section 01300 Submittals

1 04 DELIVERY STORAGE AND HANDLING

A Deliver materials in manufacturer s original unopened and undamaged packages with labels legible and intact Store materials in unopened packages in a manner to prevent damage from environment and construction operations Handle in accordance with manufacturer s instructions

PART 2 PRODUCTS

2 01 MATERIALS

A Fire extinguisher units shall be 20 pound capacity carbon dioxide type

B Fire extinguisher brackets supporting bottom and sides of extinguishers shall be provided for all fire extinguishers

PART 3 EXECUTION

3 01 INSTALLATION

A Fire extinguishers and brackets shall be furnished and installed at location required by code and as approved by the Hollywood Township Fire Department

B All fire extinguishers shall be inspected and certified within 30 days of start up

END OF SECTION

DIVISION 11

EQUIPMENT

SECTION 11204
SAND FILTERS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install continuous backwash upflow deep bed single media sand filter equipment and all appurtenances start up assistance and other services as specified herein and shown on the Contract Drawings

1 The sand filter equipment shall consist of the following
   - a Cylindrical filter tank with conical hopper
   - b Feed inlet manifold and feed distribution radials
   - c Filtrate weir and flume
   - d Airlift pipe internal sand washer sand distribution cone reject compartment with weir and flume connection for external compressed air supply and compressed air control system
   - e Local control panels

2 The filter shall operate such that the total cross sectional area of the filter shall be in a continuous filtration and a continuous backwash mode The backwashing shall not require interruption of the filtration process by shutting down a part or a whole filter

3 The sand filter equipment shall be suitable for indoor installation as shown on the Contract Drawings

B Related Sections
1 Division 1 General
2 Section 03600 Grout
3 Section 05120 Structural Steel
4 Section 03252 Concrete Anchors
5 Section 09900 Painting (Specifications for surface preparation and shop priming required under this Section are under Section 09900)
6 Section 11370 Compressed Air Equipment
7 Division 13 Sections on Plant Monitoring and Control System and Filter Media
8 Division 15 Sections on Piping
9 Division 16 Electrical

1 02 QUALITY ASSURANCE

A In order to centralize responsibility it is required that all equipment provided under this Section be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness of the system CONTRACTOR shall ensure that the supplier or manufacturer is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

B Manufacturer s Qualifications CONTRACTOR shall ensure that manufacturer has at least 3 years experience in furnishing equipment similar to that specified herein and can show evidence of at least 5 installations in satisfactory operation for at least 2 years

C Shop Tests
1 Sand filters shall be hydrostatically tested at the manufacturer s facility Written notification of the scheduled test date shall be given to the CONTRACTING OFFICER 14 days prior to hydrostatic testing Upon completion of testing the CONTRACTOR shall submit a Manufacturer s certification stating that each sand filter has been successfully tested

D Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
1 ASTM A 36 Standard Specification for Structural Steel

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s literature illustrations specifications and engineering data
2 Drawings showing fabrication methods assembly accessories and installation details
3 Setting drawings templates and directions for the installation of anchor bolts and other anchorages

B Field Test Results
1 Submit a written report giving the results of the field tests required

C Manufacturer s Reports
1 Submit written report of the result of each visit by a manufacturer s serviceman including purpose and time of visit tasks performed and results obtained

D Operation and Maintenance Manuals
1 Submit for approval complete installation operation and maintenance manuals including copies of all approved Shop Drawings maintenance data and schedules and description of operation
2 Furnish operation and maintenance manuals in conformance with the requirements of Sections 01730 and 01731

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

A Deliver materials to the site to insure uninterrupted progress of the Work
1 Deliver anchor bolts and anchorage devices which are to be embedded in cast in place concrete in ample time to not delay the Work

B Store materials to permit easy access for inspection and identification Keep steel members off the ground using pallets platforms or other supports Protect steel members and packaged materials from corrosion and deterioration

C Store mechanical equipment in covered storage off the ground and prevent condensation

D Refer to Section 01610 for additional requirements

PART 2 PRODUCTS

2 01 DESIGN CRITERIA

A General The sand filters shall meet the following conditions

Quantity	1
Location	Indoors
Design Flow	75 gpm
Total Suspended Solids of Feed Stream	20 mg/l max
Effluent TSS	< 2 mg/l
Filtration Area	19 sq ft
Bed Depth	40 inches
Max Headloss Through Filter	12 24 in H_2O
Compressed Air Required	1 4 scfm@ 15 25 psig
Compressed Air Connection	1/4 inch NPT
Feed Connection	4 inches 150# flanged
Reject Connection	1 inch 150# flanged
Filtrate Connection	4 inches 150# flanged
Filtrate Sample Connection	½ inch NPT
Drain Connection	1 inch 150# NPT with screen and 2 inch 150# NPT

2 02 DETAILS OF CONSTRUCTION

A Filter Media

1 Filter media shall meet the requirements of Section 13228

2 Mixed or multiple media shall not be allowed

3 Media shall move downward through the filter be air lifted and backwashed internally and redistributed on top of the sand bed an average of 4 8 times per 24 hours

4 The use of screens wedgewires grids or any other apparatus to retain the media in place shall not be allowed

5 Backwash surface loading shall be minimum 50 100 GPM/sq Ft

B Filter

1 The filter shall operate countercurrently the feed shall be upflow and the sand media shall flow downward

2 The filters shall not contain any moving parts

3 Each tank shall have a minimum wall thickness of 0 41 inches for fiberglass reinforced plastic (FRP) and 0 25 inches for carbon steel and a minimum hopper thickness of 0 5 inches for FRP

4 The unit shall come complete with access ladder and platform conforming to the requirements of Division 5 Metals

5 The filter shall produce a continuous filtrate stream and a continuous reject stream and shall not be shutdown for any backwash cycles No backwash valves pumps or instrumentation shall be required for backwash cycles

6 Continuous sand cleaning shall be accomplished within the filter using filtered water only Filter feed shall not be used for sand cleaning

7 The air scouring rate shall be a minimum of 100 150 scfm/sq ft

8 Multiple cell filtration units shall not be acceptable

C Accessories

1 Caged Ladder with hand rail circling top of the sand filter shall be provided in accordance with OSHA

D Compressed Air System

1 The filter air supply system shall consist of a local panel including an air filter control valve air flow meter pressure regulator and pressure gauge

2 The air scouring of the sand in the air lift pipe shall exceed 50 scfm/sq ft

3 Air shall be supplied from the plant s centralized compressed air system

2 03 MATERIALS OF CONSTRUCTION

A The materials of construction shall be as follows

Tank	FRP or carbon steel
Feed Pipe	304L SS
Feed Radials	304L SS
Filtrate Weir & Flume	FRP or carbon steel
Reject Weir	FRP
Reject Flume	FRP
Central Compartment	FRP
Air Lift Pipe	304L SS
Sand Washer Housing	FRP
Sand Washer Inserts	Polyethylene
Sand Distribution Cones	304L SS

B Resin and gelcoat system for FRP material shall be premium corrosion resistant and fire retardant chlorendic polyester resins such as Hetron 197 with 5 percent Antimony Trioxide ATLAC 797 with 5 percent Antimony Trioxide or approved equal Resin shall contain ultraviolet stabilizers

2 04 FABRICATION AND MANUFACTURE

A Fabricate in sections as large as truck or rail shipment permit

B Assemble each filter in the shop Match mark with erection marks if it must be dismantled for shipment

2 05 CONTROLS

A Each filter shall be supplied with a NEMA 4 local control panel Panels shall meet the requirements of Section 13330 Control panels shall be provided with a permanent barrier to separate electric circuitry from pressure gages and flow meter tubing

B Pneumatic Controls

1 The control panel pneumatic controls shall consist of a three way valve pressure gauge pressure switch and a flowmeter The pressure gauge shall be panel mounted with a 2 1/2 inch face and a range of 0 30 psi The flowmeter shall be of the variable area type with a stainless steel indicator The meter shall have a metering valve five inch (5) scale and a range of 0 to 10 scfm Pressure switch shall be SPDT 0 5 amp at 120 VAC Flow into the pneumatic panel shall be directed through a filter and regulator which shall be provided by the manufacturer

C Electrical Controls

1 The electric controls shall open normally open air solenoid valves when the level in the filter rises They also open a normally closed auxiliary solenoid valve when an air burst is required such as following an extended shut down The auxiliary valve shall be controlled by a timer

2 Pressure switch shall be used to develop the following signals for remote Process Building Control Panel Run status and malfunction Malfunction signal shall be result of discrepancy between open air solenoid status and low pressure in the air line Provide dry contacts for above mentioned signals

D If sand filter manufacturer uses an alternate control method any additional instrumentation and wiring required shall be supplied as part of the sand filter equipment

2 06 TOOLS AND SPARE PARTS

A Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer

B Furnish and deliver the following spare parts carefully boxed or packaged and plainly marked for reordering

1 One (1) air lift pump chamber O ring
2 One (1) air lift inlet nut O ring
3 One (1) air lift pump screen
4 One (1) compressed air regulator
5 One (1) air flow indicator
6 One (1) pressure gauge

C CONTRACTOR shall store and safeguard spare parts until completion of the Work at which time they shall be inventoried delivered and placed in an area designated by the CONTRACTING OFFICER

D CONTRACTOR shall have manufacturer furnish a list of additional recommended spare parts for an operating period of one year The list shall describe each part the quantity

recommended and the unit price of the part CONTRACTING OFFICER will purchase all some or none of the recommended parts at their option

2 07 SURFACE PREPARATION AND SHOP PAINTING

A Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900

B Coat machined polished and non ferrous surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation

C Field painting is under Section 09900

2 08 ANCHORAGE DEVICES

A General

1 Furnish anchor bolts and nuts of Type 304 stainless steel of ample size and strength for the purpose intended sized by the equipment manufacturer Anchor bolts shall be hooked and provided for direct embedment during placement of concrete

2 Anchorage devices shall conform to the requirements of Section 03252

PART 3 EXECUTION

3 01 INSTALLATION

A Install filters level and in accordance with manufacturer s instructions

3 02 FIELD TESTS

A After the CONTRACTOR and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation CONTRACTOR and a qualified field service representative of the manufacturer shall conduct the following tests during Phase I of the prove out period in the presence of CONTRACTING OFFICER to demonstrate that the mechanism and its controls will function correctly and that it is structurally sound

1 Running Test a Field test sand filter together with its controls Tests shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by CONTRACTOR at his expense

3 03 MANUFACTURERS FIELD SERVICES

A CONTRACTOR shall have manufacturer s factory trained representative check and approve the installation before operation The representative shall operate and test system in the presence of CONTRACTING OFFICER and verify that the equipment conforms to

requirements and instruct plant personnel on care and maintenance The representative shall revisit the job site as often as necessary until all deficiencies are corrected

1 As a minimum manufacturer s representatives shall perform the following tests

a Sand Level Measurement to ensure that the units are filled with the amount of sand specified

b Sand circulation test to ensure that the frequency with which the sand bed is washed and redistributed to the top of the unit is as specified

2 CONTRACTOR shall supply all equipment necessary for these tests

B Testing checkout and start up of the equipment shall be performed under the technical direction of the manufacturer s factory trained representative

3 04 TRAINING

A In addition to the above requirements furnish services of a qualified factory trained operations and maintenance serviceman to instruct and train operators in the proper care operation and maintenance of the equipment These services shall be provided for the time period required under Section 01661

3 05 WARRANTY

The equipment shall be warranted against manufacturer defects for a period of one (1) year from the time of installation

END OF SECTION

TABLE 5-1 DESIGN INFLUENT AND EFFLUENT CONDITIONS SOUTHERN MARYLAND WOOD SUPERFUND SITE

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
SEMIVOLATILE COMPOUNDS			
2,4-Dimethylphenol	12	0 018	0 036
2-Methylnaphthalene	1 94		
2-Methylphenol	28 9		
4 Methylphenol	89 1		
Acenaphthene	3 2	0 022	0 059
Acenaphthylene		0 022	0 059
Anthracene	0 44	0 022	0 059
Benzo(a)anthracene	0 55	0 022	0 059
Benzo(a)pyrene		0 023	0 061
Benzo(b)fluoranthene		0 022	0 059
Chrysene		0 022	0 059
Dibenzofuran	1 96		
Fluoranthene	3 2	0 025	0 068
Fluorene	1 9	0 022	0 059
Naphthalene	19	0 022	0 059
Phenanthrene	6 4	0 022	0 059
Phenol	110	0 015	0 026
Pyrene	1 7	0 025	0 067
PCP		0 013	0 02
Bis(2-ethylhexyl)phthalate		0 103	0 279
Di-n-butyl phthalate		0 027	0 057
Diethylphthalate		0 081	0 203
Dimethyl phthalate		0 019	0 047
VOLATILE COMPOUNDS			
Acetone	0.19		
Benzene	1 4	0 037	0 136
Chloroform	0 006	0 021	0 046
Ethylbenzene	0 22	0 032	0 108
Methyl ethyl ketone	0 091		

TABLE 5-1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
Methylene chloride		0 040	0 089
Styrene	0 21		
Toluene	0 69	0 026	0 080
Xylene	0 48		
Total Purgeable VOC			0 1
INORGANICS			
Aluminum	0 324+		
Arsenic (total)	0 0155	0 2	0 4
Arsenic (trivalent)		0 019	0 036
Barium	0 109	1 0	2 0
Beryllium	0 0065		
Cadmium	<0 003	0 0011	0 0039
Calcium	19 2		
Chromium (hexavalent)		0 0011	0 0039
Chromium (total)	0 101	0 5	1 0
Cobalt	0 0104		
Copper	0 0102	0 012	0 018
Cyanide		0 0073	0 0313
Iron (total)	184		
Iron (soluble)	154	1 5	3 0
Lead	0 0875	0 0032	0 082
Magnesium	14 6		
Manganese	13 0		
Mercury	0 0009	0 000012	0 0024
Nickel	<0 014	0 16	1 4
Potassium	11		
Selenium	0 0022	0 005	0 02
Silver	<0 0049	0 00012	0 0041
Zinc	0 0724	0 11	0 12

TABLE 5-1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg	Max.
GENERAL			
BOD		5	10
TKN		--	20
TPH		--	15
TSS		30	45
Turbidity		50 NTU	150 NTU
pH		--	6 5-8 5 (min max)
Temperature		--	90°F
Dissolved Oxygen		--	5 0 (min)
Fluoride		10	20
Phosphorus		0 5	1 0
Ammonia (pH dependent)		1 2@pH 7 0 76@pH 8	18 9@pH7 5 6@pH8

ORIGINAL Red

SECTION 11212
CENTRIFUGAL PUMPS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install end suction centrifugal pumps complete and operational with motors and accessories

2 Included but not limited to are the following components for each unit
- a Pump
- b Electric motor
- c Coupling and common base
- d Accessories as specified
- e Anchorage Devices
- f Tools and spare parts

B Responsibility CONTRACTOR shall ensure that pump manufacturer furnishes all pump components and is vested with unit responsibility for the proper function of the complete system including pumps and motors as shown and specified

C Related Sections
1 Section 09900 Painting (Specifications for surface preparation and shop priming required under this Section are under Section 09900)
2 Division 13 Sections on Instruments Panels and Devices
3 Division 15 Sections on Piping and Valves
4 Division 16 Electrical

1 02 QUALITY ASSURANCE

A Manufacturer s Qualifications CONTRACTOR shall ensure that manufacturer has experience in the production of substantially similar equipment and shall show evidence of satisfactory operation in at least 5 installations

B In order to centralize responsibility it is required that all pumps motors and other equipment offered under this Section be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness of the system CONTRACTOR shall ensure that this supplier or manufacturer guarantee and is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

C Shop Tests
1 Hydrostatic Test Test each casing hydrostatically to 75 psig

2 Running Test Operate each pump assembly from zero to maximum capacity as shown on the approved performance curve One running test shall be conducted at each of the pump speeds corresponding to the design points specified in the Design Conditions Results of each test shall be shown in a plot of test curves showing head flow horsepower efficiency and current All curves shall be plotted on a single 8 5 x 11 inch sheet Readings shall be taken at a minimum of five evenly spaced capacity points for each speed including shutoff design point and maximum capacity

3 Each test shall be witnessed by a Registered Professional Engineer who may be an employee of the manufacturer He shall sign and seal all copies of the curves and shall certify that the hydrostatic tests were performed The State of his registration registration number and his name on the seal shall be legible Tests shall be conducted in conformance with applicable methods described in the Hydraulic Institute Standards

4 Motors

a Each motor shall be given a routine test in accordance with NEMA MG1 12 51 to demonstrate that it is free from defects and to provide assurance that it meets specified requirements

b Tests shall include as a minimum

1 Winding resistance
2 No load current
3 Locked rotor current
4 High potential
5 Vibration check

c Motors shall not be shipped until CONTRACTING OFFICER has approved all test reports

D Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 Standards of the Hydraulic Institute
2 National Electric Code
3 Standards of National Electrical Manufacturers Association
4 Institute of Electrical and Electronic Engineers
5 American National Standards Institute
6 Anti Friction Bearing Manufacturers Association Standards

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s literature illustrations specifications weight of unit and engineering data including dimensions materials of construction B 10 bearing life and performance data and curves showing overall pump efficiencies required net positive suction head allowable suction lift flow rate head brake horsepower motor horsepower speed and shutoff head Variable speed curves shall also be provided with five speeds plotted from maximum to minimum

ORIGINAL Red

2 Drawings showing fabrication methods assembly accessories installation details and wiring diagrams
3 Setting drawings templates and directions for the installation of anchorages if required
4 Submit detailed test plan prior to field measurements Define procedures for calibration and installation of the instruments and testing sequence
5 Certified factory and field test reports within 14 days following completion of the tests Reports shall be certified and dated and shall demonstrate that the factory tests were successfully completed prior to shipment of the equipment
6 Manufacturer s qualifications as specified in paragraph 1 2 A
7 Deviations from Drawings and Specifications

B Motor Tests and Data Submit the following
1 For each motor furnish a certified motor data sheet or a certified motor data sheet from a previously manufactured electrically duplicate motor which was tested Provide the following minimum data
a Starting torque
b Efficiency at ½ 3/4 and full load
c Power Factor at ½ 3/4 and full load
d Percent slip
e Running light full load and locked rotor current
f Temperature rises and results of dielectric tests
g Bearing type and lubrication medium
h Insulation and enclosure type
i Motor type and frame size

C Shop Test Results
1 Submit pump performance test curves Submit results of hydrostatic tests
2 Submit an inspection report for the routine test of each motor

D Field Test Results
1 Submit a written report giving the results of the field tests required

E Operation and Maintenance Manuals
1 Submit complete installation operation and maintenance manuals including copies of all Shop Drawings test reports maintenance data and schedules description of operation and spare parts information
2 Furnish operation and maintenance manuals in conformance with the requirements of Section 01730

F Lubricant Specification Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment

1 04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A Deliver materials to the site to ensure uninterrupted progress of the Work Deliver anchorage devices if needed in ample time to not delay the Work

B Store materials to permit easy access for inspection and identification Keep all materials off the ground in approved enclosed shelter Protect steel members and packaged materials from corrosion and deterioration

C Store mechanical equipment in covered storage off the ground to prevent condensation

PART 2 PRODUCTS

2 01 DESIGN REQUIREMENTS

A General

1 Provide non clog single stage centrifugal pumps suitable for continuous duty operation

2 Pumps shall be specially designed constructed and installed for the service specified and shall comply with the specified conditions

B Design Conditions

1 Process Feed Pump (P 201)

a	No of Pumps	1
b	Type	Closed coupled
c	Suction Condition	Flooded
d	Minimum Suction Size (inches)	3
e	Minimum Discharge Size (inches)	3
f	Design Flow (gpm)	75
g	Design TDH (ft)	45
h	Minimum Pump Efficiency at max flow	66
i	Motor HP (Brake)	1 5

2 AOP Feed Pump (P 401)

a	No Of Pumps	1
b	Type	Closed coupled
c	Suction Condition	Flooded
d	Minimum Suction Size (inches)	3
e	Minimum Discharge Size (inches)	3
f	Design Flow (gpm)	75
g	Design TDH (ft)	50
h	Minimum Pump Efficiency at max Flow	66
i	Motor HP (brake)	1 5

ORIGINAL Red

C Pump Materials and Construction

1 Provide each horizontal pump and motor mounted on a common steel base
   a Base shall be fabricated of A 36 structural steel
   b Provide a circumferential gutter with 1 inch NPT drain on the pump frame
   c Provide machined surfaces on bearing pads to accept pump and motor

2 Casing
   a Casing shall be end suction top centerline self venting and arranged for back pullout
   b Casing shall be constructed of 316 stainless steel Minimum thickness shall be 0 50 in
   c Seals shall be constructed of Viton
   d Provide a handhole in the casing to access the impeller and volute interior The handhole cover shall be contoured to match the pump casing
   e Casing shall be provided with vent drain and gauge connections All connections shall be 3/4 inch and located as recommended by the manufacturer
   f Casing suction and discharge flange connections shall conform with ANSI B 16 1 Class 125
   g The casing shall be split perpendicular to the shaft with removable suction cover and stuffing box such that the impeller can be removed without disturbing the suction or discharge piping
   h Provide lifting devices on the casing for handling

3 Impeller
   a The impeller shall be constructed of 316 stainless steel
   b Impeller shall be non clog type with minimum number of vanes designed to handle solids and stringy material Pump out vanes are unacceptable
   c Impeller shall be statically and dynamically balanced Impeller shall be threaded on shaft Threads shall be sealed by a teflon O ring

4 Bearing Frame
   a The bearing frame shall be one piece rigid cast iron construction ASTM A 48 Class 30
   b The frame shall be provided with a bearing housing at the outboard end and a cover at the inboard end
   c The bearing housing shall have provisions for the addition and relief of grease
   d Both ends of the bearing frame shall be provided with lip type grease seals and labyrinth type deflectors to prevent entrance of contaminants
   e The bearing frame shall be such that the complete rotating element can be removed without disconnecting piping or coupling

5 Bearings

a Bearings shall be grease lubricated anti friction tapered roller or double row ball type

b Bearings shall be contained in a dust and moisture proof enclosure

c Bearings shall carry all radial and thrust loads with a minimum B 10 life expectancy of 100 000 hours as defined by the Anti Friction Bearing Manufacturers Association Standards

6 Nameplate

a Provide each pump with a stainless steel nameplate engraved with the manufacturer s model and serial number rated capacity head speed horsepower and all other pertinent data

D Coupling

1 Provide a lubricated flexible forged steel coupling to connect the pump and motor

2 Coupling shall be sized to transmit all power from the motor to the pump over the complete operating curve and speed range

3 Coupling shall compensate for minor inaccuracies in alignment and shall permit axial adjustment

4 Coupling construction shall be such that either pump or motor may be removed without disturbing the other

5 Provide a 14 gauge stainless steel coupling guard conforming to OSHA requirements

E Motor

1 Motors shall be supplied by the pump manufacturer

2 Motor shall be an energy efficient totally enclosed solid shaft motor with Class F inverter duty insulation Class B temperature rise with a maximum speed as indicated in the Design Conditions

3 Motor shall be of proper size to drive the pump continuously at any point on the pump operating curve without exceeding the nameplate horsepower but not less than the horsepower indicated in the Design Conditions

4 Motor shall have a 1 15 service factor and shall comply with the latest ANSI NEMA and IEEE Standards as a minimum

5 Locked rotor current shall be as specified in NEMA standards

6 Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of service and shall have a minimum B 10 life of 100 000 hours

7 Motor shall have a stainless steel nameplate which shall provide the following type frame insulation class Hp full load current RPM centigrade degree rise manufacturer s name and serial number model voltage locked rotor KVA code bearing numbers and a connection diagram

8 Motors shall be capable of carrying full load current continuously without injurious temperature rise in an ambient temperature of 40 C

9 Lubrication may be grease or oil type with ball bearings

10 Furnish factory installed winding protection in each phase of the motors Winding protection shall be thermostat type

11 Motor terminal box shall be oversized to provide adequate space for connections and shall be constructed of cast iron or fabricated steel neoprene gasketed and bolted

ORIGINAL Red

The motor leads shall be permanently marked in agreement with the connection diagram

F Controls

1 The process feed pump control shall provide mix reaction manual/auto pump operation to convey effluent from the mix reaction tank T 201 to the plate separator ME 303

2 The AOP feed pump control shall provide manual/auto pump operation to convey effluent from AOP reactor feed tank (T 401) to the AOP reactor system (ME 401)

2 02 TOOLS AND SPARE PARTS

A Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer

B Furnish and deliver the following spare parts for each pump carefully boxed or packaged and plainly marked for reordering

1 One set of packing
2 One set of gaskets
3 One shaft sleeve
4 One set of wearing rings
5 One complete set of O rings
6 One complete set of pump bearings
7 One complete set of motor bearings
8 Lubricant as specified by manufacturer in amount to equal at least one change
9 One spare impeller

C CONTRACTOR shall store and safeguard spare parts until completion of the Work

D CONTRACTOR shall obtain from manufacturer and furnish a list of additional recommended spare parts for an operating period of one year The list shall describe each part the quantity recommended and the unit price of the part

2 03 SURFACE PREPARATION AND SHOP PAINTING

A Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900

B Coat bearing gear and similar machined polished and non ferrous metal surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation

C Field painting is under Section 09900

PART 3 EXECUTION

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3 01 INSTALLATION

A Install the pumps in complete accordance with the manufacturer s instructions and with Section 01620

B Furnish and install all required oil and grease for initial operation

C Provide neatly placed 1 inch hard copper pipe from each pump convey leakage to nearest drainage inlet

D Support piping independent of pump

3 02 FIELD TESTS

A After CONTRACTOR and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a running test of each pump and its controls during Phase I of the prove out period in the presence of CONTRACTING OFFICER to demonstrate that each unit and its controls will function correctly

1 Running Tests

a Field test all pumping units together with their controls Tests shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by CONTRACTOR at his expense CONTRACTING OFFICER shall furnish all power required for the tests

b In the event that the manufacturer is unable to demonstrate to CONTRACTING OFFICER that his equipment meets the requirements of the above described test the deficient equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

c Prior to applying electrical power to any motor driven equipment the drive motor shall be rotated by an external source to demonstrate free operation of all mechanical parts

3 03 MANUFACTURER S SERVICES

A Furnish the services of a qualified factory trained service representative to assist in the installation of the equipment check the installation before it is placed into operation assist in the performance of field tests supervise initial operations and instruct the plant operators in the care operation and maintenance of the equipment

B In addition to the above requirements furnish services of a qualified factory trained operations and maintenance serviceman to instruct and train operators in the proper care operation and maintenance of the equipment

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C Reports Submit report by manufacturer of each visit to the site Reports shall provide complete information on time schedule tasks performed persons contacted problems corrected test results training instruction and all other pertinent information

3 04 WARRANTY

The equipment shall be warranted against manufacturer s defects for a period of one (1) year from the date of installation

END OF SECTION

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SECTION 11225
INCLINED PLATE SEPARATOR
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall provide all equipment materials and services for the supply and installation of a metals removal system for installation in the groundwater treatment system The system shall consist of an inclined plate separator and flash mix and flocculation tanks with mixers

B This section covers the requirements for the functional design performance construction features testing quality and handling of the equipment described in the following sections

C All components of the system including pumps piping tanks fittings valves chemicals and instrumentation and controls shall be provided completely assembled and shall be a skid mounted packaged unit

1 02 SYSTEM DESCRIPTION

A The Contractor shall provide metals removal system to provide rapid mixing flocculation and precipitation of metal hydroxide from the groundwater prior to filtration and UV oxidation

B The groundwater shall be pumped at a maximum flowrate of 75 gpm from the Mix Reaction Tank (T 201) to the Inclined Plate Separator (ME 303)

C The incline plate separator system shall include a rapid mix chamber with agitator for coagulant mixing and a flocculation tank with agitator for polymer mixing and floc aggregation

1 03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

A The Contractor shall guarantee the following performance of the metals removal system per Table 5 1

1 04 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the CONTRACTING OFFICER

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C Review of the drawings by the CONTRACTING OFFICER shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2 Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3 Six (6) copies of the operation and maintenance manual for the equipment provided

1 05 APPLICABLE CODES AND REGULATIONS

A ASTM A 36

B ANSI SSPC SP10

PART 2 PRODUCTS

2 01 EQUIPMENT

A The metals removal system shall have a maximum platform height (excluding railings) of 16 6 to allow for installation in the building and allow sufficient clearance between the building ceiling and the top of the lamella unit for removal and cleaning of the inclined plates The clearance height in the building will be 20 feet (maximum)

B Each clarifier shall be designed to the following standards to provide efficient precipitation settling and removal of iron maganese and other metal hydroxides and suspended solids from the groundwater influent at a flow rate of 75 gpm (maximum)

Influent flow gpm	75
Underflow Sludge Withdrawal Frequency	Intermittent
Minimum Effective Settling Rate gpm/Ft2	0 45 (*)
Minimum Effective Settling Area ft^2	240
Plate Inclination Angle degrees	55
Minimum Plate Spacing inches	2 0
Effluent Characteristics	TSS < 2 mg/L

(*) To be verified by equipment manufacturer

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Each Flash Mix/Flocculator Tank shall be designed to the following standards

Flow Through gpm	75
Minimum Flash Mix Detention Time seconds	30
Minimum Flocculator Detention Time minutes	2 5
Minimum Flash Mix Volume gallons	40
Minimum Flocculator Volume gallons	200
Flash Mix Mixer Motor HP	½
Flocculator Mixer Motor HP	½ DC variable speed drive

C The system shall be provided with hinged gasketed covers capable of withstanding a loading of 50 lbs per sq ft The covers shall allow ready access to the tank for inspection and cleaning or repair but in the closed position shall be gas tight The Flash Mix Tank and Flocculation Tank covers shall be equipped with hinged and gasketed inspection hatches located above each compartment The Inclined Plate Separator cover shall also be equipped with a hinged and gasketed inspection hatch located above the effluent weir Vent connections to the covers shall be easily disconnected using flex or quick connections or unions

1 The rapid mix compartment shall have a minimum volume of 40 gallons and shall include appropriate connections for system operations These include but are not limited to

inlet	3 flanged
drain	4 flanged
chemical feed nozzles (2)	½ flanged
vent	2 flanged
mixer slot	varies

2 Rapid mix agitator shall be top mounted electrically operated as manufactured by Neptune or equal Mixer shall have stainless steel wetted parts and be installed on a 45 degree angle

Mixer shall be rigidly attached to the tank and have a TEFC motor operating on 110 volt single phase Motor horsepower shall be sufficient to ensure proper mixing and shall not exceed 1 hp Tank cover shall include a cut out sufficient in size to allow proper mounting and operation of the mixer Any open space around the mixer shaft shall be eliminated to the maximum extent possible using a 1/4 thick flexible neoprene gasketing permanently fixed to the tank cover

3 Flocculation compartment shall have a minimum volume of 200 gallons and shall include appropriate connections for system operation These include but are not limited to

inlet	integral to rapid mix tank

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sludge underflow	3 flanged
vent	2 flanged
mixer slot	varies

4 Flocculation mix agitator shall be top mounted electrically operated Mixer shall have stainless steel wetted parts and installed on a 45 degree angle

Mixer shall be rigidly attached to the tank and have a TEFC motor operating on 110 volt single phase Motor horsepower shall be sufficient to ensure proper mixing and shall not exceed 1 hp Tank cover shall include a cut out sufficient in size to allow proper mounting and operation of the mixer Any open space around the mixer shaft shall be eliminated to the maximum extent possible using a 1/4 thick flexible neoprene gasketing permanently fixed to the tank cover Mixer shall include a variable speed drive suitable for the intended use and shall be capable of operation from 0% to 100% RPM Variable speed drive may be mounted on local control panel

5 The inclined plate clarifier shall include appropriate connections for system operation These include but are not limited to

inlet	integral w/flocculation zone
drain	2 flanged
vent	flanged
effluent	4 flanged
sludge outlet	2 flanged
sludge sample taps	½ (total of three)

D The Contractor shall provide a complete NEMA 4 stainless steel factory pre wired control panel suitable for a 120 volt single phase power supply Enclosure shall have a front hinged door polyurethane epoxy paint finish and be mounted on the skid Panel shall include dry contacts for remote monitoring of the mixer status from the central control panel

2 02 ACCESSORIES

A The entire system shall be skid mounted on a skid of materials and structural design consistent with the systems intended use

2 03 FABRICATION AND FINISHING

A Metal tanks compartments manways and manway extensions shall be fabricated of 1/4 inch ASTM A285 Grade C A215 Grade B or A 36 epoxy coated steel with all seams double welded Surface precipitation shall be in strict accordance with coating manufacturer s recommendations for sand blasting primer and final coat application

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B All internal tank cover and fitting surfaces shall be shop coated to SSPC SP6 near white metal blast and coated with Phenoline 368WG 20 mils (DPT) suitable continuous immersion service in water with excess of 100 mg/L of phenolic compounds

C All exterior surfaces shall be prepared to SSPC SP6 commercial blast and coated with a first coat of DuPont Corlar 825 Y 9031NF Y 632 high building chromate free primer 4 mils (DFT) min color is red oxide Finish coat shall be DuPont Imron 326 aliphatic polyurethane enamel 2 mils (DFT) finish color is Safety Blue (#326 Y 23665N6 Y 511)

D Workmanship shall be first quality and all welding shall be in accordance with American Welding Society standards and in accordance with qualified welding procedures of the governing standards and include but are not limited to the following guidelines

1 AWS A2 0 Structural Symbols
AWS D1 1 Structural Welding

2 The edges of surfaces of the parts to be joined by welding shall be machined or thermal cut and cleaned of all oil grease scale rust or other deleterious material Where thermal cutting is used all loose scale must be removed All remaining kerf material (that fused during the cutting process) and sharp cut surface cavities must be removed or blended by grinding or chipping to assure proper weld penetration

3 Filler material to be used for joining must be analytically compatible with base metal primary consideration shall be given to mechanical properties corrosion resistance and welding response as applicable for the particular application

E Nozzles and manways as required shall be attached by full penetration welds of both the wall and the reinforcing attachment Welds which penetrate the full thickness of the nozzle neck or manway neck will not be accepted

F All nozzles manways and internal components shall be accurately located both vertically and radially in accordance with the design drawing as provided by the Supplier to the nearest ± ¼ inch

G All flange connections as required shall be flush trimmed with the inside surface of the vessel and finished unless indicated otherwise on the drawings provided by the Supplier

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed in accordance with the requirements of the Contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

D Contractor shall furnish and install on the forms for the concrete pads all anchor bolts required for the installation of the equipment Contractor shall be responsible for size and location of all recesses slab openings and inserts required and shall bear the expense of all corrective work necessary should any be omitted or not properly located

3 02 TESTING AND INSPECTION

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the Specification and intended use

B The system shall be hydrostatically tests for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

C The hydrostatic testing procedure shall include a cyclic pressure test in which the piping system is subjected to a minimum of 10 pressurization cycles with water at 1 5 times the design operating pressure After the last pressure cycle the test procedure shall be maintained for one to eight hours while the line is inspected for leaks

3 03 WARRANTY AND PERFORMANCE GUARANTEE

A Equipment shall be warranted against manufacturer defects for a period of one (1) year from date of installation The vendor will provide a process performance guarantee that the clarifier overflow will meet discharge requirements total suspended solids of <10 mg/L

END OF SECTION

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SECTION 11241
POLYMER FEED SYSTEM

PART 1 GENERAL

1 01 Summary

A The Contractor shall provide all equipment materials and services for the supply and installation of a polymer feed system for installation in the groundwater treatment system

B This section covers the requirements for the functional design performance construction features testing quality and handling of the equipment described in the following sections

C All components of the system including pumps piping tanks fittings valves chemicals and instrumentation and controls shall be provided completely assembled and shall be a skid mounted packaged unit

1 02 System Description

A The Contractor shall provide a skid mounted polymer feed system which shall include a module and a 55 gallon drum mixer

1 03 Submittals

A The Contractor shall submit in the manner and within the time limit as set forth in the Contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts list if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1) Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2) Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3) Six (6) copies of the operation and maintenance manual for the equipment provided

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PART 2 PRODUCTS

2 01 Equipment

A Polymer Feed Module

1) The polymer feed module must be constructed internally and externally of compatible materials

2) The pump shall be the diaphragm transfer type equipped with an electrically manually controlled variable stroke Stroke adjustment signal shall have a 4 20 mADC linear relationship 0 100% of the capacity

3) The pump motor signal shall operate on 110 Volt power It shall come equipped with a pulsation dampener and a downstream back pressure valve sized in accordance with its use

4) The metering pump shall provide a capacity of 0 100 gph at 0 25% concentration Maximum polymer feed rate shall be 0 42 gph at 100 psig output pressure The static head requirement shall be sufficient to provide polymer solution to the flocculation portion of the metals removal system The total dynamic head requirement shall be approximately 20 ft

5) Water supply pressure to the system shall be 35 psi minimum

2 02 Accessories

A The polymer feed module bracket shall be provided for wall mounting of the module

PART 3 EXECUTION

3 01 Erection/Installation

A The equipment shall be installed in accordance with the requirements of the Contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

3 02 Testing and Inspections

A Each system component shall be given requisite factor tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction

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meet the requirements of the Specification and intended use

B The system shall be hydrostatically tested for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

C The hydrostatic testing procedure shall include a cyclic pressure test in which the piping system is subjected to a minimum of 10 pressurization cycles with water at 1 5 time the design operating pressure After the last pressure cycle the test pressure shall be maintained for one to eight hours while the line is inspected for leaks

3 03 Warranty

Equipment shall be warranted against manufacturer defects for a period of one (1) year from the date of installation

END OF SECTION

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SECTION 11242
SODIUM HYDROXIDE FEED SYSTEM

PART 1 GENERAL

1 01 Summary

A The Contractor shall provide all equipment materials and services to be for the supply and installation of a sodium hydroxide feed system for installation in the treatment system

B This section covers the requirements for the functional design performance construction features testing quality and handling of the equipment described in the following sections

C All components of the system including pumps piping tanks fittings valves chemicals and instrumentation and controls shall be provided completely assembled and shall be a skid mounted packaged unit

1 02 System Description

A The Contractor shall provide a skid mounted sodium hydroxide feed system which shall include 960 gal storage tank and one chemical feed pump

B The tank shall be of High Density Crosslinked Polyethylene (HDPE) construction

1 03 Submittals

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts list if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1) Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2) Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

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3) Six (6) copies of the operation and maintenance manual for the equipment provided

PART 2 PRODUCTS

2 01 Equipment

A Sodium Hydroxide Storage Tank

1) The sodium hydroxide storage tank shall provide 960 gallons of storage capacity and shall be constructed of an HDPE

2) The tank shall be flat bottom with domed top approximately 5 ft 4in diameter by 7 ft 0 in high and shall be mounted with the caustic metering pump on a common skid

3) The bottom tote bin shall be equipped with two (2) 1 connections with isolation valves for level instrumentation mounting level gauge a 1 pump connection and 1 connection for draining top tote bin

4) The tote bins shall be provided with a stand to support the replaceable top tote

B Caustic Feed Pumps

1) The feed pumps must be constructed internally and externally of 50% sodium hydroxide compatible materials

2) The pumps shall be the diaphragm transfer type equipped with a manually controlled stroke

3) The pump shall provide a capacity of 0 1 gph The static head requirement shall be sufficient to provide sodium hydroxide to the mix reaction tank The pump shall operate on 110V power and come equipped with a pulsation dampener and downstream back pressure valve sized in accordance with its use

The following fittings shall be provided with the tank

Fill nozzle	2 150 lb flange (top)
Pump suction	½ half coupling
U Vent	2
Drain	1 half coupling
Manway	14 gasketed
2 spares	2 each

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C Motors

1) All motors shall be supplied with their driven equipment All motors shall be compatible with the driven equipment

2) AC motors shall be rated for one phase 110 volts 60 Hz operation

3) Each motor shall have a suitable means for attaching grounding conductor Supplier s standard grounding means shall be used

4) All motors shall be drip proof for indoor use

5) Each motor shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the contract documents

2 02 Fabrication/Finishing

A The tote bins shall be fabricated of crosslinked high density polyethylene

PART 3 EXECUTION

3 01 Erection/Installation

A The equipment shall be installed in accordance with the requirements of the contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

3 02 Testing and Inspections

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the Specification and intended use

B The system shall be hydrostatically tested for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

3 03 Warranty

Equipment shall be warranted against manufacturer defects for a period of one (1) year from the date of shipment

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SECTION 11244
LIQUID PHASE CARBON ADSORPTION SYSTEM
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall supply and provide all materials fabrication drawings erection design installation testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of the liquid phase carbon adsorption system as included in the contract documents

B This section covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment described herein

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the Contractor to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

1 02 SYSTEM DESCRIPTION

A The carbon adsorption system shall be used for condensate treatment to remove acetone/ketone or other cracking compounds from the soil thermal unit before discharge and will follow the Advanced Oxidation Process (AOP) Reactor System (UV oxidation) The carbon adsorber will be designed and installed completely skid mounted with all necessary isolation and diversion valves controls face piping and appurtenances The carbon adsorption system shall consist of 2 (two) 5 000 Ib capacity carbon adsorber vessels The system piping shall allow for the adsorber vessels to be used in series or in parallel

1 03 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the CONTRACTING OFFICER

C Review of the drawings by the CONTRACTING OFFICER shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

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D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2 Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3 Six (6) copies of the operation and maintenance manual for the equipment provided

1 04 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

Flow	75 gpm (max)
Temperature	55 100 F
Influent Characteristics	Phenol 35 mg/L Others 10 % of the influent characteristics summarized in Table 5 1 represent the expected average concentrations to the carbon adsorption system
Effluent	See Table 5 1

A Contractor shall guarantee the carbon adsorption system shall remove all the constituents present in this section to levels below the required criteria

PART 2 PRODUCTS

2 01 EQUIPMENT

A Any reference to a manufacturer s name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired and is not to be considered proprietary In all cases any comparable source or device is acceptable upon approval by the CONTRACTING OFFICER

B Equipment described under this section shall be furnished by manufacturers who are experienced reputable and qualified in the manufacture of carbon adsorption systems The manufacturer shall be fully responsible for the proper operation and performance of the system as a whole

C The carbon adsorption system shall include two (2) liquid phase activated carbon adsorber vessels all necessary valves controls face piping and appurtenances Each vessel shall be capable of filtering a maximum flow of 75 gpm

D Provide carbon adsorbers containing reactivated granular activated carbon manufactured from bituminous coal meeting or exceeding the requirements below

E Select the activated carbon characteristics to remove the volatile organic compounds to the concentrations previously listed The selected carbon however shall meet the following requirements as a minimum

Iodine No (minimum)	900
Abrasion No (minimum)	75
Effective Size	0 8 1 0 mm
Screen Analysis	
over 8 mesh (maximum %)	15
under 30 mesh (maximum %)	4
Water Soluble Ash (maximum %)	0 5
Moisture as packed (maximum %)	2

2 02 ADSORBER VESSELS

A Each adsorber vessel shall be lined carbon steel and have a sufficient straight side for holding 5 000 pounds of activated carbon Vessel shall be 5 feet in diameter

B The adsorbers shall be designed for a working pressure of 75 psig and a test pressure of 1 5 times the working pressure Maximum differential pressure shall not exceed 15 PSIG

C The adsorbers shall be designed for a working temperature of 80 F and a maximum temperature of 140 F

D Adsorbers and framing shall be shop primed and finished in accordance with Section 09900 of this Specification Finished color shall be Safety Blue

2 03 PIPING/PIPE RACK

A The process and utility piping on the adsorption system shall include influent water to the system treated water (effluent) adsorber vent lines and GAC discharge piping The influent and effluent piping shall be installed such that the adsorbers can be operated in parallel or series The connections to the carbon vessels shall be flanged type

B Effluent piping shall be Schedule 80 PVC

2 04 AUTOMATIC SIPHON BREAK

A The effluent from the adsorption system shall be equipped with an automatic vacuum breaker to prevent draining of the adsorption system should influent flow be stopped

2 05 PRESSURE RELIEF

A A pressure relief valve shall be provided for each vessel with relief capacity as required by ASME Code and hydraulic system analysis Relief venting shall be integral to adsorption system piping and directed to a common collection point

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2 06 PRESSURE GAUGES

A The process piping shall be equipped with pressure gauges to indicate the pressure of water entering and exiting each adsorber to provide information on pressure drops across each adsorber and the system The pressure indicating gauge shall be 4½ inches (face diameter size) with a stainless steel bourdon tube in a glycerin filled housing The gauge shall read 0 50 psig with an accuracy of 1 % of full range

2 07 STRUCTURAL STEEL SUPPORT SKID

A All equipment items comprising the adsorption system shall be contained on one or two structural steel skids All steel contained in the skid shall be grade A36 carbon steel The skid shall consist of two outside channels with slotted holes in the bottom flange for easy removal via fork lifting with all necessary cross bracing The skid shall also or at least include a superstructure consisting of vertical channels and horizontal channels for lifting of the entire unit and pipe support An operating area shall be provided on the skid including safety plate (at top elevation of outside channels) and location on the superstructure for attachment of pressure gauges and operating valves

B All structural steel shall be cleaned to a power tool grade (mechanical grade) and a rust inhibitive alkyd metal primer shall be applied before any rust can form A finish exterior painting of an alkyd resin based paint for outside service must be applied to the exterior of the piping before rust can form beneath the primer coat

All equipment items shall be installed on the structural steel skid and secured for shipment Field connections shall be clearly noted with any extra materials secured to and shipped with the skid system

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A Installation procedures shall be in accordance with the recommendations of the manufacturers of the carbon vessels Installation of the carbon vessels will not be allowed to proceed until the recommendations are received and approved by the Engineer

3 02 TESTING AND INSPECTIONS

A Equipment Testing

1 Notify the CONTRACTING OFFICER five (5) working days prior to conducting any tests listed in the Specification to permit the CONTRACTING OFFICER to witness said tests Witness of any test shall not be deemed acceptance of the component or system tests nor waive any on site acceptance thereof

2 All non destructive testing examinations shall be performed in accordance with the ASME ANSI or ASTM codes The cost of repair and/or any additional non destructive testing shall be borne by the Contractor The Contractor shall submit his/her test procedures to the CONTRACTING OFFICER for approval

3 Prior to final inspection the inside and outside of all vessels piping and instruments shall be cleaned of slag loose scale dirt grit weld splatter pieces of metal oil etc

B System Acceptance Test

1 After the manufacturer s service engineer has inspected the system installation and is satisfied that it has been installed in accordance with his/her drawings the Contractor together with the manufacturer s service engineer shall schedule system testing and start up When the Contractor has made the adjustment he/she deems necessary for proper performance the first of the performance tests required shall be conducted

2 The guaranteed items of performance shall be verified by tests in accordance with this Section

3 The tests shall be organized conducted and reported by the manufacturer s service engineer and the Contractor except that the CONTRACTING OFFICER will furnish personnel to assist in reading and recording system measurements and provide input for any chemical analysis required by the Contractor The length of the test period shall be a minimum three (3) days continuous operation in accordance with the specification

4 Performance testing for the liquid phase carbon adsorption system shall demonstrate

1 Hydraulic capacity of the adsorber vessels

2 Operation of vessel sequencing operation of vessels in various positions (lead lag parallel)

3 Ability of vessels to meet design criteria listed in paragraph 1 04 of this section

5 If the performance is not met in all respects during the first test the Contractor and manufacturer s service engineer shall immediately take whatever remedial steps are necessary and shall restart and retest for the period referenced above to demonstrate that the performance is met If equipment still does not meet Contractor s guaranteed performance it shall be removed by the Contractor and replaced with equipment that meets performance standards at no additional cost to the Contracting Officer

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3 03 WARRANTY

Equipment shall be warranted against manufacturer defects for a period of one (1) year from the date of installation

END OF SECTION

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TABLE 5 1 DESIGN INFLUENT AND EFFLUENT CONDITIONS SOUTHERN MARYLAND WOOD SUPERFUND SITE

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max
SEMIVOLATILE COMPOUNDS			
2 4 Dimethylphenol	12	0 018	0 036
2 Methylnaphthalene	1 94		
2 Methylphenol	28 9		
4 Methylphenol	89 1		
Acenaphthene	3 2	0 022	0 059
Acenaphthylene		0 022	0 059
Anthracene	0 44	0 022	0 059
Benzo(a)anthracene	0 55	0 022	0 059
Benzo(a)pyrene		0 023	0 061
Benzo(b)fluoranthene		0 022	0 059
Chrysene		0 022	0 059
Dibenzofuran	1 96		
Fluoranthene	3 2	0 025	0 068
Fluorene	1 9	0 022	0 059
Naphthalene	19	0 022	0 059
Phenanthrene	6 4	0 022	0 059
Phenol	110	0 015	0 026
Pyrene	1 7	0 025	0 067
PCP		0 013	0 02
Bis(2 ethylhexyl)phthalate		0 103	0 279
Di n butyl phthalate		0 027	0 057
Diethylphthalate		0 081	0 203
Dimethyl phthalate		0 019	0 047
VOLATILE COMPOUNDS			
Acetone	0 19		
Benzene	1 4	0 037	0 136
Chloroform	0 006	0 021	0 046
Ethylbenzene	0 22	0 032	0 108
Methyl ethyl ketone	0 091		

TABLE 5 1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
Methylene chloride		0 040	0 089
Styrene	0 21		
Toluene	0 69	0 026	0 080
Xylene	0 48		
Total Purgeable VOC			0 1
INORGANICS			
Aluminum	0 324+		
Arsenic (total)	0 0155	0 2	0 4
Arsenic (trivalent)		0 019	0 036
Barium	0 109	1 0	2 0
Beryllium	0 0065		
Cadmium	<0 003	0 0011	0 0039
Calcium	19 2		
Chromium (hexavalent)		0 0011	0 0039
Chromium (total)	0 101	0 5	1 0
Cobalt	0 0104		
Copper	0 0102	0 012	0 018
Cyanide		0 0073	0 0313
Iron (total)	184		
Iron (soluble)	154	1 5	3 0
Lead	0 0875	0 0032	0 082
Magnesium	14 6		
Manganese	13 0		
Mercury	0 0009	0 000012	0 0024
Nickel	<0 014	0 16	1 4
Potassium	11		
Selenium	0 0022	0 005	0 02
Silver	<0 0049	0 00012	0 0041
Zinc	0 0724	0 11	0 12

TABLE 5 1 (continued)

Compound	Influent Concentration (mg/L)	Permitted Effluent Concentration (mg/L)	
		Avg.	Max.
GENERAL			
BOD		5	10
TKN			20
TPH			15
TSS		30	45
Turbidity		50 NTU	150 NTU
pH			6 5 8 5 (min max)
Temperature			90°F
Dissolved Oxygen			5 0 (min)
Fluoride		10	20
Phosphorus		0 5	1 0
Ammonia (pH dependent)		1 2@pH 7 0 76@pH 8	18 9@pH7 5 6@pH8

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SECTION 11265
OIL/WATER SEPARATION SYSTEM

PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall supply and provide all materials fabrication drawings design installation testing and delivery of services as specified in this section and/or on the drawings for complete installation and proper operation of the oil/water separation system as part of the groundwater treatment system

B This section covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment described herein

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the Contractor to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

D The work includes supply delivery complete installation and testing of the three phase oil/water separation system as part of the groundwater treatment system

1 02 SYSTEM DESCRIPTION

A The Contractor shall provide a skid mounted system which shall include an oil/water separator and integral product collection chamber The system shall be capable of treating groundwater at an expected maximum flow rate of 75 gpm and an average temperature of 55 F

B The separator shall remove LNAPL DNAPL and suspended solids from the groundwater which also may contain ppm levels of volatile organic compounds inorganics and other contaminants

C The system shall be capable of treating varying flowrates from 0 75 gpm

D The Contractor shall provide a comprehensive operation and maintenance manual fabrication shop testing shipping and start up assistance necessary for a complete system Start up assistance shall be provided by the Contractor on an as needed basis

1 03 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1) Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of hardware anchors fastenings and accessories

2) Shop drawings for the fabrication and installation which are not fully dimensioned or detailed in Manufacturer s data Provide setting drawings and templates

3) Provide instructions for installation of anchorage devices

4) Six (6) copies of the operation and maintenance manual for the equipment provided

1 04 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

A The system shall be designed to remove LNAPL (specific gravity of 0 80) and DNAPL (specific gravity of 1 07) from a total of 93 mg/l to levels less than 10 mg/l

PART 2 PRODUCTS

2 01 EQUIPMENT

A Details of the various components are presented below The general arrangement and design of all working parts shall allow ready access for inspection replacement repair and lubrication Adequate drain venting and flushing connections shall be provided

B The system shall be capable of accommodating uncontrolled surges of water non aqueous phases or mixtures ranging from zero flow up to 100% of maximum hydraulic through put capacity and maintain a water effluent containing less than 5 ppm of hydrocarbon Excess flow bypass flow control valves or mechanical adjustments are not acceptable

C The separator vessel shall have internal compartments to include a separation chamber DNAPL sump and a LNAPL chamber

2 02 OIL/WATER SEPARATION

A The oil/water separator tank shall incorporate zones or chambers for raw water hold up LNAPL separation via flow through an inclined plate pack DNAPL storage and clean water

chamber The tank shall be sized to provide a minimum of 15 minutes detention time at 75 gpm flow rate

B The oil/water and solids separation shall be accomplished by the use of an inclined plate pack Plates shall be at an angle of 45 and spaced 3/4 apart The plates shall be fabricated of PVC Continuous stiffeners shall run the full length of the plate pack The plate pack shall be suitable for coalescence of oil particles that are 20 microns in diameter and larger The plate pack shall be removable and easily accessible for maintenance purposes

C The influent and effluent of process water to the active plate area shall be engineered such that they remain submerged during operation of the unit

D The LNAPL reservoir shall be sized to hold a minimum of 59 gallons The DNAPL chamber shall be sized to hold a minimum of 70 gallons

E Nozzles shall be provided for influent and effluent water flows LNAPL gravity overflow DNAPL removal and vents All nozzles shall be provided with ANSI 125 lb flanges

F A rectangular water overflow weir shall be provided and designed for ½ inch maximum water crest

G No moving adjustable or disposal parts shall be included in the design Access hatches shall be furnished complete with covers neoprene gaskets and bolts and shall be watertight

H A steel platform and access stairs shall be provided to access the top of the separator unit The steel platform shall be capable of supporting maintenance personnel

2 03 SYSTEM PIPING

A All required valving shall be supplied including isolation and check valves In addition pressure relief valves shall be provided to protect the pumps

B All system piping shall be adequately supported on the skid to prevent damage during shipping and operation

2 04 ACCESSORIES

A The oil/water separator system including collection tank and discharge pumps shall be mounted on a structural steel skid to facilitate shipping and installation An access caged ladder in accordance with OSHA and access platform with handrails of steel construction shall be provided for maintenance of the oil/water separator

B Clips and brackets shall be provided for pipe supports and shall be constructed of the same material as the vessel

C Lifting lugs supports rings or other attachments required for installation and erection shall be provided

D All materials required for proper shipment of the system equipment and accessories to the site shall be supplied and may include crating covers etc

2 05 FABRICATION/FINISHING

A Tanks compartments manways and manway extensions shall be fabricated of 3/16 inch ASTM A285 Grade C A215 Grade B or A36 coated steel with all seams double welded Surface preparation shall be in strict accordance with coating manufacturer s recommendations for sand blasting primer and final coat application

B Carbon steel shall be coated with polyurethane

C All nozzles manways and internal components shall be accurately located both vertically and radially in accordance with the design drawing as provided by the Supplier to the nearest ± 1/4 inch

D All flange connections as required shall be flush trimmed with the inside surface of the vessel and finished unless indicated otherwise on the drawings provided by the Supplier

E The separator lid shall be totally removable by quick release half turn latches

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed in accordance with the requirements of the contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

D Contractor shall furnish and install on the forms for the concrete pads all anchor bolts required for the installation of the equipment Contractor shall be responsible for size and location of all recesses slab openings and inserts required and shall bear the expense of all corrective work necessary should any be omitted or not properly located

3 02 TESTING AND INSPECTIONS

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the Specification and intended use

B The system shall be hydrostatically tested for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

3 03 WARRANTY

Equipment shall be warranted against manufacturer defects for a period of (1) year from the date of installation

* * * * *

END OF SECTION

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SECTION 11312
SUMP PUMPS

PART 1 GENERAL

1 01 DESCRIPTION

a Scope Contractor shall furnish all labor materials equipment and incidentals required to provide and install two (2) end suction centrifugal submersible non clog type pumps complete and operational with motors and starters required controls piping and valving and other appurtenances as shown and specified

b One (1) pump (P 305) and appurtenances will be installed in the Floor Sump (T 305)
One (1) pump (P 503) and appurtenances will be installed on the Decant Tank (T 503)

c Related Work Specified Elsewhere

1 Division 15 Sections on Piping and Valves
2 Division 13 Sections on Plant Monitoring and Control
3 Division 16 Electrical

1 02 QUALITY ASSURANCE

a Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 Standards of the Hydraulic Institute
2 National Electric Code
3 Standards of National Electrical Manufacturers Association
4 Institute of Electrical and Electronic Engineers
5 American National Standards Institute
6 Standards of American Water Works Association

b Manufacturer s Qualifications Contractor shall ensure that the supplier or manufacturer has at least 10 years experience in producing similar equipment and can show evidence of at least 5 installations in satisfactory operation

c It is required that all equipment provided under this Section be furnished by a single supplier or manufacturer Contractor shall ensure that the supplier or manufacturer assumes full responsibility for the completeness of the system Contractor shall ensure that the supplier or manufacturer is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

d Shop Tests

1 Pump casings shall be hydrostatically tested to twice the discharge head or 1 5 times the shutoff head whichever is greater

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1 03 SUBMITTALS

a Shop Drawings Submit for approval the following

1 Manufacturer s literature illustrations specifications and engineering data including dimensions materials size weights performance data and curves showing overall pump efficiencies flow rate head brake horsepower motor horsepower speed and shut off head

2 Shop Drawings showing Fabrication assembly installation and schematic wiring diagrams

3 Copies of pump tests

4 Motor tests and data

5 Manufacturer s qualifications as specified in paragraph 1 2 B

b Contractor shall furnish Operation and Maintenance manuals which shall include copies of approved shop installation and electrical wiring and connection drawings The manuals shall be in conformance with the requirements of Section 01730 and the specific requirements listed below The manuals shall be furnished at the time the equipment is shipped from the factory or earlier

1 Each manual shall contain all necessary information on support and pump equipment such as pumps controls etc supplied by other manufacturers

2 A specific summary of maintenance and lubrication requirements shall be provided for each individual piece of equipment including all its component parts which may require servicing Manuals which describe general information on manufacturer s complete line of equipment will not be acceptable

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

a Prior to shipping the equipment shall be inspected for completeness and conformance with approved Shop Drawings and then boxed or crated by the manufacturer to prevent damage during shipment All machines surfaces or matching connections shall be suitably protected to prevent damage

b All boxes crates or packages shall clearly identify their contents by name or tag number using a packing slip affixed to the outside of the container

c Contractor shall be responsible for safe transportation including freight costs for delivery to job site unloading at the site in the location designated by the purchaser procuring any necessary permits handling and storage

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PART 2 PRODUCTS

2 01 SERVICE CONDITIONS

a Unless indicated the pumps shall be submersible end suction centrifugal non clog type The pumps shall be specially designed constructed and installed for the services intended and shall comply with the following minimum conditions

PUMP P 305

LOCATION	FLOOR SUMP
Number of Units	1
pH Range	6 to 9
Temperature	Ambient
Design Flow (gpm)	25
Design TDH (ft)	35
Minimum Pump Efficiency at Design Flow	58
Brake Motor Horsepower (max)	0 3
Suction Size (inches)	0 25
Discharge Size (inches)	1

PUMP P 503

LOCATION	DECANT TANK
Number of Units	1
pH Range	6 to 9
Temperature	Ambient
Design Flow (gpm)	20
Design TDH (ft)	25
Minimum Pump Efficiency at Design Flow	50
Brake Motor Horsepower	0 3
Suction Size (inches)	2
Discharge Size (inches)	2

b The pumps shall be designed for operation under complete submersion partial submersion and also under dry conditions

2 02 DETAILS OF CONSTRUCTION

a Pumps

1 The stator casing oil casing and impeller shall be of cast iron construction The impeller shall be of a single vane non clog design capable of passing solids and fibrous material Floor sump pump shall have cast iron body and impeller Decant pump wetted parts shall be made of corrosing resistant material

2 Each pump shall be provided with a mechanical seal composed of two face seals one stationary and one rotating tungsten carbide or silicon carbide ring held in contact by spring pressure The seal shall require neither maintenance nor adjustment and shall

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be easily replaceable Each seal interface shall be held in contact by spring pressure

3 The volute shall be of a single piece with smooth internal surfaces free of rough spots or flashing and shall be capable of passing solids through the impeller

4 A suitable lifting ring shall be provided on the top of the pump

5 Brass or stainless steel nameplates giving the manufacturer s model and serial number rated capacity head speed and all other pertinent data shall be attached to the pump

b Pump Motors

1 Each pump motor shall be squirrel cage induction shell type design housed in an air filled watertight chamber

2 Motors shall be one phase 60 Hz 120 volt submersible type

3 Motors shall be in accordance with all current applicable standards of NEMA IEEE AFBMA NEC and ANSI

4 Motors shall be capable of carrying full load current continuously without injurious temperature rise under all conditions of submersible operation

5 Pump motors shall have cooling characteristics suitable to permit continuous operation in a totally partially or non submerged condition at the maximum rated power

6 Motors shall be provided with a service factor of 1 1

7 Motors shall be designed for continuous duty capable of sustaining a minimum of fifteen (15) starts per hour

8 Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation from shut off to zero head

9 Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of pump operation from zero head to shutoff The anti friction bearings shall be rated for a B 10 life of 40 000 hours

10 Motors shall have integral thermal and moisture protectors to initiate an alarm in case of excessive heat or moisture in the enclosure

11 Pump motor cable shall be suitable for submersible pump application and shall bear suitable label for submersible use

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c Controls

1 The Floor Drain Pump shall be supplied with a sump level control switch LCS 301 The float type level control will have three switches ON OFF and high level

2 The Decant Pump shall be supplied with an integral float switch

3 Provide control panels and devices in accordance with the requirements of Division 13 and the drawings Panels shall contain the following devices

a) Annunciator
b) Selector switches
c) Single phase starters
d) Motor protective device circuitry as required for the accessory equipment specified under this Section
e) Control devices input and output requirements as shown on the P&ID drawings and necessary for proper operation

4 The pump control shall provide both manual and automatic pump operation The pumping control for each pump shall be in accordance with the requirements specified in Section 13331 and the P&ID drawings

2 03 PAINTING

a Pumps motors drives frames base plates appurtenances etc shall receive manufacturer s standard finish paint system prior to shipment

PART 3 EXECUTION

3 01 INSTALLATION

a Installation shall be in complete accordance with manufacturer s instructions and recommendations

b Install pumps in corresponding sump/tank as shown and specified

c Support piping independent of pumps

3 02 START UP AND TEST

a Contractor shall verify that structures pipes and equipment are compatible

b After Contractor and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation Contractor shall conduct a running test of the equipment and controls in the presence of CONTRACTING OFFICER to demonstrate that the units and their controls will function correctly

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1 Running Tests

a) Field test during Phase I of the prove out period each unit together with its controls Test shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by Contractor at his expense

b) Contractor shall operate the pumps manually and demonstrate to CONTRACTING OFFICER that pump operates as specified

c) Contractor shall operate the pumps with varying depths of water in the sump/tank and demonstrate to CONTRACTING OFFICER that all water level related automatic functions correctly

d) In the event that Contractor is unable to demonstrate to CONTRACTING OFFICER that his equipment meets the requirements of the above described test the equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

2 Installation Tests

a) Contractor shall demonstrate to CONTRACTING OFFICER that pumps can be easily removed from their respective sump/tank and subsequently easily installed back in their sump/tank and placed back in service

3 03 CONTRACTOR S SERVICES

a The Contractor shall furnish the services of a qualified factory trained serviceman who shall check the installation before it is placed into operation supervise initial operations and instruct the plant operators in the care operation and maintenance of the equipment

b In addition to the above requirements furnish services of a qualified factory trained operations and maintenance serviceman to instruct and train operators in the proper care operation and maintenance of the equipment

3 04 LUBRICANTS

a The Contractor shall furnish a complete fill of all lubricants of the type and grade recommended by the manufacturer

3 05 WARRANTY

The equipment shall be warranted against manufacturer defects for a period of one (1) year from the date of installation

END OF SECTION

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SECTION 11314
FILTER PRESS
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall supply and provide all materials fabrication drawings design installation testing and delivery of services as specified in this section and/or on the drawings for complete installation and proper operation of the filter press as part of the treatment system

B This section covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment described herein

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the Contractor to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

1 02 SYSTEM DESCRIPTION

A The Contractor shall provide a filter press complete and ready for operation as presented in the sections which follow The filter press shall be designed to efficiently dewater metal hydroxide sludges for handling as a dry cake and shall include all components necessary for a complete operating unit

B The filter press unit shall include a skeleton frame closure device filter plate pack and elevated platform The hydraulic closure system shall be manually operated via a local control panel

C The Contractor shall provide an air blowdown manifold and an elevated platform which allows for a sludge disposal system consisting of a dumpster (provided by others)

D All components shall be integrally incorporated with the filter press system including a local control panel and air blowdown assembly The entire system should be powered by compressed air The filter press system shall be delivered completely assembled

1 03 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of function parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the

Contractor has received written drawing approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility of the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1) Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2) Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3) Six (6) copies of the operation and maintenance manual for the equipment provided

1 04 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

Plate size	630 mm x 630 mm (24 x 24)
Capacity	12 cu Ft max
Filtration surface area	234 sq ft
Cake Thickness	32 mm (1¼ inch)
Pressure rating	100 psi (7 5 bar)
Filter Plates	36 Polypropylene recessed chambers
Filter cloth	Polypropylene twill weave
Air requirement for core blow	10 scfm @ 80 psi
Filter cake solids concentration % by weight	30

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PART 2 PRODUCTS

2 01 EQUIPMENT

A Structural Frame

1 The structure frame shall consist of the fixed head section a movable follower a tall stock assembly and one set of sidebar rails The frame shall be adequate to support its own weight the weight of the filter plates and the entire assembly completely filled with sludge and pressurized for dewatering The filter press shall be designed for a maximum operating pressure of 100 psi

2 Fixed Head End The fixed head end shall be of a carbon steel fabrication capable of sustaining all strains and stresses during operation The structural steel front face shall be blanchard ground flat to locate the front drainage plate Machined notches shall be provided in both sides of the head weldment to allow for a precision fit of the sidebars The fixed head plate shall have a center feed connection and four filtrate discharge connections All pipe fittings shall be threaded directly into the plastic head filter plate

3 Siderails The sidebar rails shall be supported at each end between the head and tail sections The fixed stands shall be furnished with bases of sufficient area to provide acceptable load distribution to the filter press foundation The filter press shall have a capability for expansion to 10 cu ft Each siderail shall be capped with a polished 304 Stainless Steel rail cover to allow the filter pack to move easily on the siderail surface

4 Follower The follower shall be constructed of structural steel with a solid plate built to take the stresses and strains during operation The follower shall hang by 4 rollers two per side forming a set The cylinder shall be attached to the follower with a rod coupler allowing a 5 degree of movement between the cylinder and follower The front face shall be blanchard ground flat to locate the drainage face plate

5 Tail The tail assembly shall be constructed out of solid plate with a gusseted design to provide adequate distribution of static loads The tail section is the mounting base for the single hydraulic cylinder Machined notches shall be provided in both sides of the tail weldment to allow for a precision fit of the sidebars The tail section shall incorporate the hydraulic cabinet assembly complete with hydraulic pump reservoir pressure controls and control panel

B Hydraulic Closure

1 The filter press shall have a pneumatic automatic closure The closure shall maintain the sealing pressure required to operate up to the maximum pressure rating The hydraulic closure shall provide a constant pressure throughout the

dewatering cycle to compensate for any pressure or temperature fluctuations that may expand or contract the filter plates The closure shall require 30 cfm of instrument grade compressed air for proper operation

2 Hydraulic Cylinder The hydraulic cylinder mounted in the tail section shall provide the closure force to seal the filter plates The hydraulic cylinder shall be enclosed within the hydraulic cabinet so it is not exposed to the elements The hydraulic cabinet shall offer containment for any leaks spills or drips All hydraulic fittings piping and supports shall be provided for connection to the high pressure hydraulic pack All hydraulic components shall be rated for 5000 psi of maximum operating pressure

3 The hydraulic unit shall include the hydraulic pump and all necessary components to pressurize the cylinders The pump shall be sized to provide a minimum hydraulic pressure of 3400 psi The hydraulic reservoir shall be built directly into the tail section as an integral part of the structure

C Filter Plates

1 The filter plates shall be recessed chamber gasketed or non gasketed design (depending on which is selected) The plates shall operate and provide a seal up to 100 psi The filter plates are to be of a one piece molded construction with replaceable bolt on handles Each plate shall have a three inch diameter centrally located sludge feed opening and four two inch corner filtrate discharge openings located internally in the top and bottom corners The plates shall be of the washing configuration such that the air blowdown inlet enters in one side of the cake chamber and exits the adjacent plate on the opposite side of the press

D Filter Cloths

1 *One set of the standard filter cloths (Multifilament polypropylene filter cloths)* shall be shipped and installed in each filter press The cloths shall be constructed of a twill weave with a 3 5 cfm rating Each cloth shall have a cloth center barrel neck connector The filter cloth shall cover the entire plate on both sides The strength of the cloth shall be durable under normal operation and will withstand acid washing

E Control Panel

1 The control panel shall be of a flip up hinged design built for easy access It shall contain a weather tight seal aroudn the base to prevent water from entering the hydraulic cabinet The panel shall house four gauges and three switches The first gauge shall indicate the incoming line pressure of which the first switch controls The second and third gauges shall indicate the amount of air pressure applied to the hydraulic pump and the amount of hydraulic pressure that pump is generating The second switch shall control the location of the hydraulic cylinder with options of switching it to the open off or closed positions The final gauge

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and switch shall indicate the pressure going to the head of the filter press for air blowdown

F Surface Preparation

1 All weld splatter and weld fillets shall be ground to a uniform finish All mill scale shall be removed from the steel surface The filter press shall be primed with a polyurethane based two part enamel The final finish shall consist of two coats of an acid resistant two part polyurethane gloss enamel finish

G Piping

1 Piping and valves necessary for all phases of the filtration and air blowdown cycles shall be provided for the filter press The standard air blowdown/discharge header piping shall be configured to accommodate a precoat cycle Each discharge outlet coming from the head section shall have an isolation valve allowing two bottom outlets to be closed off for proper precoat procedures All piping shall be designed for 100 psi pressure Discharge piping and valves shall be constructed of schedule 80 PVC (100 psi)

H Accessories

1 Semi Automatic Plate Shifter The function of this unit is to assist in moving the filter plates individually This unit consists of a carraige and shifter mechanism that rides on two Stainless Steel rails that are located on either side of the sidebars The shifter arm shall be aligned just behind the filter plate to be moved A single button is pushed moving the plate forward Once the button is released the shifter arm drops and retracts The shifter is now ready to be positioned to move the next filter plate This unit operates in both the forward and reverse directions The unit is pneumatically operated using 80 psig instrument air

2 Automatic Pump Control #AP 2P The pump control shall be provided with the system to assist in providing the most dense filter cake possible within the shortest period of time This is accomplished by gradually increasing the fluid pump pressure incrementally at the precise moment it is required Back pressure from the filter chambers filling up is sensed and reported to a PLC Once this pressure reaches a predetermined point the PLC adjusts the airline regulator to increase pump pressure in 5 psi increments An optional low pressure sensor shall be included to shut the airline to the fluid pump off should the press be opened for any unplanned reason

3 Platform Disposal System A standard platform shall be provided complete with catwalks on all four sides removable railings and a set of standard stairs A cake chute shall be included below the filter plate area to contain the discharging filter cakes suitable for discharge into a dumpster This stand may be incorporated with drip pans and conveyors The standard design complies with Seismic 4 earthquake zone codes The stairway shall be shipped separately to be

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modularly bolted onto the platform

2 02 AIR BLOWDOWN MANIFOLD

A The air blowdown manifold shall be factory piped and wired and shall consist of the necessary piping and valves to join the four filtrate discharge ports into a common discharge pipe Closing of the valves and introducing air into the upper filtrate port shall force air through the filter cake in each chamber of the press A 0 60 psi air regulator and air pressure gauge to control and monitor air blowdown also shall be supplied

2 04 BACK UP PLATE

A A blank plate or back up plate shall be provided which can be injected at any point in the stack with the tail plate to run a partial filter press load The blank plate isolates all filter plates between it and the follower

2 05 DISCHARGE CHUTES

A The filter press shall be provided with discharge chutes to direct sludge into a roll off container Chutes shall be constructed of 13 gauge painted steel and shall be finished in the same system and color as the press

2 06 AUTOMATIC PUMP CONTROL

A The filter press shall be furnished with an automatic control to increase the feed pressure in four intervals throughout the fill cycle and automatically shutdown the system at the end of the cycle

2 07 FABRICATION/FINISHING

A Construction

Workmanship shall be first quality and all welding shall be in accordance with American Welding Society standards and in accordance with qualified welding procedures of the governing standards and include but are not limited to the following guidelines

AWS A2 0 Structural Symbols
AWS D1 1 Structural Welding

The edges of surfaces of the parts to be joined by welding shall be machined or thermal cut and cleaned of all oil grease scale rust or other deleterious material Where thermal cutting is used all loose scale must be removed All remaining kerf material (that fused during the cutting process) and sharp cut surface cavities must be removed or blended by grinding or chipping to assure proper weld penetration

Filler material to be used for joining must be analytically compatible with base

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metal primary consideration shall be given to mechanical properties corrosion resistance and welding response as applicable for the particular application

B Nozzles and manways as required shall be attached by full penetration welds of both the wall and the reinforcing attachment Welds which penetrate the full thickness of the nozzle neck or manway neck will not be accepted

C All nozzles manways and internal components shall be accurately located both vertically and radially in accordance with the design drawing as provided by the Supplier to the nearest + 1/4 inch

D All flange connections as required shall be flush trimmed with the inside surface of the vessel and finished unless indicated otherwise on the drawings provided by the Supplier

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed in accordance with the requirements of the Contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

D Contractor shall furnish and install on the forms for the concrete pads all anchor bolts required for the installation of the equipment Contractor shall be responsible for size and location of all recesses slab openings and inserts required and shall bear the expense of all corrective work necessary should any be omitted or not properly located

3 02 TESTING AND INSPECTIONS

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the Specification and intended use

B The system shall be hydrostatically tests for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

C The hydrostatic testing procedure shall include a cyclic pressure test in which the piping system is subjected to a minimum of 10 pressurization cycles with water at 1 5 times the design operating pressure After the last pressure cycle the test procedure shall be maintained for one to eight hours while the line is inspected for leaks

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D The manufacturer shall furnish the services of a factory representative during the period of installation to inspect and supervise the final installation of equipment and supervise the testing of the equipment

E The manufacturer shall cooperate with the Contractor who shall coordinate the testing of the vendor s equipment with the testing of other Contractor equipment

3 03 WARRANTY

Equipment shall be warrantied against defects for a period of one (1) year from the date of installation

END OF SECTION

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SECTION 11317
DIAPHRAGM PUMPS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install four (4) air operated double diaphragm pumps complete with all appurtenances in accordance with this Specification for the service described herein

B General

1 The Drawings are for purposes of guidance and for showing functional features and required external connections They do not necessarily show all components required to accomplish the desired results or all components required to interface equipment All parts equipment and devices necessary to meet the functional requirements shall be provided

2 Drawings show a general arrangement of an air operated double diaphragm pumping equipment Dimensions of the pumps are not shown as they may vary with each manufacturer Dimensions of the pump and piping arrangements may have to be changed in order to accommodate the pumping equipment furnished

3 Each pump specified under this Section shall be an air operated double diaphragm pump from the same series of the specified manufacturers Interchanging different types or series of air operated double diaphragm pumps from a manufacturer is not acceptable unless specified herein

4 All equipment shall be designed and built for 24 hour continuous service at any and all points within the specified range of operation without overheating without excessive vibration or strain and requiring only that degree of maintenance generally accepted for the specific type of equipment supplied

5 Air operated double diaphragm pump manufacturer shall provide deliver and install all specified equipment required to be mounted on or within the local control panels

C Related Sections

1 Section 11265 Oil Water Separator
2 Section 11225 Inclined Plate Separator
3 Section 11370 Air Compressing Equipment
4 Section 11340 Tanks

1 02 QUALITY ASSURANCE

A Shop Testing

1 Pumps shall be hydrostatically tested at a minimum of 150 psig for a period not less than 10 minutes with no leakage or pressure drop

2 Controllers shall be functionally tested

B In order to centralize responsibility it is required that all equipment provided under this Specification be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness of the system The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment

C Manufacturer s Qualifications Manufacturer shall have at least 5 years experience in producing air operated double diaphragm pumps and shall show evidence of at least 5 installations in satisfactory service

D Reference Standards Comply with all applicable provisions and recommendations of the following except as otherwise shown or specified

1 American National Standards Institute
2 Occupational Safety and Health Act
3 National Electric Code
4 Joint Industrial Council
5 Instrument Society of America
6 Standards of American Society for Testing and Materials
7 Standards of the Hydraulic Institute
8 Standards of American Water Works Association

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s literature illustrations specifications and engineering data including

a) Dimensions
b) Materials of construction
c) Size

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d) Weight
e) Performance data and curves showing flow rate head maximum suction lift and air supply requirements

2 Drawings showing fabrication assembly installation and wiring diagrams

3 Bill of materials and detailed description of operation

4 Manufacturer s literature indicating the resistance to corrosion of finished or painted surfaces for the intended pumping fluid The finished or painted surfaces shall be completely resistant to attack by the pumped chemical

5 Deviations from Drawings and Specifications

B Shop Test Results

1 Submit copies of certified pump tests demonstrating pumps operate at the design discharge pressure and flow rates specified in Paragraph 2 01 A

2 Submit results of routine factory motor tests

C Field Test Results

1 Submit a written report giving the results of the field tests required

D Manufacturer s Reports

1 Submit a written report of the results of each visit by a manufacturer s serviceman including purpose and time of visit tasks performed and results obtained

E Operation and Maintenance Manuals

1 Submit complete installation operation and maintenance manuals including copies of all Shop Drawings test reports maintenance data and schedules description of operation and spare parts information

2 Furnish operation and maintenance manuals in conformance with the requirements of Section 01730

F Lubricant Specification Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment

1 04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A Prior to shipping the equipment shall be inspected for completeness and conformance with approved Shop Drawings and then boxed or crated by the manufacturer to prevent damage during shipment All machined surfaces or matching connections shall be suitably protected to prevent damage

B All boxes crates or packages shall clearly identify their contents by name or tag number using a packing slip affixed to the outside of the container

C CONTRACTOR shall be responsible for safe transportation including freight costs for delivery to job site unloading at the site in the location designated by the purchaser procuring any necessary permits handling and storage

D Deliver materials to the site to insure uninterrupted progress of the Work

E Store materials to permit easy access for inspection and identification Keep steel members off the ground using pallets platforms and other supports Protect steel members and packaged materials from corrosion and deterioration

F Store mechanical equipment in covered storage off the ground and prevent condensation

PART 2 PRODUCTS

2 01 SERVICE CONDITIONS

A Influent Feed Pump (P 101)

No of Units	1
Service	Feed to Oil/Water Separator
Fluid Pumped	Oily Groundwater
% Solids Range	1 3
pH Range	6 10
Flow Rate (gpm)	75
Total Discharge Head (ft)	50
Supply Air (SCFM)	35
Supply Air Pressure (psi)	125
Suction Piping (inches)	2
Discharge Piping (inches)	2

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	Air Inlet (inches)	1
	Suction Lift (ft)	10 40
B	DNAPL/Sludge Pump (P 102)	
	No of Units	1
	Service	Oil/Water Separation Effluent
	Fluid Pumped	Recovered DNAPL product/sludge
	Flow Rate (gpm)	20
	Total discharge Head (ft)	35
	Supply Air (SCFM)	35
	Supply Air Pressure (psi)	125
	Suction Piping (inches)	1
	Discharge Piping (inches)	1
	Air Inlet (inches)	1
C	Primary Sludge Pump (P 301)	
	No of Units	1
	Service	Plate Separator Effluent
	Fluid Pumped	Sludge
	Flow Rate (gpm)	20
	Total discharge Head (ft)	45
	Supply Air (SCFM)	12
	Supply Air Pressure (psi)	25
	Suction Piping (inches)	1
	Discharge Piping (inches)	1
	Air Inlet (inches)	1

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D Sludge Transfer Pump (P 501)

No of Units	1
Service	Influent to Filter Press
Fluid Pumped	Iron Hydroxide Sludge
Flow Rate (gpm)	65
Discharge Pressure (psi)	100 max
Supply Air (SCFM)	35
Supply Air Pressure (psi)	125
Suction Piping (inches)	1
Discharge Piping (inches)	1
Air Inlet (inches)	¾

E TDU Equalization Tank Transfer Pump (P 100)

No of Units	1
Service	Water
Flow Rate (gpm)	35
Total Discharge Head (ft)	20
Supply Air (SCFM)	20
Supply Air Pressure (psi)	35
Suction Piping (inches)	1
Discharge Piping (inches)	1
Air Inlet (inches)	1

F Storm Water Transfer Pumps (P 111)

No of Units	1
Service	Stormwater

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Flow Rate (gpm)	5
Total Discharge Head	11 ft
Supply Air (SCFM)	8
Supply Pressure (psi)	25
Suction Piping (inches)	3/4 NPT
Air Inlet (inches)	1/4 NPT

G Pumps shall be of the air operated double diaphragm type operable over a range of air supply pressure up to a maximum of 100 psi The pumps shall operate by application of compressed air directly to the liquid column separated by two elastomeric diaphragms Pumping rate shall be controlled by adjustment of the inlet air flow and/or pressure The pumps shall be capable of running dry indefinitely and pumping against a closed valve without damage They shall be designed and constructed for the service intended

2 02 DETAILS OF CONSTRUCTION

A Pump

1 The pump body shall be constructed of close grained cast iron of sufficient strength or polypropylene Weight and metal thickness to ensure long life and reliable operation Minimum thickness of pump body material shall be 1 25 inches Fluid passages shall be smooth and large enough at all points to pass the maximum size solid specified in Section 2 01 A

2 The suction and discharge valve assemblies and diaphragm shall be constructed of Teflon for P 101 P 102 and P 111 The diaphragm and flap valve shall be constructed of Viton for P 301 and P 501

3 The outer chamber and valve seats shall be constructed of PVDF for P 101 P 102 and P 111 The outer chamber of P 301 and P 501 shall be constructed of aluminum or stainless steel

B Accessories

1 Each pump shall be furnished with an identification label stating the manufacture model rated flow and discharge pressure as a minimum

2 Electro Pneumatic Speed Control

a Speed control system shall be capable of adjusting flow rate from 0 to 100 percent and be supplied by same manufacturer as the double air diaphragm pumps

b Control system shall be capable of operating pumps in a manual mode utilizing an on board single turn potentiometer or in an automatic mode utilizing a 4 20 mA signal Output pressure shall be proportional to incoming command signal

c The speed control accessory shall consist of a control box to select manual or automatic operation a diaphragm air piloted pressure regulator and a proportional pilot valve with a maximum inlet pressure of 125 psi

d Control system shall operate on 120 VAC power

e Control box shall be NEMA 4

f Provide all wiring in accordance with the contract documents

3 See the Instrumentation Drawings for additional requirements

2 03 SPARE PARTS

A Each pump shall be furnished with the following spare parts

1 One set of valve seats and seat O rings
2 One set of pump diaphragms
3 One set of pump shaft O rings
4 One controller circuit one of each type

2 04 MANUFACTURER S SERVICES

A Furnish the services of a qualified factory trained service representative to check the installation before it is placed into operation assist in the performance of field tests supervise initial operations and instruct plant operators in the care operation and maintenance of the equipment

B In addition to the above requirements furnish services of a qualified factory trained operations and maintenance serviceman to instruct and train operators in the proper care operation and maintenance of the equipment These services shall be provided for the time period required under Section 01661

C Field testing shall include

1 Operate the pumps and demonstrate that flow is as specified in the service conditions

PART 3 EXECUTION

3 01 INSTALLATION

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A Install in accordance with the Drawings approved shop drawings the manufacturer s instructions and Section 01620

B Align adjust and lubricate all equipment in accordance with the manufacturer s instructions and leave in proper working condition

C Provide all shims supports and mounting appurtenances required

D Install all equipment units or assemblies on concrete pads unless otherwise specified Secure in accordance with the manufacturer s recommendations

E Accurately shim equipment legs to required elevations

F Make all necessary field connections required to place feed equipment in proper operation

G Perform all electr cal work in accordance with the applicable installation specifications

3 02 FIELD TESTS

A After CONTRACTOR and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a running test of the equipment and controls in the presence of CONTRACTING OFFICER to demonstrate that the units and their controls will function correctly

1 Running Tests

a Field test each unit together with its controls Test shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by CONTRACTOR at his expense

b In the event that Contractor is unable to demonstrate to CONTRACTING OFFICER that the equipment meets the requirements of the above described test the equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

3 03 Warranty

The equipment shall be warranted against manufacturer s defects for a period of one (1) year from the date of installation

END OF SECTION

SECTION 11325
ADVANCED OXIDATION PROCESS REACTOR SYSTEM AND APPURTENANCES

PART 1 GENERAL

1 01 DESCRIPTION

A This section covers the equipment and installation requirements for a combination ultraviolet light and hydrogen peroxide oxidation system Advanced Oxidation Process (AOP) which shall include factory assembled reactor power supply reagent delivery system and process control components

B The Advanced Oxidation Process system shall be designed to provide treatment of dewatering water to the treatment targets specified herein

C While this specification is particular to Advanced Oxidation Process treatment of condensate (quench) water is performed in the liquid phase carbon absorbers as described in Section 11244

1 02 SUBMITTALS

A Manufacturer s Catalog Data

1 Advanced Oxidation Process System peroxide dosing units local control panel peroxide totes and appurtenances

B Advanced Oxidation Process System

1 Provide complete catalog information descriptive literature specifications and identification of materials of construction Include make model dry and operating weight kilowatt rating and horsepower of each equipment assembly Include an annual estimate of operation and maintenance costs and requirements including all cost components such as electricity peroxide lamp replacement and any other miscellaneous cost items Include an estimate of the peroxide feed ratio required to meet the treatment requirements listed in this specification

2 Submit manufacturer model number and catalog cuts for all instruments furnished with the system including all accessories in the control panel

C Drawings

1 Layout drawings

A Detailed mechanical and electrical drawings showing equipment fabrications and dimensions piping layouts coupling locations and interfaces with other items

2 Wiring diagrams

A Power and control wiring diagrams including terminals and numbers

3 Electrical and instrumentation details

A Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored controlled or alarmed Provide control panel elevation drawings showing construction and placement of operator interface devices and other elements

D Instructions

1 Manufacturer s instructions

A Two (2) copies of special shipping storage and protection and handling instructions and two (2) copies of the installation procedures These instructions shall be furnished to the Contracting Officer prior to shipping the unit to the jobsite Installation instructions shall include erection and installation details including fastening details Failure to furnish these installation procedures may be cause for rejection of the equipment

2 Spare parts and special tools

A Furnish manufacturer s recommended spare parts and special tools required to maintain the Advanced Oxidation Process system and peroxide feed systems for one (1) year

E Statements

1 Manufacturer s Certificate of Proper Installation

A Installation certificate signed by a legal representative of the Advanced Oxidation Process system manufacturing firm stating the representative has visually observed the installation and confirms the system is installed in accordance with manufacturer s written and recommended instructions

2 Treatability Testing Plan

A Lab scale treatability testing for definitive sizing of the oxidation system shall be performed on laboratory water synthetically spiked with phenol acetone ketone to simulate the anticipated influent conditions Representative water samples will not be collected and tested due to the unavailability of a thermal desorption condensate stream sample

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3 Peroxide Vendor Statement of Qualifications

A Submit a statement of qualifications of the proposed hydrogen peroxide vendor List a minimum of three references for the vendor Include the location of the peroxide delivery terminal certification of substance and peroxide purity and an MSDS sheet for the delivered peroxide

4 Statement of Zero Air Emissions

A It is the intent of this Specification that the selected oxidation system produce near zero air emissions The vendor shall provide a written statement indicating the estimated hourly and yearly pounds of air emissions from the proposed unit for each constituent air emissions are expected Oxidation systems may be rejected at the CONTRACTING OFFICER S discretion based solely on a subjective review of the estimated air emissions from the unit

F Factory Test Reports

1 Factory Functional Test Report and log

2 Factory Treatability Test Report and log of testing activities

G Field Test Reports

1 Field Performance Testing

H Operation and Maintenance Manuals

1 Advanced Oxidation Process System peroxide dosing units local control panels and all instrumentation and accessories

1 03 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the CONTRACTING OFFICER

C Review of the drawings by the CONTRACTING OFFICER shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2 Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3 Six (6) copies of the operation and maintenance manual for the equipment provided

1 04 STANDARD PRODUCTS

A Only equipment of the type specified in this Section which has been in service for a period of not less than three (3) years in a minimum of five (5) installations shall be considered To show compliance with this requirement the manufacturer shall provide with the submittals a list of similar installations including the date placed in operation and the unit description

B Equipment submitted for approval which does not meet the specified experience period shall be considered if the manufacturer provides a bond or cash deposit which shall guarantee replacement in the event of failure to comply with the design criteria or to meet the groundwater treatment requirements

C Equipment shall be supported by a service organization that is reasonably convenient to the jobsite Equipment of the same types shall be the product of one manufacturer

1 05 DELIVERY, HANDLING AND STORAGE

A All equipment shall be delivered handled and stored per manufacturer s written instructions During shipment all equipment shall be braced and protected from any distortion or damage any such distortion or damage shall be the basis for rejection of the equipment If special shipping and handling precautions are required prominently and legibly stencil such precautions on outside of equipment or its crating

B Inspect equipment and materials delivered to the site for damage unload and store with minimum handling Store equipment and material on site in enclosures or under protective coverings Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather including subfreezing temperatures precipitation and high winds Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures Do not store materials directly on the ground

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1 06 SAFETY REQUIREMENTS

A Gears couplings projecting set screws keys any other rotating parts and any hot equipment components so located that any person can come in close proximity thereto shall be fully enclosed or properly guarded to the satisfaction of the Contracting Officer

1 07 NAMEPLATES

A Each major equipment component shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer s name address type or style model serial number and catalog number In addition nameplates for the dosing unit pumps shall show the capacity at rated speed in rpm and head in feet of water Nameplate for each electric motor shall show at least the minimum information required by 10 38 NEMA MG 1 Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate

1 08 MANUFACTURER S SERVICES

A The manufacturer of the Advanced Oxidation Process system shall provide an experienced and fully qualified field engineer for technical assistance during installation startup testing and training The cost of this technical assistance including labor and expenses shall be borne by the contractor The minimum amount of person days to be provided are listed in SECTION 3 All system visits by the manufacturer s representative shall be coordinated with and approved by the Contracting Officer

B Services shall include but not be limited to

1 Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer s recommendations initial checks adjustments calibrations and procedures necessary to complete system startup

2 Written certification from manufacturer after all tests and adjustments are made that the system is properly installed and functioning in accordance with these Specifications and the manufacturer s recommendations and written instructions and is ready for permanent operation

3 Performance testing support as specified hereinafter

PART 2 PRODUCTS

2 01 PROCESS PERFORMANCE GUARANTEE

Written guarantee of performance as described below shall be required

A Contractor shall have laboratory scale treatability testing performed on the proposed oxidation system to definitively size the system to meet the treatment requirements listed in this specification

B The written guarantee from the oxidation system vendor shall indicate that the system when combined with the liquid phase carbon adsorbers will meet the treatment requirements listed in this specification Vendor shall also supply an estimate of the required peroxide dose rate an estimate of annual operation and maintenance costs required to keep the system in top operating condition and an estimate of annual carbon usage replacement costs etc The submittal shall include the results of the test and types of test

2 02 PERFORMANCE REQUIREMENTS

A The manufacturer shall provide a written guarantee the Advanced Oxidation Process system and equipment shall continuously meet the specified performance requirements under the following conditions

System Size	60 kW
Operating Flowrate	45 gpm (groundwater only)
Maximum Flowrate	75 gpm (hydraulic requirement)
Effluent Temperature	85 deg F (max)
Power Supply	480V/3 phase/60 Hz/140 Full Load Amps (FLA)

B The Advanced Oxidation Process system shall be supplied with a minimum electrical capacity to power UV lamps of 60 kW or as required for alternate systems

C The maximum residual hydrogen peroxide in the effluent from the Advanced Oxidation Process unit shall be 50 mg/l

D The Advanced Oxidation Process system shall be capable of reducing the design contaminant (phenol) concentration of 110 000 ppb to 35 000 ppb at flow rates of 45 75 GPM (max) Vendor shall provide a written guarantee that the system meets this groundwater treatment requirement

2 03 ADVANCED OXIDATION PROCESS SYSTEM

A The manufacturer shall furnish all tools materials labor and appurtenances necessary for the complete fabrication testing and shipment of the Advanced Oxidation Process system

B All equipment shall be new and unused except for final checkout testing

C The Advanced Oxidation Process system shall consist of a skid mounted reactor assembly power supply hydrogen peroxide delivery equipment and programmed process control system The reactor assembly shall be factory assembled and tested and ready for installation

D The Advanced Oxidation Process system skid shall be capable of completely independent operation

2 04 REACTOR SKID ASSEMBLY

A The reactor skid shall consist of one UV reactor containing two 30 kw UV lamps Each lamp shall be protected from the water stream by a quartz cylinder The reactors shall be designed for turbulent plug flow behavior to ensure axial mixing for optimum photon absorption and at the same time eliminating short circuiting

B The UV lamps used in the Advanced Oxidation Process reactor shall be specifically designed to provide a broad spectrum of light emission between 200 and 300 nm to maximize photochemical destruction of waterborne pollutants A minimum of 30 percent of the total lamp output must be below 300 nm The lamps must be capable of providing 3 000 hours of operation with no more than a 20 percent decrease in emissions in the 200 to 300 nm spectrum

C A cleaning mechanism shall be provided for each quartz tube to maintain efficient transmittance of UV light The mechanism shall be constructed of materials which are not affected by high intensity UV radiation The cleaning system must operate automatically with an adjustable time interval Limit switches must be provided at both ends of wiper travel for fail safe indication of proper operation If limit switches are not provided a UV intensity detector must be provided to ensure the transmittance of UV light through the quartz sleeve Operation of the cleaning mechanism must not reduce the effectiveness of the treatment

D Sample valves shall be provided on the influent and effluent piping to the reactor

2 05 POWER SUPPLY

A A power supply shall be provided for each UV lamp The power supply shall be installed in a NEMA 1 ventilated and drip proof enclosure and all internal wiring must comply with NEC and be certified by a US OSHA accredited Nationally Recognized Testing Laboratory (NRTL) Efficiency of the power supply(ies) must be at least 92 percent and the power factor must be greater than 0 9 at full power

B The power supply lamp starting sequence will be set to ensure extended lamp life and to minimize inrush starting current

C The power supply system shall be provided with cooling fans thermal protection safety access interlock lamp run meters ammeters and lamp voltmeters

D The power supply shall be equipped with transformers isolated from ground to provide inherent safety from electrical shock Ground fault protection is not acceptable as it is not intrinsically safe and requires periodic checking to ensure continued safe operation

E The skid shall be wired for a single 480 VAC power drop A 480 VAC/120 VAC transformer shall be provided to supply low voltage control devices All control and interlocking circuitry shall be a maximum of 24 VDC

2 06 AOP REACTOR CONTROL SYSTEM

A All instrumentation control and electrical components provided under this section shall comply with the requirements of Section 13390 Package Control Systems All components shall be prewired to the control panel Provide all conduit and conductors

B The system shall be operated from Local Control Panel with system status and operational data shall be shown on an interface display with an alphanumeric screen The control system shall permit testing of all equipment while the system is offline for maintenance This should include but not be limited to operation of quartz wiper mechanisms and interlocks and all reagent pumps

C The Advanced Oxidation Process skid shall have an individual PLC and control panel to permit completely independent operation

D The control panel shall be NEMA 1 enclosure

E Interlocks shall be provided to alarm and/or shutdown the Advanced Oxidation Process system under the following conditions

High temperature in lamp drive enclosure (alarm and shutdown)
Low flowrate (alarm and shutdown)
High temperature in the Advanced Oxidation Process reactor (alarm and shutdown)
Leak from Advanced Oxidation Process reactor (alarm and shutdown)
Lamp failure (alarm and shutdown)
High voltage cabinet door is open (alarm)
Reactor access covers are open (alarm and shutdown)
Quartz wiper failure (alarm)

2 07 HYDROGEN PEROXIDE FEED SYSTEMS

A Equipment Requirements

1 Manufacturer shall supply hydrogen peroxide feed system The feed system shall be used primarily to deliver peroxide to the Advanced Oxidation Process system

2 The peroxide feed system shall include a metering pump rotometer check valve at point of injection pulsation dampener electronic solid state low flow switch and an automatic

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priming or bleed valve The operation and speed of the chemical feed pump and pump stroke shall be controlled by the local control panel Pump stroke shall be manually controlled

3 Pump shall be solenoid driven diaphragm metering pump capable of delivering from 20 to 150 percent of the oxidation vendor s recommended peroxide dosing rate while maintaining an accuracy of plus/minus 0 5 percent

4 Pump shall be capable of delivering peroxide under a discharge head of 60 psig

5 The delivery system shall be skid mounted on an epoxy coated mild steel assembly The system shall be mounted remote from the Advanced Oxidation Process system

6 Materials Wetted parts shall be 316 stainless steel teflon viton and polypropylene Frame and fittings shall be 316 stainless steel

7 Electrical Requirements The metering pump shall be suitable for operation on 110 VAC electrical power supply with average power output of less than 15 amps

2 08 PEROXIDE STORAGE TANK

The vendor shall provide a 960 gallon hydrogen peroxide storage tank constructed of linear HDPE The tank shall be flat bottom with domed top approximately 5 ft 4 in diameter by 7 ft 0 in high and shall be mounted with the hydrogen peroxide metering pumps on a common skid The tank shall be equipped with level controls The following fittings shall be provided with the tank

Fill nozzle	2 150 lb flange (top)
Pump suction	½ half coupling
Level Transmitter	1 half coupling
U Vent	2
Drain	1 half coupling
High level switch	2 half coupling (top)
Manway	14 gasketed complete with blow away capability

2 09 VALVING

A Valving with an internal cavity (such as ball valves) for piping carrying a 50 percent solution of hydrogen peroxide which is provided by the Advanced Oxidation Process vendor shall be drilled on the upstream side to vent the ball enclosure when in the closed position

2 10 SPARE PARTS AND SPECIAL TOOLS

A Furnish manufacturer recommended spare parts and special tools required to maintain the Advanced Oxidation Process system and peroxide feed systems for one (1) year

2 11 FACTORY TESTING

A The Advanced Oxidation Process system shall be tested for satisfactory operation under the proposed operating conditions The system shall be operated successfully for one hour with no shut downs using clean water All components of the control system shall be checked to ensure appropriate operation Certified test results shall be submitted to the CONTRACTING OFFICER

PART 3 EXECUTION

3 01 INSTALLATION

A Install all equipment in accordance with manufacturers recommended and printed instructions Equipment installation shall not be allowed until the contractor furnishes the CONTRACTING OFFICER with the installation instructions

B Contractor shall furnish and install at the locations shown on the Drawings a packaged system including field instrumentation control panel motors wiring piping fittings valves anchor bolts and fasteners safety guards painting spare parts and other appurtenances and furnish all labor supervision testing training materials tools and appliances

3 02 PERFORMANCE TESTING

A The Advanced Oxidation Process system shall meet the groundwater treatment requirements specified in Part 2 02 Performance Requirements

3 03 CONTROL SYSTEM RESPONSIBILITY

All components of the control system have been included in this Section so that the Contractor will receive a completely coordinated and properly integrated system for efficiency ease in operation and correct functional relationship among all elements of the system Therefore it is the intent of this Specification that the equipment specified under this Section will be furnished by a single vendor This requires that the Advanced Oxidation Process vendor be responsible for the satisfactory operation of the instrumentation and control system furnished hereunder

3 04 MANUFACTURER S SERVICES

Provide manufacturer s services for the minimum person days listed below travel time excluded

A One (1) person day for installation assistance

B One (1) person day for functional testing initial checks adjustments and calibrations and completion of Manufacturer s Certificate of Proper Installation

C One (1) person day for pre startup or post startup site training of plant operations personnel Training schedule shall be coordinated with and approved by the CONTRACTING OFFICER

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3 05 WARRANTY

A The equipment manufacturer shall warrant the equipment for a period of 12 months from system startup or 18 months from shipment whichever is less

End of Section

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SECTION 11340
TANKS
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall provide all equipment materials and services for the supply and installation of tanks for installation in the groundwater treatment system

B This section covers the requirements for the functional design performance construction features testing quality and handling of the equipment described in the following sections

1 02 SYSTEM DESCRIPTION

A The Contractor shall provide all labor materials equipment and accessories to install one (1) 10 150 gallon Mix Reaction Tank (T 201) one (1) 2 000 gallon Product Storage Tank (T 102) one (1) 1 100 gallon AOP Reactor Feed Tank (T 401) one (1) 7 637 gallon Sludge Holding Tank (T 501) and one (1) 105 gallon Decant Tank (T 503)

1 03 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The Contractor s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment

2 Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3 Six (6) copies of the operation and maintenance manual for the equipment provided

PART 2 PRODUCTS

2 01 EQUIPMENT

A GENERAL

1 The Contractor shall supply and install tanks as described herein and as shown in the Contract drawings

2 All piping associated with the tanks including the vent lines and overflow lines shall be Schedule 80 PVC

B MIX REACTION TANK (T 201)

1 The Contractor shall provide and install a Mix Reaction Tank with flanged gasketed cover constructed of epoxy coated carbon steel or epoxy laminated FRP The tank shall be a circular and flat bottomed tank with a nominal capacity of 10 150 gallons The tank dimensions shall not exceed 12 diameter x 12 high

Influent (2 top)	4 inch
Outlet	3 inch
Drain	4 inch
Overflow	4 inch
Vent	4 inch
Spares (3)	3 inch

2 The Mix Reaction tank shall be provided with an electrically operated mixer per Section 11385 which will be used for constant mixing of the tank contents

3 The tank shall be provided with caped ladder and hand rail around top of tank in accordance with OSHA

C SLUDGE HOLDING TANK (T 501)

1 The Contractor shall provide and install one (1) sludge tank with flanged gasketed cover constructed of epoxy coated carbon steel or epoxy laminated FRP The tanks shall be of a vertical type and have nominal capacity of 7 637 gallons The tank diameter shall be 10 feet by 10 feet high The following flanged nozzles shall be provided per each sludge tank

Vents	2 inch
Inlet (top)	2 inch
Outlet (bottom)	3 inch
Overflow	4 inch
Spares (3)	3 inch

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2 The tank shall be equipped with a mixer per Section 11385

3 The tank shall be equipped with a safety ladder and handrail around top of tank in accordance with OSHA

D PRODUCT STORAGE TANK (T 102)

1 The Contractor shall provide and install a horizontal single walled Product Storage Tank constructed of carbon steel The tank shall be circular and have a nominal capacity of 2 000 gallons Flanged nozzles as listed below shall be provided

Vents	2 inch
Level probe	2 inch
Inlet (2)	2 inch
Top Nozzle	2 inch
Spares (2)	2 inch

E AOP REACTOR FEED TANK (T 401)

1 The Contractor shall provide and install a Reactor Feed tank with flanged gasketed cover constructed of epoxy coated carbon steel or epoxy laminated FRP The tank shall be circular and flat bottomed and have a nominal capacity of 1 100 gallons The tank diameter shall be 4 feet by 5 feet high Flanged nozzles as listed below shall be provided

Inlet (top mounted)	4 inch
Outlet	3 inch
Drain	4 inch
Level probe	2 inch
Additional Inlets (2)	2 inch
Vent	2 inch
Overflow	4 inch

F DECANT TANK (T 503)

1 The contractor shall provide a Decant Tank constructed of polyethylene The tank shall be circular and flat bottomed and have a nominal capacity of 105 gallons Tank dimensions shall be 3 feet O D by 2 ft high Tank shall be provided with the following fittings

Inlet (top mounted from ME 502)	2 inch
Inlet (top mounted from T 501)	2 inch
Outlet (top mounted to T 201)	2 inch
Two (2) spares	2 inch

G UTILITY WATER TANK (T 604)

1 The contractor shall provide a Utility Water Tank constructed of cold rolled steel The tank shall be 211 gallon precharged water tank Grainger Model 4P883

H ACCESSORIES

1 Each tank cover shall be equipped with one (1) 24 inch access manhole with flanged cover and flanged nozzles as specified for each tank

2 The sludge tanks shall have a least four (4) carbon steel support legs and shall be designed to hold an aqueous sludge with a specific gravity of 1 2

3 The contractor shall provide peripheral base hold down lugs on the tank and anchor to the concrete floor

4 The Contractor shall instruct the tank fabricator on the orientation elevation and location of all connections to ensure efficient hydraulic profiles and pipe testings in the finished plant

2 02 FABRICATION/FINISHING

A All nozzles manways and internal components shall be accurately located both vertically and radially in accordance with the design drawing as provided by the Supplier to the nearest ± ¼ inch

B All flange connections as required shall be flush trimmed with the inside surface of the vessel and finished unless indicated otherwise on the drawings provided by the Supplier

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed in accordance with the requirements of the Contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

D Contractor shall furnish and install on the forms for the concrete pads all anchor bolts required for the installation of the equipment Contractor shall be responsible for size and location of all recesses slab openings and inserts required and shall bear the expense of all corrective work necessary should any be omitted or not properly located

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3 02 TESTING AND INSPECTIONS

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of this specification and the intended use

B The system shall be hydrostatically tests for leaks at the factory by filling with water The system shall be checked for leaks after being filled for at least one hour

3 03 WARRANTY

Each tank shall be warranted against defects for a period of one (1) year from the date of installation

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SECTION 11346
POTASSIUM PERMANGANATE SYSTEM

PART 1 GENERAL

1 01 SUMMARY

A General

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install the Potassium Permanganate System complete and operational with a tank piping valves control equipment pumping equipment mixer and associated appurtenances as shown specified and required

2 The Potassium Permanganate System shall be designed to make up dilute mix and feed potassium permanganate The diluted potassium permanganate will be fed to the application points The Drawings show an outline of the various components of the Potassium Permanganate System and the components overall relationships Not all items internal to and between the Potassium Permanganate System equipment are shown or specified but shall be provided if required for proper operation of the system

B Related Work Specified Elsewhere

1 Division 1 General Requirements
2 Section 03252 Concrete Anchor Bolts
3 Section 05504 Miscellaneous Metal Fabrications
4 Section 09900 Painting
5 Division 11 Equipment
6 Division 12 Instrumentation and Control
7 Division 15 Mechanical
8 Division 16 Electrical Work unless specified in this section

1 02 SYSTEM DESCRIPTION

A The dry potassium permanganate is added to a mix tank and mixed with the proper quantity of dilution water to prepare a 3% KMnO4 solution The KMnO4 solution is agitated with a mechanical mixer that is mounted on the solution tank

B The 3% KMnO4 solution is fed from the mix tank to the Mix Reaction Tank by a dedicated chemical feed metering pump Output of the pumps shall be manually adjusted

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer/supplier s literature illustrations specifications engineering data and bill of materials of all proposed equipment Data shall include a complete description in sufficient detail to permit comparison with the technical specifications

2 Dimensions materials sizes weights and performance data for each piece of proposed equipment

3 Drawings showing fabrication assembly installation and wiring diagrams

4 Motor Data For each motor furnish a certified motor data sheet for the actual motor or for a previously manufactured electrically duplicate motor which was tested

5 Pump Data For each pump furnish a certified performance curve indicating head capacity efficiency speed allowable NPSH allowable suction lift and horsepower

6 A list of any and all parameters ratings or other characteristics where the proposed Potassium Permanganate System deviates from the requirements set forth in this Specification

7 Affidavits of compliance with referenced standards and codes

8 Manufacturer/supplier s standards for potassium permanganate

B Test Results

1 Submit a written report giving the results of all shop and field tests required

C Manufacturer s Reports

1 Submit written report of the results of each visit by manufacturer including purpose and time of visit tasks performed and results obtained

D Operation and Maintenance Data Submit complete Operation & Maintenance Manuals in accordance with Section 01730 and as described below

1 Required Operation Data

a Completed detailed operating instructions for each piece of equipment with moving parts

b Explanations for all safety considerations relating to operations
c Recommended spare parts lists

2 Required Maintenance Data

a Maintenance data shall include all information and instructions required by

plant personnel to keep equipment properly lubricated and adjusted so that it functions economically throughout its full design life

b Explanation with illustrations as necessary for each maintenance task

c Recommended schedule of maintenance tasks

d Lubrications charts and tables of alternate lubricants

e Trouble shooting instructions

f List of maintenance tools and equipment

g Name address and phone number of manufacturer and manufacturer s local service representative

1 04 QUALITY ASSURANCE

A All equipment provided as part of the Potassium Permanganate System specified herein must be supplied by the Potassium Permanganate System manufacturer/supplier who shall assume complete system responsibility The manufacturer/supplier shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment

B Manufacturer s Qualifications 1 The Potassium Permanganate System manufacturer/supplier shall have a minimum of five years experience in furnishing equipment of similar capacity and service capability to the equipment described herein and shall show evidence of five similar installations in satisfactory operation

C Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 OSHA Safety standards concerning personnel protection against machinery and the handling of dangerous chemicals

2 Instrument Society of America ISA

3 American Society for Testing and Materials ASTM

4 Joint Industrial Council JIC

5 National Electric Manufacturers Association NEMA

6 National Electrical Code NEC

7 Institute of Electrical and Electronic Engineers IEEE

8 American Welding Society

9 American National Standards Institute ANSI

10 Standards of the Hydraulic Institute

11 American Institute of Steel Construction AISC

12 American Society of Mechanical Engineers Standards

1 05 PRODUCT DELIVERY, STORAGE AND HANDLING

A Delivery of Equipment All equipment and materials shall be inspected against approved Shop Drawings at time of delivery Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the manufacturer/supplier for replacement or repair

B Storage All equipment and materials after inspection shall be carefully prepared for storage and labeled Equipment and materials shall be stored in a dry location and protected from the elements according to the manufacturer/supplier s instructions

C Handling Equipment and materials shall be handled in an approved manner according to the manufacturer/supplier s instructions

1 06 GUARANTEE

A Prior to acceptance of the Potassium Permanganate System provide written guarantee from the manufacturer/supplier that includes the following statements

1 Manufacturer/supplier has inspected the installation during and after completion to insure the Potassium Permanganate System is free from faults and defects and is in conformance with the Contract Documents

2 Potassium Permanganate System will remain free of defects for a period of one (1) year from the date of final acceptance

3 If the equipment requires repair or replacement as a result of ordinary wear and tear under normal operations the manufacturer/supplier will repair or replace such equipment as required without cost to the CONTRACTING OFFICER

PART 2 PRODUCTS

2 01 MANUFACTURER

A Potassium Permanganate System and appurtenances shall be furnished or supplied by a single manufacturer

2 02 SERVICE CONDITIONS

A General

1 The Potassium Permanganate System shall be provided to dilute dry potassium permanganate and to meter and feed the solution The system shall be completely independent

2 System shall include but not be limited to the following

a Mix tank

b Mechanical mixer

c One (1) metering pumps

d All piping and valving required for hydraulic interconnections

e All intra skid wiring required for system control and operation

2 03 DETAILS OF CONSTRUCTION

A Potassium Permanganate Feed System

1 General

a The system shall be an integrated package piped and wired

2 Solution Mix Tank

a The mix tank shall have a minimum capacity of 500 gallons constructed of high density polyethylene which shall be resistant to the potassium permanganate solution The tank shall have a flat bottom and top

3 Solution Mixer

a The mixer shall be designed to blend dry potassium permanganate with non potable water in order to create a 3% potassium permanganate solution

b The mixer shall have a 1/4 Hp motor 120 volt/1 phase/60Hz with starter On/Off toggle switch and 10ft power cord with plug

c Shaft diameter shall be 3/4 inches

d Shaft length shall be 48 inches

e Impeller diameter shall be 8 inches

4 Solution Metering Pumps

a Solution feed metering pumps shall be diaphragm type rated for 0 45 gph

b Pumps shall be capable of dry lift and be self priming

c Wetted parts shall be fully resistant to the solution potassium permanganate

d Each pump assembly shall come complete with pulsation dampeners calibration columns pressure relief valves and back pressure valves

5 Accessories

a The tank shall be supplied with a tank/mixer support stand and adjustable angle mounting clamp

6 Bulk $KMnO_4$ storage

a $KmnO_4$ shall be supplied as a free flowing dry Grade in 55 lb pails or 330 lb drums on pallets

2 04 TOOLS AND SPARE PARTS

A Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer

B Furnish and deliver the following spare parts carefully boxed or packaged and plainly marked for reordering

1 One set of bearings used for the mixer

C Contractor shall store and safeguard spare parts until completion of the Work at which time they shall be inventoried delivered and placed in an area designated by the CONTRACTING OFFICER

D Contractor shall obtain from manufacturer and furnish a list of additional recommended spare parts for an operating period of one year The list shall describe each part the quantity recommended and the unit price of the part

2 05 SURFACE PREPARATION AND SHOP PAINTING

A Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900

B Coat machined polished and non ferrous metal surfaces and similar painted surfaces with corrosion prevention compound which shall be maintained during storage and until

equipment begins operation

C Field painting is under Section 09900

PART 3 EXECUTION

3 01 INSTALLATION

A Installation shall be in accordance with the Drawings and with manufacturer/supplier s instructions and recommendations Conflicts of information shall be called to the attention of the CONTRACTING OFFICER

B Provide all shims supports and mounting appurtenances required

C Provide a drain for each piece of equipment according to the manufacturer s instructions

D Align adjust and lubricate all equipment in accordance with the manufacturer s instructions and leave in proper working condition

E Make all necessary field connections required to place feed equipment in proper operation

F Perform all electrical work in accordance with the applicable installation specifications of Division 16

3 02 FIELD TESTS

A After Contractor and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation Contractor and a qualified field service representative of the manufacturer shall conduct a running test of the equipment and controls during Phase II of the prove out period in the presence of CONTRACTING OFFICER to demonstrate that the units and their controls will function correctly

1 Running Tests a Field test each unit together with its controls Test shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by Contractor at his expense

b In the event that Contractor is unable to demonstrate to CONTRACTING OFFICER that his equipment meets the requirements of the above described test the equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

c Prior to applying electrical power to any motor driven equipment the drive motor shall be rotated by an external source to demonstrate free operation of all mechanical parts

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3 03 MANUFACTURER S SERVICES

A Furnish the services of a qualified factory trained serviceman to assist in the installation of the equipment check the installation before it is placed into operation assist in the performance of field test supervise initial operations and instruct plant operators in the care operation and maintenance of the equipment A certificate from the manufacturer relative to these services is required under section 01650

B Serviceman shall make one visit to the site for a period of not less than 8 hour days to perform the field test and supervise initial operation of the equipment

C Serviceman shall verify the lubrication systems are complete clean and filled with the proper grade of lubricants

D Reports Submit report by manufacturer of each visit to the site that provides complete information on time schedule tasks performed persons contacted problems corrected test results training instruction and all other pertinent information

3 04 WARRANTY

Equipment shall be warranted against defects for a period of one (1) year from the date of installation

END OF SECTION

SECTION 11370
COMPRESSED AIR EQUIPMENT

PART 1 GENERAL

1 01 DESCRIPTION

A The Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install two (2) skid mounted air compressors arranged as a duplex unit with the components described under Paragraph 1 1 B of this Section and all appurtenances start up assistance and other services in accordance with this Specification and with the Drawings included with this Specification

B The Contractor shall furnish one packaged air compressor unit

1 Included but not limited to are the following components

a Two motor driven air compressors arranged as a duplex unit
b Two inlet filter silencers
c Two after coolers with condensate traps (air cooled)
d One air receiver with accessories
e One coalescing air filter
f One refrigerated air dryer
g Control system
h Internal piping and wiring
I Anchorage devices
j Valves

C General

1 The Contract Drawings are for purposes of guidance and for showing functional features and required external connections They do not necessarily show all components required to accomplish the desired results or all components required to interface equipment All parts equipment and devices necessary to meet the functional requirements shall be provided

2 Drawings show a general arrangement of the air compressing equipment at the Process Building Dimensions of the air compressing equipment are shown but they may vary with each manufacturer Dimensions of the air compressing equipment and piping arrangements may have to be changed in order to accommodate the air compressing equipment furnished

3 All equipment shall be designed and built for 24 hour continuous service at any and all points within the specified range of operation without overheating without excessive vibration or strain and requiring only that degree of maintenance generally accepted for the specific type of equipment supplied

4 Contractor shall require air compressing equipment manufacturer to provide deliver and install all specified equipment required to be mounted on or within the local control panels Contractor shall require the equipment manufacturer to provide internal and external circuits/wiring drawings associated with the equipment s control equipment to develop proper panel system drawings and controls

D Related Sections

1 Section 03300 Cast in Place Concrete
2 Section 03252 Concrete Anchors
3 Section 11317 Diaphragm Pumps
4 Section 11204 Sand Filters
5 Division 13 Sections on Plant Monitoring and Control System
6 Division 15 Sections on piping and valves
7 Division 16 Electrical

1 02 QUALITY ASSURANCE

A Manufacturer s Qualifications Contractor shall ensure that manufacturer has a minimum of 5 years experience in the production of substantially similar equipment and can show evidence of satisfactory service in at least 5 installations

B It is required that all equipment provided under this Specification be obtained from a single supplier or manufacturer Contractor shall ensure that the manufacturer or supplier shall assume full responsibility for the completeness of the system Contractor shall ensure that the supplier or manufacturer is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

C Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 Standards of the American Society for Testing and Materials
2 National Electric Code
3 Standards of National Electrical Manufacturers Association
4 Institute of Electrical and Electronics Engineers
5 American National Standards Institute
6 AWS D1 1 Structural Welding Code
7 AISC Manual of Steel Construction
8 AGMA Standards

1 03 SUBMITTALS

A Shop Drawing Submittals Submit the following for review

1 Manufacturer s literature illustrations specifications and engineering data

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2 Drawings showing fabrication methods assembly accessories installation details and wiring diagrams

3 Setting drawings templates and directions for the installation of anchor bolts and other anchorages

4 A certified motor data sheet for each type and size of motor The data sheets shall show winding resistances torques guaranteed minimum efficiencies at full 3/4 and ½ load power factors slip full load locked rotor and running light amperes temperature rises and results of dielectric tests All values shall be from tests or previously manufactured electrically duplicate motors Data sheet shall be marked to indicate motor application manufacturer type frame size bearing type lubrication medium insulation type and enclosure type

5 Deviations from Drawings and Specifications

6 Drawings and information for instruments and control panels

B Operation and Maintenance Manuals

1 Submit for approval complete installation and operation and maintenance manuals including copies of all Shop Drawings test reports maintenance data and schedules description of operation and spare parts information

C Lubricant Specification Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment

1 04 PRODUCT DELIVERY STORAGE AND HANDLING

A Prior to shipping the equipment shall be inspected for completeness and conformance with approved Shop Drawings and then boxed or crated by the manufacturer to prevent damage during shipment All machined surfaces or matching connections shall be suitably protected to prevent damage

B All boxes crates or packages shall clearly identify their contents by name or tag number using a packing slip affixed to the outside to the container

C Contractor shall be responsible for safe transportation including freight costs for delivery to job site procuring any necessary permits handling and unloading at the site in a location designated by the CONTRACTING OFFICER

PART 2 PRODUCTS

2 01 AIR COMPRESSORS AND ACCESSORIES

A General Furnish one air compressing unit to provide air to sand filter UV oxidation system four (4) air diaphragm pumps and other miscellaneous equipment

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1 Air compressor assembly shall consist of two lubricated 100 percent capacity dynamically balanced motor driven packaged rotary screw air compressors Each air compressor shall be equipped with an air cooled after cooler with separator and condensate trap air oil separator controls intake filter silencer and all accessories and appurtenances specified The compressed air system shall be mounted on a steel skid including the receiver and refrigerated dryer

2 The air compressor shall be rated for approximately 350 scfm at a discharge pressure of 150 psig

3 Accessories to be furnished with the air compressor system shall include automatic condensate traps ASME rated relief valves discharge pressure and temperature gages and pressure switches The air compressor system shall also be provided with a compressor control panel multistage coalescing type oil filter with automatic drain valve a refrigerated air dryer and a final air filter

B EQUIPMENT

1 Air Compressor Each compressor shall be a single stage oil injected rotary screw compressor with a male and female rotor Rotor design shall be asymmetric Each rotor shall be supported by a heavy duty cylindrical roller bearing at the inlet end and a duplex angular contact bearing at the discharge end The anti friction bearings shall have a minimum L 10 life of 50 000 hours as defined by AFBMA

2 Drive Arrangement A V belt power transmission system shall drive the male rotor Motor design shall feature the following

a Type AC squirrel cage induction

b Construction Cast frame cast rotor non hygroscopic insulation corrosion resistant hardware

c Minimum motor H P 60 HP each

d Service Factor 1 25 (premium efficiency)

e Insulation Class F with Class B temperature rise

f Motor Speed 3600 rpm

g Enclosure TEFC

h Power 480 V/3 ph /60 Hz

I Each motor shall be supplied with an elapsed time meter Manufacturer

1) General Electric Co

2) Reliance Electric
3) Louis Allis
4) Or approved equal

3 Oil System Oil system shall be differential pressure type with the following components

a Oil stop valve Shall allow oil in the air end of the compressor when it stops so that immediate lubrication is provided upon next start up

b Oil filter Spin on type rated for 10 microns

c Thermostatically controlled oil valve Shall maintain the temperature of the discharge air/oil by controlling bypass of the oil cooler

d Air cooled oil cooler Cast aluminum manganese alloy core construction compressor shaft driven axial flow fan

e Air/oil separation tank Separator shall be skid mounted Tank shall be ASME coded and shall incorporate an oil fill tube with a pressure relieving safety plug and a safety relief valve Ends of the separator shall have ANSI B16 5 Class 150 flanges Separation shall occur in two stages the first by centrifugal/ mechanical means and the final by separator filter element Approximately 99 percent of water droplets and 40 percent of all aerosols shall be removed in the first stage and 100 percent of particles shall be removed in the second stage Additional features shall include an oil level indicator a bottom NPT threaded drain plug for connection of a pilot operated~automatic drain trap to provide positive discharge of condensate without air leakage and an oil scavenge line

4 Air System The air system shall include the following components

a Intake air filter The air intake for the system shall be equipped with a replaceable dry type paper filter element with differential pressure indicator

b Inlet valve Each air compressor shall be equipped with a spring loaded pneumatically operated piston type intake valve to provide unloaded start up and load/no load control capacity

c Minimum pressure/check valve

d Air separation tank with oil separator element (see 2 1 B 3 e)

e Air cooled after cooler Suitably mounted on the skid and piped between compressors and receiver The system shall be designed so that the air discharge temperature is within 19 F of the inlet cooling air temperature Maximum cooling air temperature will be 104 F

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5 Air Receiver The air compressor system shall be furnished with a minimum 120 gallon ASME coded horizontal steel receiver ASME certification shall be provided for the receiver Working pressure for the air receiver shall be 200 psig minimum Test pressure shall be 350 psig The receiver shall be equipped with a suitably sized ASME rated pressure relief valve and an isolation valve Receiver shall be furnished with the equipment specified below Receiver shall be supplied with a base ring for mounting onto a concrete surface

6 Instrumentation

a Pressure Switches

1) Type Bronze Bourdon tube type with aluminum alloy case 4 1/2 inch diameter white face with black characters and 1/4 inch NPT connection

2) Set point Accuracy ± 1 0 percent of scale range

3) Deadband 1 psig average

4) Contacts Snap action SPDT rated 5 ampers at 120 volts 60 Hz

5) Range 0 200 psig

b Pressure Gage Indicators

1) Locations Compressor outlet air discharges upstream of after cooler connected to air receiver downstream of after filter and downstream of coalescing oil filter

2) Range 0 200 psig

3) Accuracy ± 1 0 percent of scale range

4) Type Brass Bourdon tube type 4 1/2 inch diameter dial aluminum alloy case

c Air Temperature Gage Indicators

1) Locations Compressor outlet air discharges upstream of each after coole connected to air receiver upstream of air dryer

2) Range 0 to 250 F

7 Skid Heavy duty structural steel base provided with forklift holes

8 Automatic Drain Valves Drain valves shall be automatic and designed to handle moisture and oil emulsions Units shall be timer operated Materials of construction

for the valve body shall be brass Pressure rating of the units shall be 3 to 300 psig Automatic drain valves shall be Model ADV 1711 as manufactured by Deltech Engineering L P Pneumatec or approved equal for all applications except the air dryer The automatic drain valve for the air dryer shall be furnished by the dryer manufacturer Valves shall be furnished where indicated and as follows at separator receiver tank and coalescing type oil filter

9 Coalescing Type Oil Filter Unit shall be installed upstream of the refrigerated air dryer and shall be designed for an air flow of at least 350 scfm at a pressure of 150 psig Each filter shall be capable of removing particles 0 01 microns nominal and 99 9999 percent of all oils The filter shall include an impingement and separation section prior to the filter element and shall be furnished with an automatic drain identical to those specified above Units shall be as manufactured by Hankison or approved equal

10 Refrigerated Air Dryer

a The unit shall have the following characteristics

1) Operating Conditions Design Data

a) Nominal Inlet Capacity 35 scfm
b) Pressure 125 psig
c) Maximum Operating Pressure 250 psig
d) Outlet Dewpoint +35 F

2) Free standing unit

11 Miscellaneous Valves and Accessories The following miscellaneous valves and accessories shall be furnished

a Check Valve Located downstream of air compressors

b Gate Valve Located where required

c Flexible Connector Locate between air compressors and air receiver

d Pressure Relief Valves Locate a unit on compressor discharge pipes and at receiver

12 Compressor Controls

a Provide fully automatic controls to maintain air receiver pressure within preset limits Use a single dual set point pressure switch with an adjustable set point range between 50 and 137 psi to accomplish this control Control setpoints for the switch shall be 110 psi at the low limit and 150 psi at the

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high limit Automatic controls shall also monitor compressor operation including

1) hand/off/auto selector switches

2) red light for local off status

3) green light for local run status

4) amber alarm light to indicate low air pressure or low oil level plus one amber strobe light at the top of the unit to designate that either of these conditions has occurred

13 Control Panel

a Provide a skid mounted NEMA 4 control panel for the air compressor system

b Panel indicating devices and switches shall be mounted on the front door Skid mounted control switches and motors shall be prewired to the control panel for compressor control

c Panel shall contain the following instruments or devices

1) One main power disconnect switch

2) One combination circuit breaker/magnetic across the line motor starter with 120 volt control circuits for the compressor motor The starter shall have three thermal overload relays of the melting alloy type

3) Spare contacts for low pressure alarm

4) One control power transformer size to provide 120 volt power to all controls required and to provide power to the desiccant dryer

14 Each compressor shall be provided with a stainless steel nameplate indicating the manufacturer s name model number horsepower and electrical service as a minimum

2 02 TOOLS AND SPARE PARTS

A Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer

B Furnish and deliver the following spare parts carefully boxed or packaged and plainly marked for reordering

1 Two sets of finger valve for each compressor
2 Two drive belts

C Contractor shall obtain from manufacturer and furnish a list of additional recommended spare parts for an operating period of one year The list shall describe each part the quantity recommended and the unit price of the part

2 03 SURFACE PREPARATION AND SHOP PAINTING

A Clean and prime coat ferrous metal surfaces of equipment in the shop

B Coat bearing gear and similar machined polished and non ferrous surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation

C Equipment shall be painted with manufacturer s best standard finish

D Field painting shall be as specified under Section 09900

PART 3 EXECUTION

3 01 INSTALLATION

A Install in accordance with the Drawings approved shop drawings the manufacturer s instructions and the supplemental requirements below

B Align adjust and lubricate all equipment in accordance with the manufacturer s instructions and leave in proper working condition

C Provide all shims supports and mounting appurtenances required

D Install all equipment units or assemblies on concrete pads unless otherwise specified Secure with stainless steel anchor bolts in accordance with the manufacturer s recommendations

E Accurately shim equipment legs to required elevations

F All mounting hardware shall be Type 316 stainless steel Stainless steel anchor bolts shall be installed in the air receiver foundation using a bolt layout template supplied by the compressor manufacturer

G Make all necessary field connections required to place equipment in proper operation

H Perform all piping installation in accordance with the applicable installation specifications of Division 15

I Perform all electrical work in accordance with the applicable installation specifications of Division 16

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3 02 FIELD TESTS

A After Contractor and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation Contractor and a qualified field service representative of the manufacturer shall conduct running and field tests of the equipment and controls during Phase I of the prove out period in the presence of CONTRACTING OFFICER to demonstrate that the unit and its controls will function correctly

1 Running Tests

a Field test each unit together with its controls Test shall demonstrate to CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by Contractor at his expense

b In the event that Contractor is unable to demonstrate to CONTRACTING OFFICER that his equipment meets the requirements of the running and field tests the equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

2 Field Tests Conduct the following minimum field tests

a Verify the compressor develops pressure and control functions to operate as specified

b Verify compressor supplies the specified air flows

3 03 CONTRACTOR'S SERVICES

A The Contractor shall furnish the services of a qualified factory trained serviceman who shall check the installation before it is placed into operation supervise initial operations and instruct the plant operators in the care operation and maintenance of the equipment

B The serviceman will be required to make one visit to the site The visit shall be for a period of one 8 hour day to check the completed installation to start up the unit and to instruct the plant operators in the proper operation and maintenance of the equipment All costs including travel lodging meals and incidentals shall be considered to have been included in the Contractor s lump sum price for the equipment

C Service representative shall verify the lubrication systems are complete clean and filled with the proper grade of lubricants

END OF SECTION

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SECTION 11385
MIXING EQUIPMENT

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

1 Contractor shall furnish all labor materials equipment and incidentals required to provide three (3) top mounted shaft mixers

2 Mechanical mixer shall be top entering furnished complete with motors gears and accessories as shown and specified The mechanical mixers shall be furnished by a single mixer manufacturer who shall assume responsibility for proper alignment and operation of the complete mixing unit

B General

1 Drawings are for purposes of guidance and to show functional features required They do not show all components required to accomplish the desired results or all components required to interface equipment All parts equipment and devices necessary to meet the functional requirements shall be provided

2 Drawings are not intended to show exact dimensions peculiar to any specific mixing equipment

3 All mixers shall be designed and built for the specified service without overheating without excessive vibration or strain and requiring only that degree of maintenance generally accepted as peculiar to the specific type of mixer required

C Related Work Specified Elsewhere

1 Division 1 General Requirements
2 Section 05504 Miscellaneous Metal Fabrications
3 Section 09900 Painting
4 Section 11340 Tanks
5 Division 16 Electrical

D Coordination

1 Review installation procedures under other Sections and Contracts and coordinate them with the work specified herein

2 Coordinate with process tank supplier to ensure adequate support for the mechanical mixers is provided

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3 The Contract Drawings show a general arrangement of the mechanical mixers and supports Dimensions of the equipment may vary with manufacturer Similarly the unit motor requirements may vary with manufacturer It is therefore to be anticipated that dimensions and motor requirements may have to be changed to accommodate the mixer equipment furnished Contractor shall make these changes and coordinate with other affected contractors No direct payment will be made for such changes the total cost therefore including all necessary services shall be considered as having been included in the bid price

1 2 QUALITY ASSURANCE

A Manufacturer s Qualifications

1 Equipment provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five years

B Source Quality Control

1 In order to centralize responsibility it is required that mechanical mixers provided under this Specification be obtained from a single supplier or manufacturer Contractor shall ensure that manufacturer a supplier shall assume full responsibility for the completeness of the system Contractor shall ensure that the supplier or manufacturer is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

2 In order to centralize responsibility it is required that in line static mixers provided under this Specification be obtained from a single supplier or manufacturer Contractor shall ensure that manufacturer or supplier shall assume full responsibility for the completeness of the system Contractor shall ensure that the supplier or manufacturer is the source of information on all equipment furnished regardless of the manufacturing source of that equipment

C Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 American Gear Manufacturers Association
2 Anti Friction Bearing Manufacturers Association
3 Occupational Safety and Health Act
4 National Electric Code
5 National Electrical Manufacturers Association
6 Institute of Electrical and Electronic Engineers
7 American National Standards Institute
8 Joint Industrial Council

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D Each mixer shall be factory tested for a minimum of four hours to insure they are free from defects Copies of test reports shall be submitted to the CONTRACTING OFFICE prior to shipment

1 3 SUBMITTALS

A Shop Drawings Submit for approval Shop Drawings showing the following

1 Fabrication assembly installation and wiring diagrams

2 Manufacturer s literature illustrations specifications and engineering data for all equipment including

a Dimensions
b Materials
c Size
d Weight
e Torque
f Bending moment
g Critical speed
h Diameter of shaft
I Shaft rpm
J Impeller diameter
k Pitch of impeller
l Distance from bottom of tank to impeller

3 Provide setting drawings templates and directions for the installation of anchor bolts and other anchorages

4 Drawings showing fabrication assembly installation and wiring diagrams

C Field Test Results

1 Submit a written report giving the results of the field tests required

D Manufacturer s Reports

1 Submit a written report of the results of each visit by a manufacturer s serviceman including purpose and time of visit tasks performed and results obtained

E Operation and Maintenance Manuals

1 Submit in accordance with requirements of Section 01730 Operation and Maintenance Data 3 copies

F Lubricant Specification Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment

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1 4 PRODUCT DELIVERY, STORAGE AND HANDLING

A Deliver materials to the site to ensure uninterrupted progress of the Work

B Store materials to permit easy access for inspection and identification Keep steel members off the ground using pallets platforms or other supports Protect steel members and packaged materials from corrosion and deterioration

C Store all equipment in covered storage off the ground and prevent condensation

PART 2 PRODUCTS

2 1 MECHANICAL MIXERS

A Product and Manufacturer

1 To ensure that all the equipment required for the installation of the mixer is properly coordinated and will function in accordance with the intent of these Specifications the Contractor shall obtain all the equipment specified under this item from the equipment manufacturer in whom the responsibility for the proper function of all the equipment as an integrated and coordinated system shall be vested The intent of this paragraph is to establish unit responsibility for all the equipment with the mixing equipment manufacturer The use of the word responsibility relating to the mixer on equipment manufacturer is in no way intended to relieve the Contractor S ultimate responsibility for equipment coordination installation operation and guarantee

B Service Requirements

1 Mix Reaction Tank Mixer (ME 201)

a) Liquids Mixed	Process streams Potassium Permanganate and Sodium Hydroxide
b) Tank Size	10 Diameter x 9 6 Height
c) Maximum Flow	75 gpm
d) Mixing Type	Chemical Blending
e) TSS (approximate)	0 45 mg/L
f) Type of Service	Reaction
g) Duty	Continuous
h) Material of Construction	Stainless Steel

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I) Impeller diameter	16 inches
j) Shaft diameter	1 ¼ inches
k) Shaft length	72 inches
l) Motor Hp	3
m) Electrical Service	480 V/3 phase/60 Hz

2 Sludge Mixer (ME 501)

a) Liquids Mixed	Sludge Streams
b) Tank Size	8 Diameter x 9 Height
c) Maximum Flow	75 gpm
d) Mixing Type	Solids Suspension
e) TSS (approximate)	20 110 mg/L
f) Duty	Continuous
g) Shaft length	72 inches
h) Monitoring Detail	Angle offset
i) Impeller diameter	16 inches
j) Shaft diameter	1 ¼ inch
k) Motor HP	2
l) Electrical service	480V/3 phase/60 Hz

2 Each mixer shall consist of a motor driven gear reducer vertical shafting and impellers and shall be driven and controlled by its own drive and control mechanism

3 Mixing units shall be designed for continuous 24 hour per day 7 day/week operation

4 Contractor shall require equipment manufacturer to select the motor size in accordance with his prior experience and his understanding of the service conditions required Mixers shall be installed in the tanks with all required supports mounting brackets and other structural requirements shall be included as necessary to provide a complete installation

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C Details of Construction

1 General

a Design of the equipment shall permit continuous operation without excessive wear and shall permit development of the maximum operating torque without damage to or failure of the mechanism and drive components

b Shafting shall be conservatively designed to transmit the power required Deflection of shafting shall be limited to that acceptable for best practice

c Each mixer shall be supplied as a complete unit and shall include a motor support bracket and body mounting brackets

2 Speed Reducers

a Lubrication Lifetime grease system

b All gear motors shall have an AGMA Class III gear rating Gears shall be designed and rated for an AGMA service factor of not less than 1 5

c Thermal rating of the speed reducer shall exceed the design mechanical rating to eliminate the need for external coolers

d All bearings shall be anti friction type oil lubricated except for the lower output shaft bearing which may be grease lubricated All bearings shall have a minimum B 10 life of 100 000 hours

e Housing and Baseplate Cast iron

3 Impeller Shaft

a Material Stainless steel

b Removable from drive unit

c Maximum operating speed shall be less than 60 percent of first lateral critical speed Bottom steady bearings are not acceptable

d Total shaft run out shall not exceed 0 125 inches per 10 feet of shaft length

e Maximum impeller shaft speed shall not exceed 70 rpm

f Impeller shaft shall be connected to the gear reducer output shaft by a rigid flanged coupling welded to the shaft Coupling shall be designed to transmit any torque and withstand any bending moments which the coupling may be

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subject to The unit shall be supplied with a gas tight shaft seal for atmospheric pressure on both sides of shaft seal

4 Impellers

a Four (4) blade stainless steel axial turbine type keyed to the shaft

b Blades shall be pitched at a maximum of 45 degrees from the horizontal and bolted to the impeller hub

5 Motors

a Suitable for continuous operation of sufficient horsepower to operate the mixer within the nameplate rating without overloading All motors shall be built in accordance with current NEMA IEEE and ANSI standards

b Single speed squirrel cage induction TEFC NEMA Design B motor shall be suitable for operation on a 480 volt 60 Hz 3 phase supply and shall include a 1 5 service factor Motor speed shall not exceed 1800 rpm

c Equipped with non hygroscopic ball bearings of the extended duty type grease or oil lubricated

d Motor frame and shields shall be cast iron or heavy fabricated steel of such design and sizes as to hold the motor components rigidly in proper position They shall be provided with lifting lugs and stainless steel rating nameplates indicating motor characteristics

e Critical speed of the shaft and rotor assembly shall be at least 20 percent greater than maximum motor operating speed

2 2 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer

B Furnish and deliver the following spare parts carefully boxed or packaged and plainly marked

1 One set of each type of bearings used
2 One set of each type of seals used
3 One set of each type of flexible motor couplings

C Contractor shall store and safeguard spare parts until completion of the work at which time they shall be inventoried delivered and placed in an area designated by the CONTRACTING OFFICER

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D Contractor shall obtain from manufacturer and furnish a list of additional recommended spare parts for an operating period of one year The list shall describe each part the quantity recommended and the unit price of the part CONTRACTING OFFICER will purchase all some or none of the recommended spare parts at his option

2 4 PAINTING

A Equipment shall receive manufacturer s shop primer and standard protective coating system prior to shipment Primer shall be compatible with field painting specified herein

B Machined polished and non ferrous surfaces shall be coated with corrosion prevention compound

PART 3 EXECUTION

3 1 INSTALLATION

A Installation shall be in complete accordance with manufacturer s instructions and recommendations

B All electrical connections shall be in conformance with the requirements of Division 16 Electrical

C Once installation is complete touch up damaged paint with manufacturer supplied paint

3 2 FIELD TESTS

A After the Contractor and CONTRACTING OFFICER have mutually agreed that the equipment installation is complete and ready for continuous operation Contractor and a qualified field service representative of the manufacturer shall conduct a running test of the equipment and controls during Phase I of the prove out period in the presence of CONTRACTING OFFICER to demonstrate that the unit and its controls will function correctly

1 Running Tests

a Field test each unit together with its controls Test shall demonstrate to the CONTRACTING OFFICER that each part and all parts together function in the manner intended All necessary testing equipment and manpower shall be provided by Contractor at his expense

b In the event that Contractor is unable to demonstrate to CONTRACTING OFFICER that his equipment meets the requirements of the above described test the equipment will be rejected and Contractor shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements

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c Prior to applying electrical power to any motor driven equipment the drive motor shall be rotated by an external source to demonstrate free operation of all mechanical parts

3 3 MANUFACTURER S SERVICES

A Furnish the services of a qualified factory trained serviceman to assist in the installation of the equipment check the installation before it is placed into operation assist in the performance of field test supervise initial operations and instruct plant operators in the care operation and maintenance of the equipment A certificate from the manufacturer relative to these services is required under section 01650

B Serviceman shall not make less than one visit to the site The first visit shall be for a period of not less than three 8 hour days to check the completed installation to perform the field tests supervise initial operations and train plant operators

C Serviceman shall verify the lubrication systems are complete clean and filled with the proper grade of lubricants

D Reports Submit report by manufacturer of each visit to the site that provides complete information on time schedule tasks performed persons contacted problems corrected test results training instruction and all other pertinent information

E Training In addition to above requirements furnish services of a qualified factory trained operations and maintenance serviceman to instruct and train plant operators in the proper care operation and maintenance of the advanced process equipment e g oxidation system in accordance with the requirements of Section 01661

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SECTION 11500
VAPOR PHASE CARBON ADSORPTION SYSTEM

PART 1 GENERAL

1 01 Summary

A The Contractor shall supply and provide all materials fabrication drawings design installation testing and delivery of services as specified in this section and/or on the drawings for complete installation and proper operation of the vapor phase carbon adsorption system as part of the wastewater treatment system

B This specification covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment described herein

C It is not the intent of this specification to provide all details of design and fabrication It shall be the responsibility of the Contractor to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship and that is suitable for the specified service

1 02 System Description

A The vapor phase adsorption system utilizes granular activated carbon (GAC) for removal of organic compounds from the tank vents

B The vapor phase carbon adsorption drum (T 603) shall be designed for application in an Induced Draft Venting System The Contractor shall provide one (1) adsorber vessel that meets the requirements specified herein and shall provide any preconditioner unit(s) the Manufacturer recommends based on the inlet stream conditions and performance requirements specified below The drum will contain 200 pounds (approx) of GAC

1 03 Performance Requirements and Design Criteria

A The carbon adsorbers will be used to treat a maximum of 100 scfm and an average of 75 scfm of VOC laden air at a temperature of 50 F to 130 F and a relative humidity of 100%

B The removal of VOCs from the air stream via GAC adsorption shall exceed 95% (mass basis) This removal efficiency shall be obtained at air flow rates from 50 scfm up to 100 scfm Actual influent concentrations and constituents shall vary slightly from the values presented herein and any performance guarantee shall remain valid provided that the actual influent concentrations are lower than or within a reasonable range of those presented herein

C The vapor phase treatment system shall have a minimum operating capacity of 0 2 lbs of organics per pound of carbon utilized Treated vapor discharges shall be below 100% saturation and shall not contain water droplets (condensation)

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1 04 Submittals

A Contractor shall submit in the manner and within the time limit as set forth in the contract documents the items listed herein for all the equipment and materials furnished under this section

B The Contractor s drawings shall be direct reading reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until the Contractor has received written drawing review approvals from the Contracting Officer in accordance with the submittal register developed for the vapor phase carbon adsorption system

C Submittals to be provided include

1 Shop drawings outlining overall dimensions installation/connection details weights and arrangement of functional parts Detailed drawings and installation instructions for any special requirements for handling storing and final erection of equipment and systems

2 Manufacturer s literature

3 A complete set of recommended spare parts based on the equipment literature

4 Operation and Maintenance Manual including equipment manuals maintenance procedures testing preventive maintenance matrix list of spare parts and trouble shooting instructions

5 Guarantees shop test results and verifications as required herein

D Contractor shall provide 6 copies of each submittal Those submittals requiring review and approval (Items 1 2) shall be submitted no later than 45 days after award of the contract Other submittals shall be submitted no later than 12 weeks after award of contract

PART 2 PRODUCTS

A Contractor shall provide one (1) granular activated carbon adsorber meeting the following requirements

1 The drum shall be constructed of 16 gauge steel Differential pressure shall not exceed 0 5 in W C @ 100 scfm for the vessel

2 Each adsorber shall contain 140 lb (approx) of granular activated carbon meeting the specifications provided below

3 Each adsorber shall contain a 4 duct connection for process influent

2 02 Granular Activated Carbon

A 140 lbs of granular activated carbon shall be provided within each adsorber vessel delivered

B The activated carbon shall be virgin granular carbon manufactured from bituminous coal The activated carbon shall conform to the following specifications

1	Iodine No (minimum)	900
2	Butane Activity weight %	23 8
3	Calculated CCL_4 No (minimum)	60
4	Effective Size	0 8 1 0 mm
5	Screen Analysis U S Sieve Series weight %	
	a On 4 mesh (maximum)	15
	b 30 mesh (maximum)	8
6	Ash (max weight %)	8
7	Moisture as packed (max weight %)	2
8	Hardness No (Min)	95
9	Apparent Density (g/ml min)	0 44

C The delivered activated carbon adsorber must be accompanied by an analysis sheet certifying compliance of the activated carbon with these specifications

2 03 Blower

A 100 cfm blower rated for 120 V/1 phase/60 Hz service shall be provided with the carbon system

PART 3 EXECUTION

3 01 Testing and Inspections

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects

B After the equipment is completely installed acceptance tests may be performed to demonstrate performance requirements as specified herein The field tests will be governed by provisions of applicable industry and institute standards

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3 03 Warranty

For all purchased equipment Contractor shall provide a copy of Equipment and Performance Warranty documenting formal warranty coverage for a minimum of one (1) year from the date of shipment

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DIVISION 12

FURNISHINGS
(not used)

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DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13120
PRE ENGINEERED BUILDING
PART I GENERAL

1 01 SUMMARY

A The Work covered in this Section includes the furnishing of all necessary labor equipment, material engineering and incidentals required to design, fabricate deliver and install a pre engineered building complete and ready to be occupied and used as intended by the requirements of this Specification

B The building shall include at a minimum, the structural frame foundations metal walls sloped roof system including gutters and downspouts Interior and exterior doors and windows heating exhaust units and all other related work necessary for the complete construction of a pre engineered building will be handled during the final engineering stage

1 02 REFERENCE STANDARDS

A American Institute of Steel Construction (AISC)

1 Specification for the Design Fabrication and Erection of Structural Steel for Buildings

B American Society for Testing and Materials (ASTM)

1	A 36	Specification for Structural Steel
2	A 153	Specification for Zinc Coating (Hot Dip) of Iron and Steel Hardware
3	A 307	Specification for Carbon Steel Externally Threaded Standard Fasteners
4	A 325	Specification for High Strength Bolts for Structural Steel Joints
5	A 386	Specification for Zinc Coating (Hot Dip) on Assembled Steel Products
6	A 446	Specification for Steel Sheet Zinc Coated (Galvanized) by the Hot Dip Process Structural Quality
7	A 525	Specification for Steel Sheet Zinc Coated (Galvanized) by the Hot Dip Process General Requirements
8	A 529	Specification for Structural Steel with 42 KSI (290 Mpa) Minimum Yield Point (½ in (12 7 mm) Maximum Thickness)

9 C 665 Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

C 1 AWS Standard Welding Symbols

2 AWS Structural Welding Code

D SSPC Steel Structures Painting Council

E Steel Door Institute (SDI)

1 SDI 100 Recommended Specifications for Standard Steel Doors and Frames

1 03 RELATED WORK SPECIFIED ELSEWHERE

A Concrete is included in Section 03300

1 04 SUBMITTALS

A The Subcontractor shall submit for the approval of the Contractor the following

1 Shop Drawings

a Indicate assembly dimensions location of structural members connections attachments openings cambers and loads

b Indicate wall and roof system dimensions panel layout general construction details anchorages and method of anchorage and installation

c Indicate framing anchor bolt settings sizes and location from datum

2 Product Data

a Provide data on profiles component dimensions and fasteners

3 Certification

a Submit written Certification prepared and signed by a Maryland State licensed Professional Engineer verifying that the design meets indicated loading requirements and codes of authorities having Jurisdiction

1 05 BUILDING DESCRIPTION

A The building shall have the following provisions at a minimum

1 House all the precess units and equipment that are part of the treatment facility other then those intended and designed as outdoor installations

B Primary Framing consisting of a rigid frame of rafter beams and columns end wall columns and wind bracing

C Secondary Framing consisting of purlins girts flange bracing dips and other Items detailed

D Wall and Roof System consisting of pre formed metal panels of profile with subgirt framing/anchorage assembly insulation liner sheets and accessory components

E Doors and windows interior and exterior as necessary

F Drainage features including gutters downspouts side drains grating and related items

G All necessary plumbing fixtures and related plumbing

1 06 DESIGN REQUIREMENTS

A Thermal Resistance of Roof System

1 6 inch w/R value of 19 with Thermal Blocks

B Thermal Resistance of Wall System

1 4 inch w/R value of 13

C Roof members to withstand 3 psf mechanical dead load 35 psf snow load and 20 psf design loads due to pressure and suction of wind (wind speed 80 mph) Structure shall be designed for Seismic Zone 1 Exposure C 1 10

D Exterior wall and roof system to withstand imposed loads with maximum allowable deflection of span = L/180

E Provide drainage to exterior for water entering or condensation occurring within wall or roof system

F Assembly to permit movement of components without buckling failure of joint seals undue stress on fasteners or other detrimental effects when subject to temperature range not to exceed 150 F

G Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance

1 07 QUALIFICATIONS

A Manufacturer

1 Company specializing in manufacturing the products specified in this Section with minimum three years documented experience

B Design work under direct supervision of a Professional Engineer

1 08 REGULATORY REQUIREMENTS

A Conform to Maryland State Basic Building Code and BOCA Basic Building Code for submission of design calculations reviewed shop drawings and as required for acquiring permit

1 09 WARRANTY

A Provide 20 year warranty

B Warranty Include coverage for exterior pre finished surfaces to cover prefinished color coat against chipping cracking or crazing blistering peeling chalking or fading

C Warranty Include coverage for weather tightness of building enclosure elements after installation

PART 2 PRODUCTS

2 01 MANUFACTURERS BUILDING SYSTEM

A Steel Span of Georgia Inc

2 02 MATERIALS FRAMING

A Structural Steel Members shall be as given in ASTM A 36

B Plate or Bar Stock shall be as given in ASTM A 529

C Anchor Bolts shall be unprimed field primed and painted as given in ASTM A 36

D Bolts Nuts and Washers shall be as given in ASTM A 325

E Welding Materials shall be as given in AWS

F Primer shall be alkyl red oxide

G Grout shall be non shrink type pre mixed compound consisting of non metallic aggregate

cement water reducing and plasticizing agents capable of developing minimum compressive strength of 2400 psi in two days and 7000 psi in 28 days

2 03 MATERIALS WALL AND ROOF SYSTEM

A Sheet Steel stock shall be ASTM A 446 Grade A galvanized to galvalume G90 designation with a silicone polyester and a 0 5 mil white interior washcoat

B Insulation shall be as given in ASTM C 665 roll glass fiber type faced with reinforced white vinyl UL flame spread class~lcation of 25 or less where exposed blanket type fit

C Joint Seal Gaskets shall be Manufacturer s standard

D Fasteners shall be Manufacturer s standard type with finish to match adjacent surfaces when exterior exposed

E Bituminous Paint shall be Asphatic type

F Metal Mesh shall be galvanized steel wire woven

2 04 METAL DOORS AND FRAMES

A Steel doors and frames shall be hot rolled pickled and oiled in accordance with ASTM A 569 and A 568 cold rolled in accordance with ASTM A 366 and A 568

B Doors shall comply with provisions of SDI 100 of the types and styles required for materials quality metal gages and construction details

C Frames shall comply with provisions of SDI 100 of the types and styles required for materials quality metal gages and construction details

1 Provide standard insulates metal frames for doors borrowed lights and other openings as indicated

2 Prepare frames to receive 2 silencers on strike jambs of single swing frames and on heads of double swing frames

3 Provide 26 gage steel plaster guards or mortar boxes welded to frame at back of hardware cutouts where installed in concrete masonry or plaster openings

2 05 OVERHEAD DOORS

A Overhead Coiling Doors shall be as manufactured by Raynor Manufacturing Company Model N40 with IF slats and RGJH operator or approved equivalent

B The Curtain shall consist of interlocking flat vertical exterior surfaces roll formed from not

less than 22 gage commercial quality hot dipped galvanized (G 90) steel in accordance with provisions given in ASTM A 525 and ASTM A 526 Curtain slats shall incorporate a two coat baked on prime paint applied prior to roll forming to assure complete and even coverage

C Interlocking slats shall have a 3/4 inch thick expanded polystyrene core place within the full length of each slat

2 06 WINDOWS

A Windows shall be DIG glass

B The size of the windows shall be 40 square

2 07 FABRICATION FRAMING

A Fabricate members in accordance with AISC Specification for plate bar tube or rolled structural shapes

B Anchor Bolts shall be formed with bent shank assembled with template for casting into concrete

C Provide framing for wall mounted exhaust fan and make up air handler wall louvers

2 08 FABRICATION WALL AND ROOF SYSTEMS

A Siding shall be 26 gage silicone polyester with exposed screw fastener Major rib dimensions are per panel profile selected by contractor

B Roofing shall be minimum 24 gage metal thickness standing seam roof system overlapped at adjoining panels 3 inches deep 24 inches wide fitted with continuous gaskets

C Interior Liner Panel shall be minimum 26 gage metal overlapped at adjoining panels approximately 1 1/4 inch deep

D Insulated Wall Panel shall be exposed fastener non insulated panel

E Girts/Purlins shall be rolled formed structural shape to receive siding roofing and liner sheet and 14 gage minimum

F Internal and External Corners shall be the same material thickness and finish as adjacent material profile shop cut and factory mitered to required angles

G Flashing Closure Pieces Facia and Caps shall be the same material and finish as adjacent material profile to match

H Explosion Relief Fasteners shall be a luminum bolts having a necked down area which will fail by tension when subjected to an internal pressure of 15 lbs per sq ft Exterior visible portion of bolt to have a finish color to match siding

I Fasteners shall maintain load requirements and weather tight installation same finish as cladding non corrosive type finish

2 09 FABRICATION METAL DOORS AND FRAMES

A Fabricate units to be rigid neat in appearance and free from defects warp or buckle Welb exposed joints continuously grind dress and make smooth flush and invisible

B Prepare steel doors and frames to receive mortised and concealed finish hardware including cutouts reinforcing drilling and tapping complying with ANSI A 115 Specifications for Door and Frame Preparation for Hardware

1 Reinforce units to receive surface applied finish hardware to be field applied

2 Locate finish hardware as indicated or if not indicated in accordance with DHI

C Shop paint exposed surfaces of doors and frame units including galvanized surfaces using manufacturer s standard baked on rust inhibitive primer

2 10 FABRICATION OVERHEAD COILING DOORS

A Fabricate units to be rigid neat in appearance and free from defects warp or buckle Weld exposed joints continuously grind dress and make smooth flush and invisible

B The door shall be provided with bottom astragal weatherstrip vinyl jamb seal and hood baffle as a factory standard

C Lateral movement of the slats to be eliminated by means of malleable cast iron galvanized endlocks fastened to alternate slats with two (2) zinc plated steel rivets per lock Endlocks shall be designed to prevent slats from wearing at the surfaces coming in contact with the guide angles

D Windlocks shall be provided on doors as required by door size or special design windload requirements Windlocks to be galvanized malleable cast iron and fastened to curtain slats with three (3) zinc plated steel rivets per lock

E The bottom of the curtain will be reinforced with two (2j steel angles minimum11/2~ x 1 1/2~ x 1/8 Supply bottom single contact type bottom astragal weatherstripping extended into guides as standard

2 11 FABRICATION GUTTERS AND DOWNSPOUTS

A Fabricate of same material and finish as roofing material

B Form gutters and downspouts from 26 gage thick sheet to collect and remove water Fabricate with connection pieces

C Form sections in maximum possible lengths Hem exposed edges

D Fabricate support straps of same material and hnish as roofing and wall metal color to match

2 12 FINISHES

A Framing Members shall be clean prepared and shop primed Do not prime surfaces to be field welded

B Vinyl Vapor Barrier at Interior Face of Insulation shall be white

C Exterior Standing Seam Roof Finish shall be Galvalume

D Exterior Wall Panels Interior Liner Panels silicone polyester color to be selected by Contractor

PART 3 EXECUTION

3 01 EXAMINATION

A The Subcontractor shall verify site conditions under provisions as given in the General Conditions

B The Subcontractor shall verify that foundation floor slab mechanical and electrical utilities and plated anchors are in correct position

3 02 ERECTION FRAMING

A Erect framing in accordance with AISC Specification

B Provide for erection and wind loads Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing

C Set column base plates on leveling plates to full plate bearing

D Do not field cut or alter structural members without approval of Contractor

E After erection prime welds abrasions and surfaces not shop primed

3 03 ERECTION WALL AND ROOFING SYSTEMS

A Install in accordance with manufacturer s instructions

B Exercise care when cutting prefinished material to confirm cuttings do not remain on finished surface

C Fasten cladding system to structural supports aligned level and plumb

D Locate siding and roofing end laps over supports End laps minimum 12 inches (1 major rib) Place sidelaps over bearing

E Use exposed fasteners

F Install insulation and vinyl vapor barrier utilizing roof purlins Place wire mesh under vinyl for support between framing members

G Install sealant and gaskets to prevent weather penetration

H System shall be free of rattles noise due to thermal movement and wind whistles

3 04 ERECTION METAL DOORS AND FRAMES

A Install hollow metal units in accordance with manufacturers instructions and final shop drawing Fit doors to frames and floors with clearances specified in SDI 100

3 05 ERECTION OVERHEAD COILING DOORS

A Install doors and operating equipment complete with necessary hardware in accordance with final shop drawings manufacturer s instructions and as specified herein

B Upon completion of installation including work by other trades lubricate test and adjust grilles to operate easily free from warp twist or distortion

3 06 ERECTION GUTTER AND DOWNSPOUT

A Rigidly support and secure components Join lengths with formed seams sealed water tight Flash and seal gutters to downspouts

B Apply bituminous paint on surfaces in contact with cementatious materials

C Gutters shall be profiled to match eave trim

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3 07 INSTALLATION ACCESSORIES

A Install window and glass in accordance with manufacturer s instructions

B Seal wall and roof accessories watertight and weather tight with sealant

3 08 TOLERANCES

A Framing Members shall be 1/4 inch from level 1/8 inch from plumb

B Siding and Roofing shall be 1/8 inch from true position

END OF SECTION

SECTION 13228
SAND FILTER MEDIA
PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install filter media

B Related Sections

1 Division 1 General
2 Section 11204 Sand Filters

1 02 QUALITY ASSURANCE

A Supplier s Qualifications

1 Contractor shall ensure that supplier maintain complete engineering continuous quality control and service capabilities in the application and production of materials specified herein Provide a letter or certificate describing quality control program

2 Contractor shall ensure that supplier have a minimum of 3 years of experience in furnishing materials similar to that specified herein and shall show evidence of at least 5 installations in satisfactory operation

B Installer s Qualifications

1 Provide a single installer experienced in and regularly engaged in the installation of all types of filter media Submit name and qualifications to CONTRACTING OFFICER

C Testing Agency

1 Contractor shall provide the services of a qualified testing laboratory experienced in testing granular filter media materials to perform the tests specified in Paragraph 1 2 D

2 Selection of the testing laboratory shall be subject to approval of CONTRACTING OFFICER

3 All costs in connection with the work of the testing laboratory shall be paid by Contractor and is deemed included in Contractor s Bid Price

D Source Quality Control

1 Sampling

a Perform sampling of filter media materials in accordance with ASTM D 75 as modified and supplemented in Section 3 of AWWA B100

b The minimum size of composite field samples shall be as specified in Section 3 of AWWA B100

c Collect representative samples from bags or semibulk containers of filter media shipped to the job site using a core sampler Combine the representative samples from each bag or semibulk container to produce the required field sample Sample number of bags or semibulk containers as specified in Section 3 of AWWA B100

2 Testing

a Test all filter materials to demonstrate compliance with requirements of these Specifications The various tests required are specified below Have tests performed by the approved laboratory specified in Paragraph 1 2 C except as indicated herein

b Tests Before Shipment
1) Perform on samples obtained directly by the approved testing laboratory at the source of supply of the filter media materials
2) Obtain samples not sooner than 30 days prior to the date scheduled for shipment of the filter media to job site
3) Include the following tests
a) Grain size analysis
b) Acid solubility
c) Specific gravity
d) Effective size
e) Uniformity coefficient

c Receipt Tests
1) Perform tests on samples obtained directly by the approved testing laboratory from filter media delivered to the job site
2) Conduct Receipt Tests in the same manner as those required for the Tests Before Shipment
3) If the Receipt Tests indicate that the samples do not meet the specified requirements modify or replace filter media to comply with specifications

d No separate payment will be made in connection with sampling and testing of filter media materials

E Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 AWWA B100 Standard for Filtering Material

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Filter media data sheets indicating material unit weight effective size uniformity coefficient and other pertinent data for filter media

2 Complete installation drawings including a description of placement procedures

3 Affidavits of compliance in accordance with AWWA B100

4 Results of all required tests Provide certified copies of all tests performed by the approved testing laboratory

1 04 PRODUCT DELIVERY STORAGE AND HANDLING

A Deliver filter media to the job site to ensure uninterrupted progress of the Work

B Deliver filter media in bags or semibulk containers only Bulk shipment by rail car or truck will not be permitted

C Conform to AWWA B100 the requirements and recommendations of the supplier

D Store filter media on pallets Cover media stored outdoors with black polyethylene sheets to prevent UV deterioration and moisture contamination

E Do not order materials for shipment until CONTRACTING OFFICER has approved the results of Tests Before Shipment

1 05 JOB CONDITIONS

A Protection

1 Dust Control

a Provide adequate protection for surrounding areas at all times during the installation of filter media

2 Personnel Protection

a Provide OSHA approved type dust protection for personnel placing filter media and the CONTRACTING OFFICER S representatives

PART 2 PRODUCTS

2 01 DESIGN CONDITIONS

A Description

1 Filter media shall consist of a bed of silica sand placed to the thicknesses specified

B Filter Operating Conditions

1 See Section 11204

2 02 FILTER MEDIA MATERIAL

A Filter Sand

1 Filter sand shall consist of hard dense durable and sub angular particles of siliceous material which will resist degradation during handling and use and shall be visually free of clay dust and micaceous and organic matter Place filter sand in a single layer

2 Characteristics of the filter sand shall be as follows
- a Thickness of Layer 40 inches
- b Effective Size 1 05 1 15 mm
- c Uniformity Coefficient 1 30 to 1 60
- d Apparent Specific Gravity Not less than 2 50
- e Acid Solubility Less than 5 percent
- f Hardness Minimum 6 5 on Moh s scale
- g Silica Content Minimum 95% by wieght silica dioxide

2 03 SPARE PARTS

1 Contractor shall supply an additional 10 cubic yards of filter media to the site in addition to that required in paragraph 2 2 A of this Section The media shall be supplied in bags no greater than 100 lbs in weight Store media in accordance with the requirements of Section 01610

PART 3 EXECUTION

3 01 INSTALLATION OF FILTER MEDIA

A General

1 Conform to requirements of Section 5 AWWA B100 and with the recommendations of the filter media supplier

2 Thoroughly clean each filter before any filter media is placed and keep clean throughout the placement operations

3 Exercise care in transporting handling and placing filter media materials to avoid contamination with dirt or organic material Remove all media which becomes dirty or contaminated either before or after it has been placed in the filter and replace with clean media of the proper size and type

4 Do not use pneumatic methods to transport or place filter media

5 Prior to placing any material mark the surface elevation of the layer with a level line on the inside wall of each filter

B Filter Sand

1 Place the material in a level layer

2 Upon completion of placement of the filter sand layer wash scrape and skim the material in accordance with Section 6 of AWWA B100

3 After skimming of the sand is completed install additional material if required to bring the final thickness of the layer to that specified

3 02 MANUFACTURER S SERVICES

A A qualified representative of the supplier of the filter sand shall be in attendance at all times when the media is being placed The representative shall instruct the Contractor s personnel in the correct procedures for installing the media and check the appropriate aspect of work in each filter before it is placed in service

3 03 TRAINING

A In addition to the above requirements furnish services of a qualified factory trained operations and maintenance service personnel to instruct and train operators in the proper care operation and maintenance of the filter media These services shall be provided for the time period required under Section 01661

END OF SECTION

SECTION 13330
LOCAL CONTROL PANELS

PART 1 GENERAL

1 01 WORK INCLUDES

A Hinged cover enclosures

B Cabinets

C Terminal blocks and accessories

1 02 REFERENCES

A NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

B ANSI/NEMA ICS 1 Industrial Control and Systems

C ANSI/NEMA ICS 4 Terminal Blocks for Industrial Control Equipment and Systems

D ANSI/NEMA ICS 6 Enclosures for Industrial Control Equipment and Systems

1 03 SUBMITTALS

A Submit product data under provisions of Section 01300

B Shop Drawings for Equipment Panels Include wiring schematic diagram wiring diagram outline drawing and construction diagram as described in ANSI/NEMA ICS 1

PART 2 PRODUCTS

2 01 HINGED COVER ENCLOSURES

A Construction NEMA 250 Type 12 steel (indoors only)

B Finish Manufacturer s standard enamel finish gray exterior white interior

C Covers Continuous hinge held closed by clamps operable by screwdriver hasp and staple for padlock

D Panel for Mounting Terminal Blocks or Electrical Components 14 gauge steel white enamel finish

2 02 CABINETS

A Enclosures for Control Panels shall conform to details on Construction Plans

2 03 TERMINAL BLOCKS AND ACCESSORIES

A Terminal Blocks ANSI/NEMA ICS 4 UL listed

B Power Terminals Unit construction type closed back type with tubular pressure screw connectors rated 600 volts

C Signal and Control Terminals Modular construction type channel mounted tubular pressure screw connectors rated 300 volts

2 04 FABRICATION

A Shop assemble and wire enclosures and cabinet housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6 and as shown on Construction Plans

B Provide watertight conduit hubs on enclosures Myers or equal

C Provide protective pocket inside front cover with schematic diagram connection diagram and layout drawing of control wiring and components within enclosure

PART 3 EXECUTION

3 01 INSTALLATION

A Install cabinets and enclosures plumb anchor securely to wall or structural supports at each corner minimum Mount with top 6 feet above floor

B Provide accessory feet for free standing equipment enclosures

C Install trim plumb

D Provide concrete pad or foundation where appropriate

+ + END OF SECTION + +

SECTION 13600
PROCESS CONTROL SYSTEM
PART 1 GENERAL

1 01 SUMMARY

A This specification covers the requirements for the for the functional design performance materials construction features testing quality and handling of all process monitoring and control equipment described herein

B The work shall include all materials fabrication software installation testing and delivery of services as described in this specification and/or drawings for completion and proper operation of the groundwater extraction treatment system facility

C It is not the intent of this specification and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the Contractor to provide equipment and system that have been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

D The work includes but is not limited to the supply complete installation and testing of the following

1 A complete microprocessor based control system (Programmable Logic Controller) to monitor the process outlined in the Process and Instrument Diagram Drawings and to perform control of functions as shown in the Drawings

2 All control and data equipment specified in Part 2 1

3 All input/output cards subsystem as required The number of inputs and outputs will be finalized at the 100% design level

1 02 CONTRACTOR S SCOPE OF RESPONSIBILITY

A The contractor shall be an experienced and accepted system integrator who shall assume single source responsibility for providing a complete turnkey monitoring and control system as described in this specification The system integrator shall be required to demonstrate a minimum of 5 years of recent experience in the design programming manufacturing and commissioning of control systems of comparable size type and complexity as the proposed system The contractor shall be required to have his own in house capability to handle complete system engineering fabrication and testing This responsibility includes but is not limited to the following

1 System Engineering

2 System Hardware

3 System Programming

4 System Documentation

5 System Installation Support

6 Factory Testing

7 Packing and Shipping to the Job Site

8 Start Up Assistance

9 Loop Checkout

10 Operating Manual

11 Recommended Spare Parts

12 Field Instruments calibration

1 03 CONTROL SYSTEM

A General

The principal means of control of the treatment system is via local control panels containing microprocessor based Programmable Logic Controllers (PLCs) A central PLC combined with an Operator Interface (OI) unit will provide the plant operator with complete supervision of all plant operation functions

B Plant Alarm System

1 Provide overall plant alarm system Alarm events shall be displayed at the OI unit

C General Programming Guidelines

1 Alarm conditions shall be visibly displayed on the OI unit and shall remain active until acknowledged by the operator

2 Provide adjustable timers for alarm display points to prevent nuisance alarm Timer values shall be 0 30 seconds Initial setting unless otherwise specified shall be 5 sec

3 Unless otherwise specified in logic description following timer values to generate equipment fail alarms

a Valve fail to open 60 sec

a Valve fail to close 60 sec

c Equipment fail to start 60 sec

4 All digital alarms or interlock signal shall be fail safe i e contact opens for alarm or shutdown unless otherwise noted

5 For shutdown or permissive interlock (i e High High level) signal from analog input provide deadband in signal to prevent rapid recycling of the equipment

6 In AUTO position of the soft MAN AUTO control station motor shall start and stop based on the logic description In MAN position operator will use soft START/STOP push button the start signal shall be momentary contact in MAN position all interlocks are by passed unless otherwise noted

7 Switch over of MAN AUTO switch from MAN to AUTO shall not stop the motor if interlocks are satisfied

8 Automatic Shutdown and Manual Restart of the System shall be as follows

Upon system power up or system restart all analog and digital outputs shall go to the fail safe positions/states specified by Engineer Upon system power up or system restart AUTO MAN station modes shall come up in the MAN mode with fail safe outputs All tunable parameters however shall remained in the value last assigned during run time session Thus although all tuning changes made during run time shall be retained through a system exit and restart outputs and AUTO MAN stations shall come up in their fail safe position in the manual mode This state shall be referred to as the System Restart Mode Operator will restart the plant manually

There shall only be one system restart mode regardless of the cause of system shutdown the system restart mode shall be identical whether shutdown was caused by controlled exiting of runtime software Motor Control Center power loss UPS power loss or other system fault (e g watchdog timer time out)

On MCC or UPS power failure an auto dialer shall notify the operator

1 04 SUBMITTALS

A The Contractor shall submit in the manner and within the time limit as set forth in the contract documents drawings showing outline and overall dimension connection details weights anchorage details arrangement of functional parts and parts list if applicable for all equipment and material furnished

B Review of the drawings by the Contractor shall not relieve the Subcontractor of the entire responsibility for the engineering design programming workmanship and material under the Project Documents

C The drawings shall include but not limited to the following details

1 Overall dimensions and details of all equipment including Central Control Panel OI and peripherals Location of all connections supports and accessories and bill of materials

2 Exact location of all terminals points and control components mounted on Central Control Panel shall be shown

3 Central Control Panel wiring diagrams which shall include internal wiring and also field I/O (instruments) wiring showing point to point connections between field and local and central control panel terminals

4 Ladder diagrams and/or strategy building blocks

5 Operator interface displays

D Program documentation including complete set of all original manuals received from software supplier in sufficient detail to enable understanding trouble shooting and any future system modifications

E All original system software disc and copy of all hard disc files and logic and/or ladder diagrams

F Submittals Register

Detailed hardware list including catalog cuts	3 weeks after award	Review/Approval
Main Control Panel wiring diagram	2 weeks after award	Review/Approval
Software information	4 weeks after award	Review/Approval
OI Displays	8 weeks after award	Review/Approval
Programming	10 weeks after award	Review/Approval
Spare parts list w/pricing	With shipment	Information
System O&M manuals (6 Copies)	With shipment	Review/comment

1 05 CONTROL LOGIC DESCRIPTION

A This section provides a detailed process control description for the following major equipment components by unit process operation

NAPL separation from the groundwater and on site storage until removal for disposal
Metals and suspended solids removal via chemical oxidation and sedimentation/clarification
Destruction and removal of organic compounds by an advanced oxidation process
Carbon adsorption for acetone/ketone removal and final polishing
Discharge to the surface water creek

The groundwater from excavation activities and intermittent storm water are processed in the order of unit operation presented above where the carbon is used for final polishing because there will be no acetone/ketone in these waters However the condensate water will be directed through carbon (pre filtered first) and either discharged if no further treatment is required or redirected to the metals removal operations if necessary

1 Oil/Water Separation System

System Loop ME 101

Function Oil/Water Separator
Equipment Groundwater transfer pump P 101 DNAPL/Sludge Transfer Pump P 102 Automatic timer KIC 102

Oil/Water separator ME 101 shall be controlled by a vendor supplied automatic control panel The control panel shall provide necessary control of the unit and associated equipment An operating alarm shall be provided with the unit and shall be interlocked with the operation of the remaining process Groundwater transfer pump P 101 shall be manually started by placing the HOA switch in the automatic position In the automatic position the pump shall be energized through solenoid valve unless LSHH 101 and LSHH 201 are energized High water level in the oil/water separator shall be determined by a float type level switch LSHH 101 Activation of LSHH 101 or LSHH 201 shall deenergize Pump P 101 and send an alarm signal to discontinue dewatering operations The free product transfer pump P 102 shall automatically start through a timer KIC 102 Activation of high level switch LSH 102 located in product recovery tank T 102 shall prevent P 102 from operating

System Loop LSH 102, LAH 102

Function Level Alarm in Product Storage Tank Equipment Product Tank T 102 Oil/Water Separator ME 101 DNAPL/Sludge Pump P 101

Product level (high level only) in tank T 102 shall be measured with displacer type level element LSH 102 When LSH 102 is activated solenoid valve SV 102 associated with product transfer pump P 102 shall be deenergized and pump P 102

shall stop Additionally a signal shall be sent to discontinue the dewatering operations

2 Chemical Oxidation System

System Loop LCS 201 (LSL 201, LSH 201, LSHH 201)

Function	Level Control Switch and Interlock
Equipment	Mix Reaction Tank (T 201) Process Feed Pump P 201 Mixer ME 201

Water level in equalization tank T 201 shall be measured with a displacer type level control system LCS 201 located in an external 4 clear PVC standpipe associated with the tank The level control system shall provide output signals to the control panel for low level (LSL 201) high level (LSH 201) and high high level (LSHH 201) When the water level rises above LSHH 201 a level alarm shall activate at the control panel Activation of LSHH 201 shall send a signa~ to deenergize influent feed pump P 101 sump pump P 302 and the dewatering operation When the water level drops below LSL 201 P 201 shall deenergize When the water level rises above LSH 201 P 201 shall energize Activation of high high level switch LSHH 301 from the floor sump T 302 or LSHH 101 from the AOP feed tank T 401 shall deenergize P 201

Tank Mixer ME 201 shall be manually started through a hand switch Failure of ME 201 shall be indicated at either a local control panel or the main control panel

System Loop AE 201, AIT 201, AI 201

Function	pH Sensor Indicator Transmitter
Equipment	Mix Reaction Tank (T 201)

The pH of the process water after chemical addition (Tank T 201 effluent) is measured with a pH sensor located in the piping system The pH is indicated locally at the field device and at the PLC A low pH as indicated by AAI 201 or a high pH as indicated by AAH 201 shall activate an alarm at the PLC

System Loop TS 201

Function	Low Temperature Alarm
Equipment	Caustic Soda Feed Tank T 203

Low temperature in the chemical storage area is monitored with a temperature switch TS 201 A low temperature alarm contact shall be used for alarm indication at the PLC

System Loop FS 201

Function Flow Switch
Equipment Chemical Feed Pumps P 202 and P 203

Influent flow from dewatering operations thermal desorber condensate and storm water flow shall be verified with a flow switch FS 201 Verification of flow shall allow chemical feed pumps P 202 and P 203 to operate Chemical metering pumps P 202 and P 203 shall be manually started Speed and stroke settings shall be manually set based upon influent conditions Variations in either flow or inorganic concentration shall require manual change to the metering pump output settings

3 Metals Removal System

System Loop FS 301

Function Flow Switch
Equipment Polymer Feed System ME 303 Plate Separator ME 303

Process flow from process pump P 201 shall be verified with a flow switch FS 301 Verification of flow shall allow polymer feed system ME 305 to operate The polymer feed system shall be manually started Polymer feed rate settings shall be manually set based upon influent conditions Variations in flow shall require manual change to the polymer feed output settings

System Loop ME 303

Function Plate Separator/Metals Removal
Equipment Flash Mix Tank/Mixer (T 3011ME 301) Floc Mix Tank/Mixer (T 302/ME 302) Primary Sludge Pump/Timer (P 301/KIC 301)

Mixers ME 301 and ME 302 shall be manually started through a hand switch located at the panel provided with ME 303 A timer located at either at the panel or in the PLC provides timed sequence control of the primary sludge pump P 301 to transfer sludge from ME 303 to the sludge holding conditioning tank T 501 P 301 shall be deenergized when either high level switch LSH 501 associated with T 501 or LSHH 301 associated with sump T 302 is energized

System Loop F 304

Function Sand Filtration/Metals Removal
Equipment Air Compressor ME 601

Sand filter F 304 shall be controlled from a control panel provided by the unit manufacturer

System Loop LCS 302

Function Level Control and Alarm

Equipment Floor Drain Sump (T 302) Sump Pump (P 302)

Floor sump pump P 302 shall be controlled by a control panel provided with the pump Level control switch LCS 302 provides the level control for energizing the sump pump P 302 to maintain the level in the sump T 302 When the water level in the sump rises above LSH 302 P 302 shall be energized When the water level in the sump drops below LSL 302 P 302 shall be deenergized When the water level in the sump rises above LSHH 302 an alarm shall activate at the PLC and shut down the process feed pump P 201 and AOP feed pump P 401 If LSHH 201 in T 201 is energized P 302 shall not be able to start

4 Organic Removal System

System Loop LCS 01(LSL 401,LSH 401 LSHH 401)

Function Level Control Switch and Interlock
Equipment AOP Feed Tank (T401) Process Feed Pump P401

The water level in the AOP Feed Tank T-401 shall be measured with a displace type level control system LCS-401 located in an 4 clear PVC standpipe associated with the tank The level control system shall provide output signals to the Control Panel for low level (LSL 401) high level (LSH 401) and high high level(LSHH 401) When the water level rises above LSHH 401 a level alarm shall activate at the PLC display screen Acdvadon of LSHH 401 shall deenergize process feed pump P 201 When the water level drops below LSL 401 P 401 shall deenergize When the water level rises above LSH 401 P 401 shall energize

System Loop ME 401

Function Organic Removal
Equipment Advanced Oxidation Process ME 401 Operating Alarm OA 401

The Advanced Oxidation Process (AOP) unit ME-401 shall be controlled by a vendor supplied automatic control panel The control panel shall provide necessary control of the AOP unit and associated equipment An operating alarm OA 401 shall be provided with the unit and shall be interlocked with the operation of the remaining process

System Loop FE/FI 401

Function Flow Sensor Indicator
Equipment None

Flow is measured with a magnetic flow element and transmitter FE/FIT 401 The flow rate is indicated locally at the flow transmitter

System Loop AE 401, AIT 401,AAH 401

Function pH Sensor Indicator Transmitter and Alarm
Equipment None

The pH of the treated process water is measured with a pH sensor located in the piping system The pH is indicated locally at the field device and at the PLC display screen A high pH as indicated by AAH 401 shall activate an alarm at the PLC and shall deactivate AOP feed pump P 401 process feed pump P 201 and send a signal to discontinue dewatering operation

5 Sludge Dewatering System

System Loop LS 501

Function High Level Interlock Alarm
Equipment Sludge Holding/Conditioning Tank (T 501)

The sludge level in the sludge holding/conditioning tank T 501 is measured with a displacer type level element LS 501 located in an external 4 clear PVC standpipe associated with the tank

The level indicator shall provide an output signal to the PLC for tank high level (LSH 501) Activation of LSH 501 shall deenergize primary sludge pump P 301 and activate a level alarm at the PLC

System Loop ME 502

Function Sludge Dewatering
Equipment Sludge Transfer Pump P 501 Tank Mixer ME 501 Decant Tank T 503 Decant Pump P 503

The sludge dewatering system shall be manually activated Mixer ME 501 shall be manually started through a hand switch Sludge transfer pump P 501 shall be started by opening a manual ball valve on the process air line Decant liquid from Tank T 501 and filtrate from Filter Press ME 502 shall flow by gravity to decant tank T 503 Decant transfer pump P 503 shall be controlled by a float type level switch LS 503 integral with the pump

6 Ancillary Systems

System Loop OA 601

Function Operating Alarm
Equipment Air Compressor (ME 601) Refrigerated Dryer (ME 602)

The air compressor system shall be provided with a vendor supplied local control panel as specified The control panel shall be provided with an operating alarm OA 601 Activation of OA 601 shall be indicated at the local air compressor control panel and shall be transmitted to the PLC

System Loop B 603

Function	Vapor Phase Blower
Equipment	Vapor Phase Carbon Drum T 603

Blower B 603 shall be manually started through a hand switch

The controls to carry out these operations are located in on the treatment floor (local) control packages provided by equipment vendors and in a central control cabinet (CCP) designed and installed by OHM located in the treatment building office

1 06 FACILITY OPERATION

A The treatment facility is intended to operate continuously Periodic shutdown/startup and temporary operations may be required for routine maintenance and/or automatic equipment shutdown

B The Piping and Instrumentation Diagrams along with the above logic description provides the basis for the treatment facility operation

1 07 ENVIRONMENTAL CONDITIONS

A The Central Control Panel and OI will be located in the process treatment area The equipment supplied shall be able to operate safely and continuously within the specified accuracy and reliability s with the approximate extreme conditions indicated below

Temperature 5 100 F

Humidity (non condensing) 5 100% RH

1 08 QUALITY ASSURANCE

A The Contractor shall have a quality assurance program which will ensure that the equipment and services provided will properly reflect the specification requirements The program shall cover as a minimum the following areas

1 Design and procurement control
2 Control of purchased material
3 Inspection and testing
4 Handling and storage

5 Corrective action

PART 2 PRODUCTS

2 01 EQUIPMENT

A Programmable Logic Controller (PLC) (central)

PLC Processor shall have following minimum features

1 Word Length 16 bits minimum
2 Memory Cycle Time Not more than 10 ms/used/Kbytes of memory

3 Real Time Clock Minimum resolution of 50 ms

4 Watchdog Circuit Timer circuit external to the processor to sense processor halt conditions and instruction failures

5 Error Detection Instruction execution checks and error trap Periodic verification of initialization of I/O structure is required

6 Processor Memory 14K program (i e ladder logic) memory and data storage (i e register) memory of at least 16 bit words Provide greater memory if required by application

7 CMOS Semiconductor type memory module shall be provided with lithium battery protection for protecting data in memory for at least six months in the event of normal ower failure

8 Ladder programming

9 LED indicator to display status of processor operation and power supply/battery

B OI Display Module

An operator interface (OI) shall be provided to allow communication between the process control perations and the systems operator A two line LCD display associated with the PLC shall provide the OI function

C Programmer

A programmer for operation with the programmable logic controller shall be provided Programming shall be done in relay ladder diagram language A portable or desktop personal computer is preferred

D Central Control Panel Cabinet

1 This Cabinet shall be a NEMA 12 floor mounted enclosure with hinged doors and front access panels This enclosure shall be constructed using commercial available industry standard HOFFMAN or equal type enclosure PLC processor and I/O cards shall be mounted inside the enclosure and prewired to the terminal blocks together with all other accessories in this cabinet

2 All external cable entering the I/O cabinet shall enter from the top and shall interface with internal component via terminal blocks These terminal blocks shall be ENTRELEC Series 5000 rail mounted or equal Terminal blocks for digital inputs shall be sized to receive #14 AWG min wire and for analog input shall be sized to receive #16 wire Terminal blocks shall be compression type

3 Terminal blocks shall be readily accessible and mounted not less than 12 inches above the floor and 6 inches below the top of the cabinet Minimum distance between rows of terminals shall be 6 inches No terminals block shall carry more than two wires on either side of any terminal Terminal blocks and associated cable ties raceways and wire troughs shall be manufactured from nonburning materials defined by ASTM D635

4 Each terminal shall be suitably identified in accordance with drawings and wire lists

5 Termination cabinet low level terminals and wiring shall be physically separated from 120 VAC terminals and wiring by metal barriers or required separation distance

6 The shield wires for low level analog signal twisted pair field cable shall be terminated at terminals and grounded at a convenient isolated shield bus bar within the termination cabinet

7 Each type of terminal block shall include 20% spare (non wired) screw terminals for owner s future use

8 Miniature knife gate switches similar to ENTRELEC M 6/8 SNB or equal shall be provided on each digital output circuit to enable service and maintenance operation

9 All 120 VAC and 24 VDC power to the field instruments shall be individually fused

ORIGINAL
R 01

10 Main circuit breaker for incoming 120 VAC regular power and 120 VAC UPS power shall be provided

11 Redundant 24 VDC power supplies shall be provided for I/O and instrument loop power feed Power supplies shall be monitored for loss of power

12 All internal wiring shall be of such cross section temper and flexibility as to provide ample and safe current carrying capability and physical strength Insulation shall be fire retardant All wiring shall be clearly marked and correspondingly designated on system drawings It shall be the vendor s responsibility to make point by point checks on all wiring proper connections and correct designations

E I/O Subsystem

The central Programmable Logic Controller (PLC) and its I/O subsystem shall be configured with sufficient capacity for all specified inputs and outputs in the I/O list The PLC processor performance shall ensure I/O scan and operating cycle execution time are adequate to perform the control supervisory and data acquisition goals Cycle I/O scan of less than 100 milli seconds or better shall be achieved LED indicators shall be provided to display status of each inputs/outputs

Type of I/O cards shall be as follows

1 Analog Input (AI) Modules

Resolution shall be 12 bit minimum Analog inputs from transmitters shall be 4 20 mA isolated powered by individually fuse protected DC power supply source Two wire or Four wire transmitter power requirements are identified in the I/O list Precision 250 ohm dropping resistor shall be used to convert current to voltage signal

2 Analog Output (AO) Modules

Analog outputs shall be 4 20 mA DC individually fused protected

3 Digital Input/Output (DI DO) Modules

Optically isolated inputs and outputs with on board LED for status monitoring All digital input circuits shall be powered from the control system 120 VAC power distribution Digital output circuits which controls instruments directly from control panel i e solenoid valve shall be powered from panel 120 VAC power supply Digital output shall be via solid state relays with output rating at a minimum 3A at 120 VAC or to match the load (solenoid or starter coil requirements)

A minimum of 15% installed spare I/O for future applications shall be furnished and wired to the terminal blocks

F Auto Dialer

For system remote interface an Auto Dialer shall be provided mounted inside the Central Control Panel Alarms if not Acknowledge by operator after a specified period of time will be annunciated and will communicate via telephone line through Auto Dialer to a remote office phone and/or beeper (telephone and/or beeper number and selected priority 1 alarms to be specified after award of the contract)

Auto Dialer shall meet the following requirements

1 Number of channels Four (4) N O or N C contacts

2 Solid state component capable of dialing multiple eight phone numbers in succession until it is acknowledged

3 Solid state voice recording and playback No mechanical tape mechanism shall be employed

4 Compatible with pager

5 Compatible with rotary pulse or tone dialing

6 Time between alarm phone calls Programmable 0 1 to 99 9 minutes

7 Programming Standard phone jack on front panel for programming phone Voice menu instruction guide programming

8 RJ11 Telephone line jack for connection to public telephone network

9 Battery backup Rechargeable 8 hours

10 Surge protection Solid state protector on phone power and signal lines

G Un interruptible Power Supply (UPS)

An on line UPS sized to enable 30 minutes of continuous operation of control and data acquisition system shall be provided to ensure uninterrupted information processing and safe shutdown in the event of power loss Provide alarms on low UPS battery battery replacement and on AC power output failure

2 02 SOFTWARE

A PLC Software

1 Relay ladder diagram programming to implement specified control strategies

2 Perform data acquisition and control of associated process equipment Function as totally independent unit from SCADA software

3 Relays timers counters math comparators data transfer PID control and other pre defined control programming necessary to implement specified control strategies

4 Software shall allow PLC ladder program to be documented assign labels to address points in program display labels on programmer monitor and annotate on ladder printout

5 Capability to add delete or modify any portion of PLC program while system is running or stopped

B During first year of process control system use by Owner provide product upgrades for entire system at no additional cost to Owner Upgrades limited to include software revision updates

2 03 CODES AND STANDARDS

A The equipment furnished under this specification shall be in accordance with but not limited to the following codes and standard including all addenda in effect at the date of purchase order unless otherwise stated in this specification

American National Standard Institute (ANSI)

ANSI S50 1 Compatibility of Analog Signals for Electronics Industrial Process Instruments
ANSI C2 National Electrical Safety Code

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code

Instrument Society of America (ISA)

RP 55 1 Hardware testing of Digital Process Computers
RP 12 6 Installation of Intrinsically Safe Instrument System in Classified Location

National Electrical Manufacturing Association (NEMA)

ICS 6 Enclosure for Industrial Controls and systems

Federal Communication Commission (FCC) Rules and Regulations

PART 3 EXECUTION

3 01 INPUT/OUTPUT HANDLING

A Point Identification Each system addressable point shall have a unique identification number assigned by the Contractor which will not exceed twelve alpha/numeric characters The identification number will be same as the instrument tag number whenever possible and will be used by the operator to address point data In addition a twenty four character (minimum) abbreviated English description of each point shall be part of the data base It shall be possible for the operator to easily modify point identification numbers and descriptions in the future as required

B I/O List The Engineer shall compile specific I/O list information (range units point type etc) in the form of a list and will be submitted to the vendor prior to the start of the engineering This list is not intended to include the specific requirements of the vendor The Contractor is required to compile an I/O assignment list for review by the Engineer Any I/0 required by the vendor to implement the scope of this system such as analog to digital converter check points system alarms cold junction compensation and power supply voltage checks shall be provided in addition to the quantity of inputs and outputs specified by the purchaser The Engineer will not be responsible for filling out the Vendors keypunch or similar coding forms The Engineer shall provide ranges functions and other information

3 02 ERECTION/INSTALLATION SUPPORT

A Factory supported start up service personnel is required The duties includes inspection of the equipment installation to insure it is installed in accordance with the manufacturer s recommendations check the control system hardware and software configuration make tuning adjustments necessary to place the system in trouble free operation and instruct the operating personnel in the proper operation and maintenance of the equipment furnished

B The Contractor shall allow minimum of 5 days for training loop check and start up service time to perform functions described above to customer s satisfaction If this service time is completed in less than the schedule service time allotted than start up personnel can be released early The only valid charge for extra service would be if service personnel had completed the start up service but were requested to remain on site and unit start up was delayed by circumstances beyond the Contractor s control

3 03 FIELD CALIBRATION AND LOOP CHECKS

A Field Instruments Calibration If calibration service is included in Scope of Responsibility para 1 02 than installed instruments shall be calibrated to the ranges specified in the instrument list and following the manufacturer s recommended practices and with required calibration equipment Most instruments are supplied factory calibrated with the exception of the level pH and certain flow instruments Factory calibrated instruments

shall be checked to make sure their ranges spans and field adjusted set points are as specified Adjustments in accordance with the manufacturer s instructions shall be made to meet the required specifications

B Complete filled in field calibration data sheets for each instrument shall be submitted for records

C Loop checks shall be performed with the fully operational control system in coordination with the Electrical contractor and Calibration contractor (if separate than control system contractor)

3 04 TESTING AND INSPECTIONS

A During the course of fabrication The Contractor shall inspect and test the equipment for materials connections assembly workmanship completeness proper operation and strict conformance to this specification and approved design drawings The Engineer shall have the right to inspect for quality control including calibration records of test equipment at any time In addition to the Contractor ongoing tests and inspections a demonstration test and a site acceptance test shall be performed

B Prior to shipment of control system equipment to the jobsite but upon completion of system fabrication software implementation and documentation reflecting the current system the Subcontractor shall perform a demonstration test to the satisfaction of the Contractor In the event that complete test can not be performed due to shipment of the control panel at the site before software completion partial test shall be performed at the factory and complete operational test will be performed at the jobsite Any deficiency found during test in the field shall be corrected by the Subcontractor at its own time and expense

C The various tests performed during the Engineer witnessed factory test shall be designed to demonstrate that hardware and software fulfill all the requirements of the specifications The test conditions shall resemble as closely as possible the actual installed conditions Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no cost to the Contracting Officer

Some of the test to be performed shall include but not limited to the following

Building and loading the System Data Base

Conduct on line modifications to the data base

Demonstrate operability of the interfaces (hardware and software)

Verify the OI displays

Simulate selected operating conditions to verify the performance of the monitoring and control functions

During the test the Engineer shall have unrestricted access to the system and all faults identified during this period shall be corrected and re tested prior to completion of factory test All test data and procedures followed during testing shall be logged and certified copies of logs shall be provided to the Contracting Officer

The Subcontractor shall notify the Engineer or Contractor a minimum of 15 days in advance of his proposed starting date of the witnessed factory test At the time of notification the Contractor shall submit a detailed test procedure for approval by the Contracting Officer

3 05 TRAINING

A The cost of training programs shall be included in the Contract price to be conducted with designated operations personnel covering programming operation and maintenance of the system as specifically set forth hereinafter The training and instruction insofar as practicable shall be directly related to the system being supplied here under

B The field training program shall be run at the operations site and consist of two days of instruction for the operations personnel covering system operation system debugging program modification troubleshooting and maintenance procedures This training program will be run at a time chosen by the Engineer and will be during start up service time unless otherwise noted

END OF SECTION

SECTION 13750
INSTRUMENTATION
PART 1 GENERAL

1 01 SUMMARY

A This specification covers the requirements for the functional design performance materials construction features testing quality and handling of the Instrumentation package

B It is not the intent of this specification to provide all details of design and fabrication It shall be the responsibility of the Contractor to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship and that is suitable for the specified service

1 02 PERFORMANCE REQUIREMENTS

A Instrumentation specified herein shall be designed in accordance with high engineering standards and capable of performing the desired tasks Each instrumentation shall be supplied with a stainless steel name tag which shall include the full tag number of the instrument as shown on the Process Instrumentation Diagrams Each instrument shall be factory calibrated to the maximum extent possible Calibration sheets certifications and instructions shall be provided with each instrument

B Instruments shall be rated for general purpose except when located in Division I Class 2 environments

1 03 SUBMITTALS

A Contractor shall submit in the manner and within the time line as set forth in the Contract documents the items listed herein for all the equipment and materials furnished under this section

B The Contractor s drawings shall be direct reading reproducible able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until the Contractor has received written drawing review approvals from the CONTRACTING OFFICER in accordance with the submittal register developed for the instrumentation

C Submittals to be provided include

1 Shop drawings outlining overall dimensions connection details weights and arrangement of functional parts Foundation or pad requirements including type and location of loading and size and material of anchor bolts Detailed drawings and installation instructions for any special requirements for handling storing and final erection of instruments and systems

3 Manufacturer s literature including performance curves electric motor data including rated horse power full load amps motor speed efficiency and power requirements

3 A complete set of recommended spare parts based on the equipment literature

4 Instrument Calibration sheets

5 Operation and Maintenance Manual including equipment manuals maintenance procedures testing lubrication requirements preventive maintenance matrix list of spare parts and trouble shooting instructions

6 Guarantees and verifications as required herein

D Contractor shall provide 6 copies of each submittal Those submittals requiring review and approval (Items 1 3) shall be submitted no later than 4 weeks after award of the Contract Other submittals shall be submitted no later than 6 weeks after award of Contract

PART 2 PRODUCTS

2 01 EQUIPMENT INSTRUMENTATION

A Local pressure gages and indicators shall be direct reading gauges 4 1/2 face diameter with a low internal volume spiral/helical bourden tube type with solid front and rear blow out C tube bourden tubes shall not be used Gauges shall conform to ANSI B40 1 (Grade A) Gauges shall be tapped ½ NPT to both bottom and back connections and shall be provided with a viton diaphragm type chemical seal tapped ½ by ½ Pressure gauge dial ranges shall be as required for each application Gauges shall be as manufactured by Ashcroft or equal

B Differential pressure transmitters/indicators shall be diaphragm operated with sensing element motion restrained by a calibrated spring affixed with a strain gage transducer Electrical signal shall be internally conditioned to a two wire standard 4 10 mA isolated control loop output Transmitter shall have a local pointer indication of sensed pressure with a white dial black figures and graduations and pointer zero adjustment The instrument range shall be 0 to 30 W C of differential pressure Transmitter shall be Dwyer Instruments Inc or equal

C Rotameter flow meters/indicators/transmitters shall be capable of local indication and included capability for an isolated 4 20 mA output signal Display range shall be 0 1 to 9999 and loop accuracy shall be +1 50 mA Flow sensor shall be rotameter type constructed of polypropylene with a titanium shaft Units shall be FM approved and shall include an integral mounting kit for the sensor and transmitter Units shall be as manufactured by Signet or equal

D Local air flow meters/transmitters/indicators shall be mass flow meter type calibrated for a flow range of 0 to 300 scfm Flow element material shall be stainless steel with an operating range of 0 250 F and up to 200 psig Transmitter shall be capable of a standard isolated 4 20 mA output Electrical enclosures shall be NEMA 4X housings capable of remote mounting Flow element/sensor shall include a shielded PVC or equal interconnecting cable Unit shall include local flow indication displayed as either mass flow velocity or volume flow Unit can operate on 115 AC power Flow meter insertion length shall be as required to operate in an 6 or 8 inch PVC duct line Connection shall be a compression type fitting 3/4 NPT Unit shall be as manufactured by FCI or equal

E Temperature indicators/transmitters shall utilize a solid state sensor and shall be enclosed within a NEMA 4X housing The unit shall have an integrally mounted sensor and transmitter capable of a 4 20 mA isolated output adjustable to any 20 degree C span up to 0 to 90 degree C Accuracy shall be within +/ 1 degree C Unit shall be manufactured by Signet or equal

F Level switches shall be specific gravity compensating switches with continuous buoyancy control switch activation at the water interface for liquids with a specific gravity between 0 6 and 1 5 Unit shall have a 15 amp 115 VAC SPDT switch action with relays Housing shall be a NEMA 4 cover with corrosion resistance fiberglass and reinforced plastic cover and body Unit shall be constructed of a 316 stainless steel float shaft and a Fortron (PPS) body float and busing All seals shall be Viton Unit shall be as manufactured by Harwil Corporation or equal

G Three way and four isolation valves shall be Hayward true union ball valves and shall have brush less shaded pole unidirectional UL approved motor and shall drive the valve through a seated permanently lubricated gear train Unit shall include an auxiliary limit switch which shall indicate the valve position as normally open or normally closed The motor shall have a mechanical brake to lock the motor shaft at the end of travel and an automatic reset thermal overload protector to guard the motor against burn out Actuator housing shall be rated NEMA 4 and be manufactured from glass fiber reinforced polypropylene Cycle time to be 2 5 seconds for 90 degree rotation or less than 5 seconds for 180 degree rotation Actuator and valve to be manufactured by Hayward Industrial Products or equal

H Inline air flow meter/indicators combination balancing valve systems shall be constructed of 304 stainless steel with flanged ends and rated for full vacuum Instrument shall be as manufactured by Preso or equal

I Inline water flow meters shall be constructed of clear acrylic with 316 stainless steel guide rods 316 stainless steel floats and viton seals Ends shall be true union NPT ends and shall have a scale range from 0 17 gpm

J Level element transmitters for the process equipment shall be RF/Admittance principle type for continuous level measurement Each level transmitter shall be provided with a hermetically sealed rigid sensor The unit shall be provided with a separate NEMA 4 electronics housing and a RF filter for radio frequency interference protection Each

transmitter shall provide a 4 20 mA DC signal Contractor shall provide standard 5 0 long coaxial cable connector between probe and transmitter Each probe shall be supplied with stainless steel splash guard protector Level probe and transmitter shall be manufactured by Drexelbrook or approved equal

K Magnetic type flowmeters with local indication and integral transmitters shall be rated for a minimum flow of <1 ft/sec and wafer connections The transmitters shall be micro processor based with zirconium electrode material NEMA 4X classifications an accuracy of +1% of rate and 4 20 mA DC output Flowmeters and transmitters shall be by ABB Kent Taylor or an approved equal

L Submersion type anti fouling pH sensors shall be provided that are highly resistant to iron and metals poisoning and have a measurement range of 0 14 (S U) with a 100 psig pressure rating Materials of construction shall be PES with a ceramic/kynar liquid junction or as specified by the supplier Sensor cable shall be four conductor 22 GA with common shield The pH sensor shall be Rosemount Signet or approved equal

M Contractor shall provide pipe mounted pH transmitters with 4 20 mA DC signal output The transmitters shall be provided with a NEMA 4X enclosure an FM/CSA hazardous area classification a 4 digit LCD read out display and an 18AWG 2 wire Beldon 8160 cable The transmitter shall have a 0 14 pH measurement range 0 01 pH accuracy 0 1 stability oil repeatability and an external zero and span of + 7% The pH transmitters shall be Rosemount Signet or approved equal

N Temperature control valve shall be a thermostatic temperature regulator with integral bulb connection The regulator shall automatically control the flow of water passing through the valve by responding to temperature change at the bulb The regulator shall control within the temperature range stamped on nameplate and shall be adjustable at any point within its range Bulb shall be copper Unit shall be manufactured by Hoffman ITT McDonnell & Miller or equal

O Temperature elements shall be Type K chromel alumel simplex type with an inconel shealth and the appropriate insertion length Screw cover shall be cast aluminum head waterproof and watertight with grounded junctions Thermocouples shall be as manufactured by Tudor Technology Ltd

P Pneumatic flow control valves shall have a polyproplyene valve body and disc and stainless steel shaft Valve shall have flanged connections and pneumatic controls integrally mounted to the valve body Valves shall be as manufactured by GF or equal

Q Solenoid valves shall be designed for their intended use i e water or air service and shall be constructed of stainless steel and where appropriate seals and discs shall be Kynar or viton Valves shall include standard 4X general purpose and watertight enclosure Coil shall be rated for continuous duty molded Class F Operating electrical shall be 110 VAC Units shall be CSA certified and UL listed general purpose valves Valves as manufactured by ASCO or equal Solenoid valves for air operated diaphragm pumps and reinjection lines shall fail closed

R Flow switches shall be designed for continuous operation Wetted surfaces shall be constructed of Fortron PPS or Hastelloy and Viton seals Switch shall include an Integral SPDT 15 amp switch with a dry circuit PLC interface model Maximum operating temperature shall be 200 F continuous and maximum operating pressure shall be 100 psig Switch shall operate on 125 VAC and be UL and CSA listed Switch shall be as manufactured by Harwal Corporation or equal

S Temperature switches shall be designed for their intended use and include a NEMA 4 enclosure suitable for outdoor installation Units shall include heavy duty switch(es) and be suitable for temperatures up to 2000°F The set point temperatures shall be fully adjustable over the entire range Tubes shall be constructed of inconel and include appropriate compression fittings Units shall be FM approved and operated on 115 VAC Units as manufactured by Burling Instruments or equal

2 02 ACCESSORIES

A Each instrument shall be supplied with a stainless steel tag or equivalent material resistant to wear and abrasion permanently affixed to the instrument such that it is clearly visible but does not interfere with the operation or insulation of the unit The tag shall include the full instrumentation tag number as shown on the Process Instrumentation Diagram

PART 3 EXECUTION

3 01 TESTING AND INSPECTIONS

A Each instrument component shall be given requisite factory tests and calibrations as necessary to determine that the work and materials are free from defects

B Acceptance tests after the equipment is completely installed may be performed to demonstrate performance requirements as specified herein The field tests will be governed by provisions of applicable industry and institute standards

3 02 WARRANTY

A Contractor shall provide a copy of Equipment and Performance Warranty documenting formal warranty coverage for a minimum of one (1) year from the date of shipment

END OF SECTION

ORIGINAL
Red

DIVISION 14

CONVEYING SYSTEMS
(not used)

ORIGINAL
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DIVISION 15

MECHANICAL

ORIGINAL
R-01

SECTION 15051
BURIED PIPING INSTALLATION
PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to install and test all buried piping fittings and specials The work includes but is not limited to the following

a All types and sizes of buried piping except those under other Sections

b Piping embedded in concrete within a structure or foundation

c Piping beneath structures

d Supports restraints and clean outs

e Testing

g Installation of all jointing and gasketing materials specials flexible couplings mechnical couplings harnessed and flanged adapters sleeves tie rods and all other work required to complete the buried piping installation

h Incorporation of valves meters and special items shown or specified into the piping systems as required and as specified in the appropriate Division 15 Sections

i Unless otherwise specifically shown on Drawings specified or included under other Sections buried piping installation includes all buried piping Work required beginning at the outside face of structures or building foundations and continuing to the effluent discharge location

B Coordination

1 Review installation procedures under other Sections and coordinate with the Work that is related to this Section

2 Section 15051 specifies the installation of all buried piping materials specified in Division 15 Coordinate with the appropriate Sections

C Related Sections

1 Section 01110 Safety Health and Emergency Response

2 Section 01490 Environmental Protection

3 Section 02200 Excavation and Backfill

4 Section 02230 Backfill Materials

5 Section 09900 Painting

6 Division 15 Sections on Piping Valves and Appurtenances

1 02 QUALITY ASSURANCE

A Requirements of Regulatory Agencies

1 Comply with requirements of NFPA Standard No 24 for Outside Protection where

applicable to water pipe systems which are used for fire protection

2 Comply with requirements of UL FM and other jurisdictional authorities where applicable

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ASTM D 2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

2 AWWA M23 PVC Design and Installation

1 03 SUBMITTALS

A Shop Drawings Submit for approval of the following

1 Laying schedules for all HDPE and PVC pipe

2 Full details of piping specials joints and cleanouts

B Tests Submit description of proposed testing methods procedures and apparatus Prepare and submit report for each test

C Certificates Submit certificates of compliance with referenced standards

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

A Deliver materials to the site to ensure uninterrupted progress of the Work

B Handle all pipe fittings specials and accessorites carefully with approved handling devices Do not drop or roll material off trucks Do not otherwise drop roll or skid piping Materials cracked grouged chipped dented or otherwise damaged will not be acceptable and shall be removed from the site immediately

C Unload pipe fittings and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling Keep pipe interiors completely free from dirt and foreign material

PART 2 PRODUCTS

2 01 MATERIALS

A Pipe materials required are listed in the Piping Schedules Refer to applicable Sections for materials Specifications

B General

1 Pipe Marking

a Clearly mark each piece of pipe or fitting with a designation which conforms with those shown on the laying schedule

b Pipe and fittings smaller than 4 inches in diameter shall be clearly marked by manufacturer as to material type and rating

PART 3 EXECUTION

3 01 INSTALLATION

A General

1 Install piping as shown specified and as recommended by the manufacturer

2 Request instructions from CONTRACTING OFFICER before proceeding if there is a conflict between the manufacturer s recommendations and the Drawings or Specifications

3 All trench excavations shall be inspected by CONTRACTING OFFICER prior to laying pipe Notify CONTRACTING OFFICER in advance of excavating bedding and pipe laying operations

4 Pipe fittings specials and accessories that are cracked damaged or in poor condition or have damaged linings will be rejected

5 Minimum cover over piping shall be as specified and as shown All work will be subject to the approval of the CONTRACTING OFFICER

6 Excavation and backfill work is specified in Section 02220

7 Excavation in excess of that required or shown and which is not authorized by the CONTRACTING OFFICER shall be replaced at CONTRACTOR S expense with approved material It shall be furnished placed and compacted in accordance with the requirements of Section 02220

B Manufacturer s Installation Specialist

1 CONTRACTOR shall provide the services of a competent installation specialist of the pipe manufacturer when pipe laying commences for the following

a PVC pipe

b HDPE pipe

2 Retain installation specialist at the job site until competency of the pipe laying crew has been satisfactorily demonstrated

C Plugs

1 Temporarily plug installed pipe at the end of each day s work or other interruption to the installation of any pipe line Plugging shall be adequate to prevent the entry of animals liquids or persons into the pipe or the entrance or insertion of deleterious materials

2 Install standard plugs into all bells at dead ends tees or crosses Cap all spigot ends

3 Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure

4 Where plugging is required for contract division or phasing of the Work for later connection install watertight permanent type plugs

D Bedding Pipe Bed pipe as specified below and in accordance with the details shown

1 Trench excavation and backfill work and backfill materials shall conform to the requirements of Section 02200 and Section 02230 respectively

a Install in accordance with ASTM D 2774

2 Do not lay pipe until the CONTRACTING OFFICER approves the bedding

condition If a conflict exists obtain clarification from CONTRACTING OFFICER before proceeding

3 NO pipe shall be brought into position until the preceding length has been bedded and secured in its final position

E Laying Pipe

1 Conform to manufacturer s instructions and requirements of the standards listed below where applicable

a Thermoplastic Pipe ASTM D 2774

b ASCE Manual of Practice No 37

2 Install all pipe accurately to line and grade shown unless otherwise approved by CONTRACTING OFFICER Remove and relay pipes that are not laid correctly

3 Slope piping uniformly between elevations shown

4 Ensure that ground water level in trench is at least 6 inches below bottom of pipe before laying piping Do not lay pipe in water Maintain dry trench conditions until jointing and backfilling are complete

5 Start laying pipe at lowest point and proceed towards the higher elevations unless otherwise approved by CONTRACTING OFFICER

6 Place bell and spigot pipe so that bells face the direction of laying unless otherwise approved by CONTRACTING OFFICER

7 Excavate around joints in bedding and lay pipe so that only the barrel receives bearing pressure from the trench bottom

8 Deflections at joints shall not exceed 75 percent of the amount allowed by the pipe manufacturer

9 For copper tubing and thermoplastic piping snake piping in trench to compensate for thermal expansion

10 Carefully examine all pipe fittings and specials for cracks damage or other defects while suspended above the trench before installation Immediately remove defective materials from site

11 Inspect interior of all pipe and fittings and completely clean all dirt gravel sand debris or other foreign material from pipe interior before it is moved into the trench Bell and spigot mating surfaces shall be thoroughly wire brushed and wiped clean and dry immediately before the pipe is laid

12 Field cut pipe where required with a machine specially designed for cutting specific piping material Make cuts carefully without damage to pipe or lining and with a smooth end at right angles to the axis of pipe Cut ends on push on joint shall be tapered and sharp edges filed off smooth Flame cutting will not be allowed

13 Blocking under piping will not be permitted unless specifically approved by CONTRACTING OFFICER for special conditions If permitted conform to requirements of AWWA C600

14 CONTRACTOR shall notify CONTRACTING OFFICER in advance of his backfilling operations schedule

15 On steep slopes take measures acceptable to CONTRACTING OFFICER to prevent movement of the pipe during installation

F Jointing Pipe

1 Thermoplastic Pipe Joints

ORIGINAL RED

a Solvent Cement Joints

1) Bevel pipe ends and remove all burrs before making joints Clean both pipe and fittlngs thoroughly Do not make solvent cement joints if temperature is below 40 F nor in wet conditions

2) Use solvent cement supplied or recommended by the pipe manufacturer

3) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the Joint materials and the pipe manufacturer

4) Observe safety precautions with the use of joint primers and solvent cements Allow air to circulate freely through pipelines to permit solvent vapors to escape Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes

b Push On Joints

1) Bevel all field cut pipe remove all burrs and provide a reference mark the correct distance from the pipe end

2) Clean the pipe end and the bell thoroughly before making the joint Insert the O ring gasket making certain it is properly oriented Lubricate the spigot well with an approved lubricant do not lubricate the bell or O ring Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell

2 HDPE Piping Joints

a Heat Fusion Joints

1) Assemble and weld joints via heat fusion equipment obtained from the pipe manufacturer Strictly observe joining instructions and recommendations of the pipe manufacturer

G Backfill

1 Conform to the applicable requirements of Section 02220 and Section 02230

2 Place backfill as construction progresses and as allowed by other Sections of these Specifications

3 02 TESTING OF PIPING

A General

1 Test all piping except as otherwise authorized by CONTRACTING OFFICER

2 Notify CONTRACTING OFFICER 48 hours in advance of testing

3 Provide all testing apparatus including pumps hoses gages and fittings

4 Unless otherwise noted pipelines shall hold specified test pressure for a period of two hours

5 Repair and retest pipelines which fail to hold specified test pressure or which exceed the allowable leakage rate

6 Unless otherwise specified test pressures required are at the lowest elevation of the pipeline section being tested

7 Conduct all tests in the presence of CONTRACTING OFFICER

8 Advise local authorities having jurisdiction if their presence is required during testing

B All buried piping shall receive a combination pressure and leakage test

C Leakage Testing

1 Conduct leakage test for all liquid conveying piping after satisfactory completion of pressure test

2 Allow concrete pipe to remain full of water at least 12 hours prior to starting leakage test

3 Maintain test pressure constantly for the minimum test period and accurately measure the amount of water which must be added to maintain the test pressure

4 Allowable Leakage Rates (gallons per hour per 1 000 feet per inch diameter)

a HDPE FRP and Thermoplastic None allowed

5 Leakage Test Procedure

a Examine exposed pipe joints fittings and valves Repair visible leakage or replace the defective pipe fitting or valve

b Refill the line under test to reach the required test pressure

c Provide a test container filled with a known quantity of water at the start of the test Attach the test pump suction to the test container

d Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report

e Perform all repair replacement and retesting required because of failure to meet testing requirements

f Leakage shall be less than rate specified above

D Pressure Test Procedure

1 Complete backfill and compaction no higher than the pipe centerline before testing unless otherwise required or approved by CONTRACTING OFFICER

2 Allow concrete for thrust blocks to reach design strength before testing

3 Fill section to be tested slowly with water and expel all air Install corporation cocks if necessary to remove all air

4 Test only one section of pipe at a time

5 Apply test pressure at 1 ½ times the working pressure under which it is to be used for two hours and observe pressure gage Check carefully for leaks while test pressure is being maintained

G Vertical Deflection Test for Thermoplastic Pipe Fiberglass Reinforced Plastic Pipe and High Density Polyethylene Pipe 4 inches and Larger

1 After completion of backfill and at a time approved by CONTRACTING OFFICER CONTRACTOR shall manually pull a pin type vertical gage mounted on a sled through the pipe Gage shall be set so that if vertical deflection of pipe exceeds 5 percent it will stop CONTRACTOR shall excavate and relay all such piping Gage shall be as manufactured by Quality Test Products or approved equal Gage/method shall be as recommended by pipe manufacturer

ORIGINAL Red

3 03 CLEANING

A Cleaning

1 Thoroughly clean all piping and flush prior to placing in service in a manner approved by CONTRACTING OFFICER

2 Piping 24 inches diameter and larger shall be inspected from inside and all debris dirt and foreign matter removed

3 If piping which requires disinfection has not been kept clean during storage or installation CONTRACTING OFFICER will require CONTRACTOR to swab each section individually before installation with a five percent hypochlorite solution to ensure clean piping

4 Cleaning method and solvent shall be recommended by pipe manufacturer

** END OF SECTION **

ORIGINAL Red

SECTION 15052
EXPOSED PIPING INSTALLATION

PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to install and test all exposed piping fittings and specials The Work includes but is not limited to the following

a All types and sizes of exposed piping except those specified under other Sections

b Piping entering a sump and within a sump shall be considered exposed if that pipe is exposed just before entering the sump

c Supports restraints thrust blocks and other anchors

d Testing

e Cleaning and disinfecting

f Installation of all jointing and gasketing materials specials flexible couplings mechanical couplings harnessed and flanged adapters sleeves tie rods and all other Work required to complete the exposed piping installation

g Valves meters and special items shown or specified shall be incorporated into the piping systems as required and as specified in the appropriate Division 15 Sections

h Unless otherwise specifically shown specified or included under other Sections exposed piping installation includes all exposed piping Work required beginning at the outside face of structures or building foundations extending into the building

B Coordination

1 Review installation procedures under other Sections and coordinate with the Work that is related to this Section

2 Section 15052 specifies the installation of all exposed piping materials specified in Division 15 Coordinate with the appropriate Sections

C Related Sections

1 Section 03300 Cast in Place Concrete

2 Section 09900 Painting

3 Section 15094 Pipe Hangers Supports and Restraints

4 Section 15096 Wall Pipes Floor Pipes and Pipe Sleeves

5 Section 15100 Valves and Appurtenances

6 Division 15 Sections on Piping Valves and Appurtenances and Plumbing

ORIGINAL 4 91

1 02 QUALITY ASSURANCE

A Requirements of Regulatory Agencies
1 Comply with applicable requirements of UL and other authorities having jurisdiction

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
1 ANSI B16 3 Malleable Iron Threaded Fittings Classes 150 and 300
2 ANSI B16 5 Pipe Flanges and Flanged Fittings Steel Nickel Alloy and Other Special Alloys
3 ANSI B16 9 Factory Made Wrought Steal Butt Welding Fittings
4 ANSI B16 11 Forged Steel Fittings Socket Welding and Threaded
5 AWWA C206 Field Welding of Steel Water Pipe Joints
6 AWWA C606 Grooved and Shouldered Type Joints
7 AWWA M11 Steel Water Pipe Design and Installation
8 AWWA M23 PVC Piping
9 NFPA 13 Installation of Sprinkler Systems

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Detailed drawings in plan and profile and laying schedules
2 Details of piping valves supports accessories specials joints harnessing and connections to existing pipes and structures
3 Types and locations of pipe hangers and/or supports shall be shown on the piping layouts for each piping submittal
4 The Contractor is hereby notified that for clarity not all piping has been shown on the Contract Drawings however the Contractor must show all piping on the shop drawings regardless of size that is part of this Contract

B Tests Submit description of proposed testing methods procedures and apparatus Submit copies of test report for all tests

C Certificates Submit certificates of compliance with referenced standards

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

A Deliver materials to the site to insure uninterrupted progress of the Work

B Handle all pipe fittings and accessories carefully with approved handling devices Do not drop or roll pipe off trucks Do not otherwise drop roll or skid pipe Materials cracked gouged chipped dented or otherwise damaged shall be removed from the site immediately

C Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground

ORIGINAL Redj

D Unload pipe fittings and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling Keep pipe interiors completely free from dirt and foreign matter

PART 2 PRODUCTS

2 01 MATERIALS

A Required pipe materials are listed in the Exposed Piping Schedule Refer to the applicable Sections for detailed material Specifications

B General
1 Pipe Marking
a Each piece of pipe and fitting shall be clearly marked with a designation which shall conform with the designations shown on the Shop Drawings
b Piping smaller than 4 inches in diameter shall be clearly marked by manufacturer as to material type and rating

C Pipe Identification Markers and Arrows Refer to Section 09900 Painting

2 02 EXPOSED PIPING SCHEDULE

A Attached to the end of this Section is the Exposed Piping Schedule Conform to requirements of the schedule unless otherwise specified or approved by CONTRACTING OFFICER

PART 3 EXECUTION

3 01 INSTALLATION

A General
1 Install piping as shown specified and in complete accordance with manufacturer s instructions
2 Request instructions from CONTRACTING OFFICER before proceeding if there is a conflict between the manufacturer s recommendations and the Drawings or Specifications
3 Pipe fittings and accessories that are cracked damaged or with damaged linings will be rejected

B Manufacturer s Installation Specialist
1 Provide services of a competent installation specialist of pipe manufacturer when pipe installation begins for following
a HDPE double wall pipe
2 Retain installation specialist for a minimum of days or until competency of the pipe installation crew has been satisfactorily demonstrated

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C Piping

1 Install straight runs true to line and elevation

2 Install vertical pipe truly plumb in all directions

3 Install piping parallel or perpendicular to building walls Piping at angles and 45 degree runs across corners will not be accepted unless specifically shown or approved

4 Install small diameter piping generally as shown when specific locations and elevations are not indicated Locate such piping as required to avoid ducts equipment beams etc

5 Install piping in vaults and manholes so as to provide easy access without stepping on piping

6 Install piping so as to leave all corridors walkways work areas and like spaces unobstructed Unless otherwise approved provide a minimum headroom clearance under all piping of 7 feet 6 inches

7 Protect and keep clean water pipe interiors fittings and valves

8 Provide temporary caps or plugs over all pipe openings at the end of each days work and when otherwise required or directed by CONTRACTING OFFICER

9 Cutting Cut pipe from measurements taken at site not from Drawings

10 Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping

11 Provide a union downstream of each valve with screwed connections

12 Provide screwed or flanged unions at each piece of equipment where shown and where necessary to install or dismantle piping

13 Additional Requirements for FRP and Thermoplastic Piping

a Support all valves independently of the piping system

b Utilize wide band supports as recommended by manufacturer and approved by CONTRACTING OFFICER to minimize localized stresses

c Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping

d When anchors are required at locations other than equipment or tanks they shall be placed at elbows valve locations and at bends in pipe line

e Spacing of supports shall be in accordance with the manufacturer s published values at the maximum design operating temperature of the pipe

f Use U clamps with wide band circumferential contact Avoid all pressure contact with piping

g Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe Space guides as recommended by manufacturer

h Use bellows with low axial force to take up pipe expansion Provide anchors to restrain the expansion joint Use of bellows joints shall be kept to a minimum Flexible connectors may be used to absorb thermal movement when approved by CONTRACTING OFFICER

I Do not install pipe when temperature is less than 60 F

D Joints

1 General

a Make joints in accordance with the pipe manufacturer s recommendations and the requirements below

ORIGINAL Red)

b Cut piping accurately and squarely and install without forcing or springing

c Ream out all pipes and tubing to full inside diameter after cutting Remove all sharp edges on end cuts

d Remove all cuttings and foreign matter from the inside of pipes and tubing before installation Thoroughly clean all pipe fittings valves specials and accessories before installing

2 Mechanical Joint Pipe

a Wipe clean the socket plain end and adjacent areas immediately before making joint Make certain that cut ends shall be tapered and sharp edges filed off smooth

b Lubricate the plain end and gasket with soapy water or an approved pipe lubricant in accordance with AWWA Clll just prior to slipping the gasket onto the plain end of the joint assembly

c Place the gland on the plain end with the lip extension toward the plain end followed by the gasket with the narrow edge of the gasket toward the plain end

d Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess Keep the joint straight during assembly

e Push gland toward socket and center it around pipe with the gland lip against the gasket

f Insert bolts and hand tighten nuts

g Make deflection after joint assembly if required but prior to tightening bolts All bolts shall be alternately torque tightened 180 degrees apart to seat the gasket evenly The bolt torque shall be as follows

Pipe Size (inches)	Bolt Size (inches)	Range of Torque (ft lbs)
3	5/8	45 60
4 24	3/4	75 90

3 Flanged Joints

a Assemble flanged joints using 1/8 inch ring type gaskets for raised face flanges Use full face gaskets for flat face flanges unless otherwise approved by ENGINEER Gaskets shall be suitable for the service intended in accordance with the manufacturer s ratings and instructions Gaskets shall be properly centered

b Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads

c The length of bolts shall be uniform and they shall not project beyond the nut more than 1/4 inch or fall short of the nut when fully taken up The ends of bolts shall be machine cut so as to be neatly rounded No washers shall be used

d Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly

e Alternately tighten bolts 180 degrees apart to compress the gasket evenly

ORIGINAL REC'D

4 Steel Pipe Joints

a Joints in steel pipe shall be butt welded flanged or threaded joints except that flexible couplings mechanical couplings or flanged connections may be provided where shown on the Drawings

b Welding shall conform to the requirements of AWWA C206 After welding the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating

c For threaded joints use standard right hand tapered full depth threads on steel piping and apply an approved joint compound to the male threads only before installation Remove all cuttings and foreign matter from the inside of pipes installation Thoroughly clean all pipe fittings valves specials and accessories before installing

5 Thermoplastic Pipe Joints

a Solvent Cement Joints See Section 15067 for solvent cement joints

b Threaded Joints

1) Cut pipe square and smooth and remove burrs or raised edges with a knife or file Hold pipe firmly in a pipe vise Protect pipe at the point of grip by inserting a rubber sheet or other material between the pipe and vise Thread pipe in accordance with the pipe manufacturer s recommendations Brush threads clean of chips and ribbons Then starting with the second full thread and continuing over the thread length wrap TFE (Teflon) thread tape in the direction of the threads Overlap each wrap by one half the width of the tape Screw the fitting or coupling onto the pipe and tighten by hand Using a strap wrench only further tighten the connection an additional one to two threads past tightness

6 Copper Tubing Joints

a Assemble copper tubing with soldered joints Solder shall be 95 5 tin antimony conforming to ASTM B 32

b Ream or file pipe to remove burrs

c Clean and polish contact surfaces of joints

d Apply flux to both male and female ends

e Insert end of tube into full depth of fitting socket

f Heat joint evenly

g Form continuous solder bead around entire circumference of joint

h Runs shall contain unions at connections to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment

E Installing Valves and Accessories

1 Provide supports for large valves flow meters and other heavy items as shown or required

2 Install floor stands as shown and as recommended by the manufacturer

3 Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by the manufacturer

4 Provide steel sleeves where operating stems pass through floor Extend sleeves 2 inches above floor

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5 Position valve operators as shown When the position is not shown install the valve so that it can be conveniently operated and as approved by CONTRACTING OFFICER Avoid placing operators at angles to the floors or walls

6 Position flow measuring devices in pipe lines so that they have the amount of straight upstream and down stream runs recommended by the manufacturer unless specific location dimensions are shown Position swing check valves so that they do not conflict with the discs of butterfly valves

F Unions

1 Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping

2 Provide a union downstream of each valve with screwed connections

3 Provide screwed or flanged unions at each piece of equipment where shown and where necessary to install or dismantle piping

G Eccentric Reducers Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size

H Transitions from One Type of Pipe to Another

1 Provide all necessary adapters specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers

3 02 THRUST RESTRAINT

A Provide thrust restraint on all pressure piping systems

B Thrust restraint shall be accomplished by means of restrained pipe joints All thrust restraints shall be designed for the axial thrust exerted by the test pressure given in the Exposed Pipe Schedule

C Restrained Pipe Joints

1 Pipe joints shall be restrained by means suitable for the type of pipe being installed

a Steel pipe shall have butt welded joints flanged joints or flexible or mechanical coupling connectors Tie rods connected to ears welded to the steel pipe shall be provided for restraint at all flexible coupling connectors

3 03 PAINTING

A Field painting is under Section 09900

3 04 TESTING OF PRESSURE PIPING

A General

1 Test all piping as specified below unless otherwise authorized by CONTRACTING OFFICER

2 Notify CONTRACTING OFFICER 48 hours in advance of testing

3 Provide all testing apparatus including pumps hoses gages and fittings

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4 Pipelines shall hold the specified test pressure for a period of two hours
5 Pipelines which fail to hold specified test pressures or which exceed the allowable leakage rate shall be repaired and retested
6 Test pressures required are at the lowest elevation of the pipeline section being tested unless otherwise specified
7 Conduct all tests in the presence of the CONTRACTING OFFICER Repeat tests in the presence of local authorities having jurisdiction if required

B Schedule of Pipeline Tests
1 Test piping at the test pressure listed in the Exposed Piping Schedule
2 For piping not included in the Schedule the CONTRACTING OFFICER will notify the Contractor in writing of the test pressure to be utilized

C Pressure Test Procedure
1 Insure that all supports and restraint protection are securely in place
2 Fill section to be tested slowly with water and expel all air install cocks if necessary to ensure removal of air Test only one section of pipe at a time
3 Apply test pressure at 1 ½ times the working pressure under which it is to be used two hours and observe piessure gage Check carefully for leaks while test pressure is being maintained

D Pressure Air Testing
1 Clean pipeline prior to beginning test
2 Contractor shall furnish test plugs test gages air compressors and personnel and all required miscellaneous equipment to complete the test as directed by the CONTRACTING OFFICER
3 Slowly supply air to the test section until the test pressure is reached Allow a minimum of two minutes for temperature stabilization after terminal pressure is attained and then cut off air supply
4 The pipelines shall have zero leakage

E Leakage Testing
1 Conduct leakage test after satisfactory completion of pressure test
2 Maintain test pressure constantly for a 2 hour period and accurately measure the amount of water which must be added to maintain the test pressure
3 Allowable Leakage Rates
a Copper Steel Plastic and all Other Piping No leakage permitted
4 Leakage Test Procedure
a Examine exposed pipe joints fittings and valves Repair visible leakage or replace the defective pipe fitting or valve
b Refill the line under test to reach the required test pressure
c Provide a test container filled with a known quantity of water at the start of the test Attach the test pump suction to the test container
d Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report

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e Perform all repair replacement and retesting required because of failure to meet testing requirements

f Leakage shall be less than rate specified above

F Testing of Drainage Piping

1 General

a Test all drainage piping installed under this Section

b Provide all testing apparatus required

c Notify CONTRACTING OFFICER 48 hours in advance of test

d Conduct all tests in presence of CONTRACTING OFFICER

2 Procedures

a Perform test on entire system or on individual sections as approved by CONTRACTING OFFICER

b Completely seal all openings except highest opening in system or section to be tested

c Fill with water completely and test with at least 10 feet of water above highest point

d Allow water to stand in system for a least 15 minutes Inspect for leaks and repair all leaks found Retest repaired sections

3 05 CLEANING AND DISINFECTION

A Cleaning

1 Thoroughly clean all piping and flush prior to placing in service in a manner approved by CONTRACTING OFFICER

2 If piping which requires disinfection has not been kept clean during storage or installation Contractor shall swab each section individually with a five percent hypochlorite solution to ensure clean piping

B Disinfection

1 Disinfect all potable and finished water piping

2 A suggested procedure for accomplishing disinfection is specified below Other procedures will be considered for approval by the CONTRACTING OFFICER

a Thoroughly flush piping prior to disinfection with water

b Conform to procedures described in AWWA C651 Continuous feed method of disinfecting shall be used unless alternative methods is acceptable to CONTRACTING OFFICER

3 Water for initial flushing testing and chlorination will be furnished by CONTRACTING OFFICER Contractor shall provide all temporary piping hose valves appurtenances and services required Cost of water required for redisinfection will be paid by Contractor to CONTRACTING OFFICER at CONTRACTING OFFICER S standard rates

4 Chlorine will be supplied by Contractor

5 Bacteriologic tests will be performed by CONTRACTING OFFICER A certified laboratory report will be available to Contractor if requested

6 Chlorine concentration in the water entering the piping shall be between 50 and 100 parts per million such that a minimum residual concentration of 25 mg/l will be left

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after a 24 hour retention period Care shall be taken to insure disinfection of the piping in all its parts The operation shall be repeated as necessary to provide complete disinfection

7 After the required retention period the heavily chlorinated water shall be flushed to drain unless otherwise directed

3 06 EXPOSED PIPING SCHEDULE

A See Page 12 for the Exposed Piping Schedule which are included as part of this Section

B The following abbreviations are used in the piping schedule

1 Service Abbreviations

CB	Sludge Return
DEC	Sludge Decant Water
FP	Free Product
FR	Filter Return
H202	Hydrogen Peroxide
KMNO4	Potassium Permangenate
NaOH	Sodium Hydroxide
PA	Process Air
PF	Process Flow (groundwater)
PR	Polymer
QW	Quench Water (condensate)
SH	Sodium Hydroxide
SL	Sludge
SP	Sump Pump Return
SW	Storm Water
TQW	Treated Quench Water
TV	Treated Vent Gas
TW	Treated Water
UW	Utility Water
V	Vent

2 Material Abbreviations

Copper	C
Carbon Steel	CS
Fiberglass Reinforced Plastic	FRP
High Density Polyethylene	HDPE
Polyvinyl Chloride	PVC
Stainless Steel	SS

3 Lining Abbreviations

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	Painted	P
4	Joint Abbreviations	
	Flanged	FLG

++ END OF SECTION ++

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SECTION 15067
THERMOPLASTIC PIPE
PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish install and place in satisfactory service polyvinyl chloride (PVC) piping fittings and specials

2 The extent of piping is shown on the Drawings and in schedules in Section 15052

B Related Sections

1 Section 15051 Buried Piping Installation
2 Section 15052 Exposed Piping Installation
3 Section 15094 Pipe Hangers Supports and Restraints
4 Section 15096 Wall Pipes Floor Pipes and Pipe Sleeves
5 Section 15100 Valves and Appurtenances

1 02 QUALITY ASSURANCE

A Source Quality Control Obtain each type of pipe and fitting from one manufacturer

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ASTM D 1598 Test for Time to Failure of Plastic Pipe Under Constant Internal Pressure
2 ASTM D 1599 Test for Short Time Rupture Strength of Plastic Pipe Tubing and Fittings
3 ASTM D 2122 Determining Dimensions of Thermoplastic Pipe and Fittings
4 ASTM D 1784 Rigid Poly(Vinyl Chloride) PVC Compounds and Chlorinated Poly(Vinyl Chloride) CPVC Compounds
5 ASTM F 441 Chlorinated Poly(Vinyl Chloride) (PVC) Plastic Pipe Schedules 40 80 and 120
6 ASTM F 439 Socket Type Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings
7 ASTM F 493 Solvent Cements for Chlorinated Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
8 American National Standards Institute
9 ASTM D 2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
10 ASTM D 2672 Joints for IPS PVC Pipe Using Solvent Cement
11 ASTM D 2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
12 ASTM F 656 Primers For Use in Solvent Cemented Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

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C Shop Tests

1 CONTRACTOR shall ensure that piping manufacturer maintains a continuous quality control program All plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D 1784 CONTRACTOR shall furnish the CONTRACTING OFFICER with certified test results

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Detailed drawings and data on pipe fittings and appurtenances Submit these with Shop Drawings required under Section 15052

B Certificates Submit certificates of compliance with referenced standards

1 04 PRODUCT DELIVERY, HANDLING AND STORAGE

A Conform to Section 15052

B All pipe materials shall be stored off the ground in a dry location Pipe ends shall be secured by caps or plugs Do not store pipe fittings or specials in sunlight Pipe fittings and specials shall be stored to prevent sagging or bending

PART 2 PRODUCTS

2 01 MATERIALS

A Polyvinyl Chloride (PVC) Pipe

1 Provide SDR 41 pressure rated PVC pipe with solvent cement joints and flanged connections as required

2 Pipe and fittings shall be manufactured from a compound which meets the requirements of Class 12454 B as outlined in ASTM D 1 7Ra

3 Fittings

a All other fittings shall be solvent welded and shall conform to ASTM D 2672 for socket type Provide flanged fittings at all equipment with gaskets suitable for the service intended

4 Solvent Cement All socket type connections shall be jointed with primer and solvent cement complying with ASTM F 656 and D 2564

B All thermoplastic flanges shall be furnished with back up flanges with minimum 1/8 inch thickness Back up flanges and connecting bolts shall be of type 304 stainless steel

B CONTRACTOR shall supply type grade and strength of pipe required to meet the specified service conditions Submit to CONTRACTING OFFICER for approval

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2 02 DETAILED REQUIREMENTS

A Workmanship The pipe shall be homogeneous throughout and free from visible cracks holes foreign inclusions or other defects The pipe shall be uniform in color opacity density and other physical properties

B Dimensions and Tolerances Dimensions and tolerances shall be measured in accordance with ASTM D 2122 The eccentricity of the inside and outside circumference of the pipe walls shall not exceed 12 percent

C Sustained Pressure The pipe shall not fail balloon burst or weep as defined in ASTM D 1598

D Burst Pressure The minimum burst pressure shall be as given when determined in accordance with ASTM D 1599

E Marking

1 Marking on the pipe shall include the following spaced at intervals of not more than 5 feet Markings on double wall pipe shall be on the carrier pipe

a Pipe nominal size

b Pipe schedule

c Specification of plastic material

d Type and grade of plastic

2 03 ADAPTERS

A Where necessary to join piping of different materials CONTRACTOR shall provide the necessary adapters as recommended by the thermoplastic pipe manufacturer

PART 3 EXECUTION

3 01 INSTALLATION

A Joint Assembly

1 General The procedure below may be used as a guide the approved pipe manufacturers recommended procedures should be followed unless the procedures listed below are more stringent

2 Cut pipe square with miter box or plastic tube cutter

3 Chamfer pipe and to a 10 to 15 degree angle (1/16 inch to 1/32 inch)

4 Clean and dry socket of all dirt moisture and grease

5 Check dry fit of pipe in fitting Pipe should enter socket about 1/3 to 3/4 depth

6 Dissolve inside socket surface by brushing with primer Use brush ½ the size of pipe diameter Use a scrubbing motion to assure penetration Repeat application as necessary

7 Dissolve surface of male end of pipe to be inserted into socket to depth of fittings socket by brushing on liberal coat of primer Be sure entire surface is well dissolved

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8 Brush inside socket with primer one more time then without delay apply proper cement liberally to male end of pipe See paragraph 2 1 A 4 above for cement recommendations The amount of cement should be more than sufficient to fill any gap

9 Apply proper cement lightly to inside of socket Keep excess cement out of socket to prevent solvent damage to pipe Apply a second coat of cement to the pipe end Time is important at this stage two people may be required when cementing larger size pipe and fittings

10 While both inside socket and outside surface of male end of pipe are SOFT and WET with cement forcefully bottom the male end of pipe into socket giving the male a one quarter (1/4) turn The pipe must go to the bottom of the socket Hold joint together until both surfaces are firmly gripped (approximately 30 seconds)

11 After assembly wipe excess cement from the pipe at the end of the fitting socket A properly made joint will normally show a bead around its entire perimeter Any gaps at this point may indicate a defective assembly job due to insufficient cement or use of light bodied cement on large diameters where heavy bodied cement should have been used

12 Do not disturb joint initial setup of the cement occurs see manufacturers solvent cement set time schedule for setup times at various ambient temperatures

13 Prepare containment pipe system joints in accordance with manufacturer s recommendations and specific procedures

B Pipe Anchors
Pipe anchors shall be spaced according to the manufacturer s recommendations

3 02 INSPECTION

A CONTRACTOR shall inspect all piping to verify that it is free from defects in material and workmanship The compatibility of all pipe fittings and coatings shall be verified

+ + END OF SECTION + +

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SECTION 15070
FIBERGLASS REINFORCED PLASTIC PIPE
PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish install and place in satisfactory service fiberglass reinforced plastic (FRP) piping fittings and specials

B Related Sections

a Section 15052 Exposed Piping Installation
b Section 15094 Pipe Hangers Supports and Restraints
c Section 15096 Wall Pipes Floor Pipes and Pipe Sleeves
d Section 15100 Valves and Appurtenances

1 02 QUALITY ASSURANCE

A Source Quality Control Obtain each type of pipe and fitting from one manufacturer

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ASTM D 1598 Test for Time to Failure of Plastic Pipe Under Constant Internal Pressure
2 ASTM D 1599 Test for Short Time Rupture Strength of Plastic Pipe Tubing and Fittings
3 American National Standards Institute
4 ASTM D 2996

C Affidavit

1 All FRP piping and related FRP accessories shall be fabricated in a heated and well ventilated structure protected from the weather and temperature extremes Entire fabrication curing and assembly process of any piece of FRP equipment shall be indoors CONTRACTOR shall submit an affidavit certifying that all FRP equipment shall be fabricated cured and assembled as described in this Specification

D Qualifications

1 CONTRACTOR shall require the pipe manufacturer to submit information indicating suitable evidence of experience in the design fabrication and installation of piping as specified herein must be submitted for approval of the manufacturer Information shall at a minimum include a list of operating installations (minimum of five (5) that are in satisfactory operation for a minimum of five (5) years) Information shall include location installation date service capacity and records of any maintenance performed by the manufacturer

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Detailed drawings and data on pipe fittings and appurtenances Submit these with Shop Drawings required under Section 15052

B Certificates Submit certificates of compliance with referenced standards

C Affidavit Submit affidavit as described in paragraph 1 02 C of this Section

D Qualifications Submit manufacturer s qualifications as described in paragraph 1 02 D of this Section

1 04 PRODUCT DELIVERY HANDLING AND STORAGE

A Conform to Section 15052

B All pipe materials shall be stored off the ground in a dry location Pipe ends shall be secured by caps or plugs Do not store pipe fittings or specials in sunlight Pipe fittings and specials shall be stored to prevent sagging or bending

PART 2 PRODUCTS

2 01 DESIGN CRITERIA

A The watertight piping system shall be specifically designed constructed and installed for the service intended and shall comply with the following minimum conditions

1 Piping shall be suitable for temperature between 0 to 150 degrees F

2 Pipe internal pressure shall not exceed 50 psi for up to 6 inch diameter pipes or as recommended by the piping system manufacturer

3 All straight sections fittings and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of the field connections

2 02 MATERIALS OF CONSTRUCTION

A Service FRP pipes shall be capable of operating at temperatures from 0 F to 150 F

B Pressure Rating 150 psig

C Service and containment pipes shall be manufactured according to ASTM D 2996 for filament wound premium grade vinylester thermosetting resin Structural wall of FRP pipe shall have continuous glass fibers wound at a 54 75 degree helical angle in a matrix Pipe shall have a resin rich corrosion barrier reinforced with a synthetic surfacing veil The corrosion barrier shall have a minimum resin content of 80% Minimum thickness of corrosion barrier shall be 50 mils All pipe and fittings shall have a minimum 3 to 1 safety factory at 200 F

D FRP piping shall be resistant to phenolic compounds found in LNAPL and DNAPL

E Subassemblies

1 All end seals drains and pipe supports shall be fabricated out of the same material completely integrated into the system Supports shall be designed to ensure proper alignment of the service pipes during field fabrication

F Fasteners Furnish all bolts nuts washers and other fasteners required Material of metallic fasteners shall be Series 300 stainless steel

G Guides Anchors and Supports Guides anchors and supports shall be in accordance with the manufacturer s recommendations Provide saddle bands and appropriate FRP build up as recommended by the pipe manufacturer Support spacing shall be recommended by the pipe system manufacturer

H Expansion Compensation CONTRACTOR shall have the pipe manufacturer review the piping layout shown in the Contract Drawings including the number and position of anchors expansion joints and supports If recommended by the pipe manufacturer and approved by the CONTRACTING OFFICER CONTRACTOR shall supply additional expansion joints pipe supports and pipe anchors as required for the particular piping system proposed by the manufacturer at no additional cost

I All FRP piping shall be painted in accordance with Detailed Specification Section 09900

2 03 DETAILED REQUIREMENTS

A Workmanship The pipe shall be homogeneous throughout and free from visible cracks holes foreign inclusions or other defects The pipe shall be uniform in color opacity density and other physical properties

B Marking

1 Marking on the pipe shall include the following spaced at intervals of not more than 5 feet

a Pipe nominal size

b Pipe schedule

c Specification of plastic material

d Type and grade of plastic

2 04 ADAPTERS

A Where necessary to joint piping of different materials CONTRACTOR shall provide the necessary adapters as recommended by the FRP pipe manufacturer

PART 3 EXECUTION

3 01 INSTALLATION

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A General

1 Refer to Section 15052 for piping installation testing painting cleaning and acceptance

B Joint Assembly

1 All joints installed or constructed in the field shall be assembled by CONTRACTOR personnel who have been trained and certified by the pipe manufacturer The pipe manufacturer or their authorized representative shall train the CONTRACTOR s personnel in the proper joining and assembly procedures required for this project including hands on training by the CONTRACTOR s personnel Each bonder shall fabricate one pipe to pipe and one pipe to fitting joint which shall pass the minimum pressure test for the application without leaking Only bonders who have successfully completed the pressure test and certified by the pipe manufacturer or their authorized representative shall be allowed to bond pipe and fittings

2 Joint Assembly The procedure below may be used as a guide The approved pipe manufacturer s recommended procedures should be followed unless the procedures specified herein are more stringent

a Cut pipe square with a fine tooth (32 teeth per inch) hacksaw or circular saw with a crushed tungsten carbide or reinforced abrasive blade

b Thoroughly sand the outside of the spigot with 40 60 grit sandpaper to remove gloss and to allow insertion into the socket A belt sander disc sander or coarse cut flat file is acceptable

c The minimum sanded length of the spigot must be 1 7/16 inches for 1 inch and 1 1/2 inch pipe 2 1/8 inches for 2 inch 8 inch pipe and 4 1/8 inches for 10 inch and 12 inch pipe

d All fitting bonding surfaces must be thoroughly sanded to obtain fresh bonding surface immediately prior to bonding

e Before applying adhesive wipe the sanded surface with a clean cloth or clean paper towel to remove any sanding dust dirt or foreign matter

f Using pressure with a spatula apply a thin coat of adhesive (manufacturer recommended) to wet out the machined area inside the socket After wet out cover the entire machined surface of the socket with a 1/16 inch coating of adhesive Remove any excess adhesive because it may be forced into the inside of the pipe and may cause a flow constriction

g Use pressure on the spatula to coat the sanded area of the pipe spigot and endure wet out Then apply a thicker coating (1/16 to 1/8) to the sanded area of the spigot

h Coat any cut ends of pipe or machined edges of fittings before assembling

I Carefully centering the spigot to ensure that the spigot end does not scrape the adhesive out of the socket firmly push the two parts together until the spigot bottoms out at the stop in the socket Do not twist at any time When bonding sleeve couplings insert spigots to the midpoint of the coupling Do not allow the adhesive on one side of the spigot/sleeve coupling bond to cure prior to bonding to bonding the second spigot into the coupling If both coupling joints cannot be bonded at the same time wipe out excess adhesive immediately Then re sand before bonding the second joint Make sure that adhesive fills any gaps between spigot and socket

j Smooth out any excess adhesive on the outside of the joint with the spatula to form a fillet between the pipe and the socket Do not disturb the joint until it is cured

k After assembly of a joint and during assembly of adjacent joints it is extremely important that the joint not be moved until the adhesive is solid Therefore the assembly sequence should be carefully planned when making large or complex assemblies

3 02 INSPECTION

A CONTRACTOR shall inspect all piping to verify that it is free from defects in material and workmanship The compatibility of all pipe fittings and coatings shall be verified

END OF SECTION

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SECTION 15094
PIPE HANGERS, SUPPORTS AND RESTRAINTS
PART 1 GENERAL

1 01 DESCRIPTION

A Scope

1 CONTRACTOR shall furnish all labor material equipment and incidentals as shown on the Contract Drawings specified and required to provide an acceptable system of support guidance and anchorage for all piping valves and specials

B Coordination

1 Review installation procedures under other appropriate Sections and coordinate the Work that must be installed with or attached to the hangers and supports

2 CONTRACTOR shall coordinate the location and placement of any concrete inserts and any cutting or drilling of structural members required

C Related Work Specified Elsewhere

1 Section 03300 Cast In Place Concrete

2 Section 09900 Painting

3 Division 15 Sections on Piping Valves and Specials

1 02 QUALITY ASSURANCE

A General CONTRACTOR shall ensure that the manufacturer conforms to the following general criteria

1 Materials and systems using stock or production parts shall be utilized unless otherwise shown or approved

2 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment concentration

3 Pipe hangers shall be capable of supporting the pipe in all conditions of operation They shall allow free expansion and contraction of the piping and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment

4 Hangers shall be installed so that they cannot become disengaged by movements of the supported pipe

5 Conform to the recommendations of MSS SP 58 and 69 except where requirements of this Section 15094 are more stringent

B Source Quality Control

1 Obtain each type of pipe hanger or support from no more than one manufacturer

C Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 The Manufacturers Standardization Society of the Valve and Fittings Industry

a MSS SP 58 Pipe Hangers and Supports Materials and Design

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b MSS SP 69 Pipe Hangers and Supports Selection and Application
2 FS WW H 171 Hangers and Supports Pipe
3 Underwriters Laboratories Inc Standard UL 203 Pipe Hanger Equipment
4 ANSI B1 1 Unified Inch Screw Threads
5 ANSI B31 Codes for Pressure Piping
6 ASTM A 36 Structural Steel
7 ASTM A 47 Malleable Iron Castings
8 ASTM A 276 Stainless and Heat Resisting Steel Bars and Shapes
9 ASTM A 307 Carbon Steel Externally Threaded Standard Fasteners
10 ASTM A 320 Alloy Steel Bolting Materials for Low Temperature Steel
11 ASTM A 575 M Grades Merchant Quality Hot Rolled Carbon Steel Bars
12 ASTM A 666 Austenitic Stainless Steel Sheet Strip Plate and Flat Bar for Structural Applications
13 ASTM A 668 Carbon and Alloy Steel Forgings for General Industrial Use

1 03 SUBMITTALS

A Shop Drawings Submit for approval Shop Drawings showing the following
1 All hangers and supports for piping system specified
2 Location installation material loads or forces and deflection of all hangers and supports
3 Manufacturers catalogs literature and engineering data on all hangers and supports
4 Load ratings materials and installation shall be consistent with the recommendations of the MSS SP 58 and MSS SP 69

1 04 PRODUCT DELIVERY STORAGE, AND HANDLING

A Delivery of Materials All materials shall be inspected for size quality and quantity against approved Shop Drawings

B Storage of Materials All materials shall be packaged labeled and stored in a covered dry location until time of installation

PART 2 PRODUCTS

2 01 GENERAL REQUIREMENTS

A Unless otherwise noted or shown CONTRACTOR is responsible for designing and supplying supports for all piping systems

B The hangers and supports shall meet with the following requirements
1 Standard and fabricated hangers and supports shall be furnished complete with necessary inserts bolts nuts rods washers and other accessories
2 Run piping in groups and parallel to building walls where practicable Provide minimum clearance of one inch between pipe and other work
3 Install hangers or supports at all locations where piping changes direction

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Horizontal valves 6 inches and larger shall be supported by a hanger on each side of valve

4 All hangers and supports shall be capable of adjustment after placement of piping
5 Types of hangers or supports shall be kept to a minimum
6 All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub
7 Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration
8 Hanger rods shall be straight and vertical Chain wire strap or perforated bar hangers shall not be used Hangers shall not be suspended from piping
9 Prevent contact between dissimilar metals by use of copper plated rubber vinyl coated or stainless steel hangers or supports
10 Hangers and supports shall provide for expansion throughout the full operating temperature range
11 All plastic piping shall be supported by plastic coated steel pipe attachments
12 Vertical struts and horizontal members shall be of a size suitable for the service intended and be compatible with frame inserts as specified in Section 05504 Miscellaneous Metal Fabrications

2 02 HANGERS AND SUPPORTS

A Components of hangers and supports shall conform to the following where applicable

1 Materials
   a Bolts ASTM A 307 Grade A unless otherwise specified below
   b Anchor and Expansions Bolts Type 315 stainless steel including nuts and washers
   c Forgings ASTM A 235
   d Malleable Iron ASTM A 47
   e Rods and Bars ASTM A 107
   f Threads Unified Screw Threads Class 2A and 2B ANSI B1 1
   g Structural Steel ASTM A 36
2 Finish
   a Steel Items Galvanized unless otherwise specified or shown on the Drawings
   b All plastic piping shall be supported by plastic coated (PVC) steel pipe attachments

B Pipe Attachments The following types of pipe attachments are acceptable

1 Adjustable Steel Clevis FS WW H 171E Type 1
2 Steel Double Bolt Pipe Clamp FS WW H 171E Type 3
3 Riser Clamp FS WW H 171E Type 8
4 Adjustable Pipe Saddle Support FS WW H 171E Type 39
5 Adjustable Pipe Roll and Base FS WW H 171E Type 47
6 Insulation Protection Shield FS WW H 171E Type 41
7 Insulation Protection Saddle FS WW H 171E Type 40A and 40B
8 Adjustable Roller Hanger FS WW H 171E Type 44
9 Pipe Slide Assembly

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a Material Carbon steel tee with stainless steel slide plate carbon steel base with filled Teflon pad

b Type Suitable for field welding to steel pipe Modify with clamps and U bolts for use with ductile iron pipe

C Structural Attachments The following types of structural attachments are acceptable

1 Welded Steel Bracket FS WW H 171E Type 33
2 Side Beam Bracket FS WW H 171E Type 35
3 Malleable Concrete Insert FS WW H 171E Type 18
4 Center I Beam Clamp with Eye Nut FS WW H 171E Type 28

D Hanger Rod Attachments Use as required to complete assembly

1 Forged Steel Clevis FS WW H 171E Type 14
2 Adjustable Turnbuckle FS WW H 171E Type 15
3 Forged Steel Weldless Eye Nut FS WW H 171E Type 17

E Anchorage Items All anchor or expansion bolts nuts and washers for anchoring pipe hangers and supports shall be Type 316 stainless steel where stainless steel piping is installed and Type 304 stainless steel in all other locations

F All other hangers and supports shall be in accordance with MSS SP 58

2 03 SURFACE PREPARATION AND PAINTING

All pipe supports except stainless steel and plastic coated steel for all piping listed in the Schedule to be painted shall be prepared and painted in accordance with the requirements of Section 09900 Painting

PART 3 EXECUTION

3 01 GENERAL

A Locate hangers supports and accessories to support piping valves and at all concentrated loads

B Locate hangers supports and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings

C Install hangers or supports at all locations where piping changes direction

D Locate hangers and supports to prevent vibration or swaying and to provide for expansion and contraction

E Hangers rods shall be straight and vertical Chain wire strap or perforated bar hangers shall not be used Hangers shall not be suspended from piping

F Install items to be embedded before concrete placement

G Fasten embedded items securely to prevent movement during concrete placement

H Hanger and support units installations methods shall be in accordance with manufacturer s recommendations

I Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations Grout shall be as specified in Section 03300 Cast in Place Concrete

J Prevent contact between dissimilar metals by use of copper plated rubber vinyl coated or stainless steel hangers or supports

3 02 INSTALLATION

A Supports and Hangers for Horizontal Pipes

1 Space supports and hangers for all piping no farther apart than shown below unless otherwise noted

a Copper Tube

1) Pipes up to 2 inch 6 feet 0 inch center to center

2) Pipes 2 1/2 inch and larger 8 feet 0 inch center to center

b Steel Ductile Iron and Stainless Steel Pipe

1) Pipes up to 1 inch 6 feet 0 inch center to center

2) Pipes 1 1/2 inch to 6 inch 8 feet 0 inch center to center

3) In addition ductile iron pipe shall have a minimum of two supports per length and shall have a hanger or support adjacent to each hub

c Plastic Pipe

1) Maximum support spacing for plastic pipe at ambient temperature shall be one half the above values for steel pipe except that support spacing shall not exceed 4 foot 0 inches

2 Additional supports shall be placed immediately adjacent to any change in piping direction and on both sides of valves expansion joints and couplings

3 Hanger Rods shall be sized for maximum pipe loads and according to the schedule herein for minimum rod diameters

Nominal Pipe (Inches)	Minimum Rod Diameter (Inches)
½ through 3	½
4 through 5	5/8

4 Hangers and supports for pipe 3 inch diameter and larger shall be adjustable

B Supports for Vertical Piping

1 Provide riser clamp placed under hub fitting or coupling with approved solid bearing on steel sleeve

2 Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe

3 Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration

4 Vertical plastic piping riser clamps shall be PVC coated

C Expansion Anchors

1 Use to fasten all base supports to floors

2 Use at hangers and brackets to support piping 1 inch diameter and smaller and only if the anchor is designed to carry 200 percent of the load

3 03 ACCEPTANCE AND SERVICE

Acceptance All pipe systems shall be brought up to operating pressures and temperatures Systems shall be cycled to duplicate operating conditions All malfunctions shall be corrected CONTRACTOR shall furnish all labor and materials to readjust and correct faults with hangers and supports for the piping systems

END OF SECTION

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SECTION 15100
VALVES

PART 1 GENERAL

1 01 SUMMARY

A This section covers the requirements for the functional design performance materials construction features testing quality and handling of all valves described herein

B The work shall include the supply of all materials fabrication drawings erection design installation testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of all system valving as included in the contract documents

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the CONTRACTOR to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

1 02 SYSTEM DESCRIPTION

A The work includes supply erection complete installation and testing of the valves and related accessories

1 03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

A The CONTRACTOR shall verify and certify that all valve materials are suitable for their intended use

1 04 SUBMITTALS

A The CONTRACTOR shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The CONTRACTOR s drawings shall be direct reproducibles able to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the CONTRACTOR has received written drawing review approvals from the ENGINEER

C Review of the drawings by the ENGINEER shall not relieve the CONTRACTOR of the entire responsibility for the engineering design workmanship and material under the contract documents

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D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Literature and drawings describing the equipment in sufficient detail including parts list and materials of construction

PART 2 PRODUCTS

2 01 EQUIPMENT

A Ball Valves ¼ through 2 shall be stainless steel construction with flanged end connections Seals to be Viton with teflon seats Valves to be full port design for low pressure loss and have a fine pitches threaded seal retainer for precise seat adjustments All valve seats to be reversible and self lubricating for bubble tight seal All valves to be rated to 225 psi Ball valves shall be in accordance with type 1 Grade C PVC and shall have true union ends with socket connections Seals to be viton with teflon seals

B All ball check valves shall be of stainless steel bronze or PVC body Ball and spring shall be 300 seies stainless steel Cover gland shall be stainless steel

C All pinch valves shall be manually operated Valves shall be full port design cast iron or aluminum body Sleeves shall be neoprene Buna N Viton or EPDM Valves shall have flanged ends Flanges shall be faced and drilled to ANSI B16 1 Class 125/150

D All needle valves shall be bronze construction suitable for 125 psi working pressure

E All check valves to be stainless steel construction with flanged end connections Seals and seats shall be Viton Seat O ring to be square cut for positive sealing with minimal back pressure ½ to 4 valves to be of full port design

F Globe valves shall be stainless steel construction (or PVC construction) as shown on drawings or approved equal per ASTM B16 34 inside screw rising stem construction and shall have integral seal swivel disc and screwed bonnet

G Pressure relief valves shall be stainless steel construction and Viton seals with threaded connections and non sticking design utilizing a Teflon shaft passing through three (3) vented U cup seals They shall be an angle type design The valves shall have no external metal fasteners and have one corrosion resistant coated internal spring to cover the valves entire set pressure range All pressure relief valves to be hand adjustable without tools to relieve pressures between 5 and 100 psi

H Flow Control Ball Valves shall be of PVC or stainless steel body and EPDM diaphragms and stainless steel fasteners

I Solenoid valves shall be stainless steel wetted construction as manufactured by ASCO Solenoid valves for all air operated diaphragm pumps and reinjection lines shall fail closed

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed in accordance with the requirements of the contract documents and the manufacturer s instruction and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

3 02 TESTING AND INSPECTIONS

A Each piece of equipment shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the contract document

B Acceptance tests after the equipment is completely installed may be performed to demonstrate performance requirements as specified herein The field tests will be governed by provisions of applicable industry and institute standards

C Hydrostatic testing shall be governed by AWWA C504 and ANSI B16 1

D Seat leakage testing shall be per ANSI B16 104 Control Valve Seat Leakage

E Refer to Section 015020 for additional testing requirements

3 03 WARRANTY

A Equipment shall be guaranteed against manufacturer defects for a period of one year from the date of installation

END OF SECTION

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SECTION 15401
PLUMBING, GENERAL PURPOSE
PART 1 GENERAL

1 01 SUMMARY

A The CONTRACTOR shall supply and provide all materials fabrication drawings erection design installation testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of the plumbing system as included in the Contract documents

B This section covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment described herein

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the CONTRACTOR to provide equipment that has been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

1 02 SYSTEM DESCRIPTION

1 03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

A Plumbing systems shall be designed constructed and maintained so as to guard against fouling clogging and depositing of solids

B Plumbing systems shall be installed in such manner as not to weaken structural members nor cause damage or deterioration to any part of the building through fixture usage

C For the purpose of water conservation from laboratory sink the flow shall not exceed the rates and quantity as set forth in Section 26 17 06 02 of Maryland Department of Environment

D Plumbing fixtures shall have smooth impervious surfaces shall be durable for the uses intended and shall be free from defects and concealed fouling surfaces

E Plumbing fixtures shall be installed with regard to spacing so as to be reasonably accessible for their intended use and for cleaning and repairs Where practical fixture supply and drain pipes shall be run to piping connections in the nearest wall rather than through the floor Fixtures having concealed packing or gasket type slip joints connections shall be provided with an access panel on utility space arranged so as to make the slip joint accessible for repair

F Plumbing fixtures and equipment shall be provided with water in sufficient volume and at pressures adequate to enable them to function satisfactorily and without excessive noise under normal conditions of use

G The water supply distributing system shall be designed and adjusted to supply fixtures and equipment with the minimum quantity of water consistent with proper performance and cleaning The system shall be maintained to prevent leakage and excessive waste of water

H The minimum pressure available at all times at water outlets shall be 8 psi except at other equipment requiring higher pressure at which the minimum shall be that required for satisfactory performance

I CONTRACTOR shall verify static and residual pressures with Hollywood Township water department

J CONTRACTOR shall assess the need and acceptability of alternative water service and sewer pipe materials under the current site conditions and line routing shown on the contract drawings CONTRACTOR shall have all alternative materials approved by the Engineer and the applicable state or local agency prior to installation

K Underground equipment drain line to building sump shall conform to all applicable state and local requirements

1 04 SUBMITTALS

A The CONTRACTOR shall submit in the manner and within the time limit as set forth in the contract documents shop drawings showing outline and overall dimensions connection details weights anchorage details arrangement of functional parts and parts lists if applicable for all equipment and materials furnished

B The CONTRACTOR s drawings shall be direct reproducibles above to produce clear sharp and legible prints Fabrication of the equipment shall not be started until after the CONTRACTOR has received written drawing review approvals from the Engineer

C Review of the drawings by the Engineer shall not relieve the CONTRACTOR of the entire responsibility for the engineering design workmanship and material under the contract documents

D Submittals Register The following shall be submitted in accordance with Section 01300 Submittals

1 Six (6) copies of detail drawings consisting of illustrations schedules performance charts instructions brochures diagrams and other information to illustrate the requirements and operations of each system Detail drawings for the complete plumbing system including piping layouts and locations of connections dimensions for roughingin foundation and support points and schematic diagrams and wiring diagrams or connection and interconnection diagrams Detail drawings shall indicate clearances required for maintenance and operation Where piping and equipment are to be supported other than as indicated details shall include loadings and proposed support methods

2 Manufacturer s detailed technical data for materials fabrication and installation Include catalog cuts of all equipment hardware anchors fastenings and accessories

3 Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria completion and testing of the installed system Each test report shall indicate the final position of controls

4 Where material or equipment are specified to comply with requirements of ADA or ASME proof of such compliance The label or listing of the specified agency will be acceptable evidence In lieu of the label or listing a written certificate may be submitted from an approved nationally recognized testing organization equipped to perform such services stating that the items have been tested and conform to the requirements and testing methods of the specified agency

5 Written certification that the bolts furnished comply with the requirements of this specification provided by the bolt manufacturer The certification shall include illustrations of product required markings the date of manufacture and the number of each type of bolt to be furnished based on this certification

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1 05 APPLICABLE CODES AND REGULATIONS

Plumbing Code Section 900 BOCA National Plumbing Code

ARI 1010	(1984) Drinking Fountains and Self contained Mechanical Refrigerated Drinking Water Coolers
ANSI A117 1	(1986) Providing Accessibility and Usability for Physically Handicapped People
ASTM A 53	(1990b) Pipe Steel Black and Hot Dipped Zinc Coated Welded and Seamless
ASTM B 32	(1991) Solder Metal
ASTM B 88	(1992) Seamless Copper Water Tube
ASHRAE 90A	(1980 90A a) Energy Conservation in New Building Design
ASME A112 1 2	(1991) Air Gaps in Plumbing Systems
ASME A112 21 1M	(1991) Floor Drains
ASME A112 36 2M	(1991) Cleanouts
ASME B1 20 1	(1983) Pipe Threads General Purpose (Inch)
ASME B16 3	(1985) Malleable Iron Threaded Fittings Classes 150 and 300
ASME B16 18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16 39	(1986) Malleable Iron threaded Pipe Unions (Classes 150 250 and 300)
ASME B40 1	(1991) Gauges Presssure Indicating Dial Type Elastic Element
ASSE 1001	(1988) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1011	(1981) Hose Connection Vacuum Breakers
ASSE 1013	(1988) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
CDA 1 0	(1990) Standard Test Method1 0 for Liquid and Paste Fluxes for Soldering Applications of Cooper and Cooper Alloy Tube
FS QQ L 201	(Ref F AM 2) Lead Sheet

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FS TT P 1536	(Rev A) Plumbing Fixture Setting Compound
FS TT S 00230	(Rev C) Sealing Compound Elastomeric Type Single Component for Caulking Sealing and Glazing (for Buildings and Other Structures)
FSTT S 001543	(Rev A) Sealing Compound Silicone Rubber Base (for Caulking Sealing and Glazing in Buildings and Other Structures)
FS WW C 440	(Rev B Am 2) Clamps Hose (Low Pressure)
FS WW P 541/GEN	(Rev E Am 1) Plumbing Fixtures
FS WW P 541/5	(Rev B Am 1) Plumbing Fixtures (Sinks Sample and Service)
FS WW P 541/6	(Rev B Am 1) Plumbing Fixtures (Drinking Fountains)
FS WW P 541/7	(Rev C Am 1) Plumbing Fixtures (Shower Bath and Emergency Eye and Face Wash Outfits)
FS WW U 516	(Rev B Notice 1) Unions Brass or Bronze Threaded Pipe Connections and Solder Joint Tube Connections
FS WW V 35	(Rev C) Valve Ball
MSS SP 25	(1978 R 1988) Standard Marking System for Valves Fittings Flanges and Unions
MSS SP 58	(1988) Pipe Hangers and Supports Materials Design and Manufacture
MSS SP 69	(1991) Pipe Hangers and Supports Selection and Application
MSS SP 80	(1987) Bronze Gate Globe Angle and Check Valves
MSS SP 83	(1987) Steel Pipe Unions Socket Weldings and Threaded
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

PART 2 PRODUCTS

2 01 EQUIPMENT

A Pipe fittings shall be compatible with the applicable pipe materials Pipe threads (except dry seal) shall conform to ASME B1 20 1 Grooved pipe couplings and fittings shall be of the same manufacturer Material or equipment containing lead shall not be used in any potable water system Pipe materials shall be in accordance with applicable Building Codes 15400 6

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B Joints and gaskets materials shall conform to the following

a Coupling for Steel Pipe AWWA C606

b PTFE Tape for use with Threaded Metal or Plastic Pipe MS MIL T27730

C Miscellaneous materials shall conform to the following

a Lead Sheet FS QQ L 201 Grade B

b Hose Clamps FSWW C 440

c Supports for Off the Floor Plumbing Fixtures ASME A112 6 1 M

d Metallic Cleanouts ASME A112 36 2M

e Plumbing Fixture Setting Compound FS TT P 1536 Type II

f Gauges Pressure and Vacuum Indicting Dial Type Elastic Element ASME B40 1

D Pipe hangers insets and supports shall conform to MSS SP 58

E Valves shall be provided on supplies to equipment and fixtures Valves 2 1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder type connections for tubing Valves three inches and larger shall have flanged iron bodies and bronze trim Pressure ratings shall be based upon the application Valves used for water service shall have the zinc content limited to no more than 6 percent for the stem body bonnet wedge or disk in contact with the fluid Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard

Description	Standard
Ball Valves with Flanged and Butt Welding Ends for General Service	MSS SP 72
Ball Valves	FS WW V 35
Bronze Gate Globe Angle and Check Valves	MSS SP 80
Trap Seal Primer Valves	ASSE 1018

F Wall faucets with vacuum breaker backflow preventor shall be brass with 3/4inch male inlet threads hexagon shoulder and 3/4 inch hose connection Faucet handle shall be securely attached to stem

G Wall hydrants with vacuum breaker backflow preventer shall have a nickel brass or nickel bronze wall plate or flange with nozzle and detachable key handle A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building and the portion of the hydrant between the outlet and valve is selfdraining A bras or bronze valve with coupling and union elbow having metal tometal seat shall be provided Valve rod and seat washer shall be removable through the face of the hydrant The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet

H Reduced pressure principle assemblies double check valve assemblies atmospheric (nonpressure) type vacuum breakers and pressure the vacuum breakers shall be tested approved and listed in accordance with FCCHR 01 Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012 Reduced pressure principle backflow preventers shall be in accordance with ASSE 1011 Pipe applied atmospheric type vacuum breakers shall be in accordance with ASSE 1001 Air gaps in plumbing systems shall be in accordance with ASME A112 1 2

I Floor drains shall consist of a galvanized body integral seepage pan and adjustable perforated or slotted chromium plated bronze nickel bronze or nickel brass strainer consisting of grate and threaded collar Floor drains shall be cast iron except where metallic waterproofing membrane is installed Drains shall be of soluble drainage pattern for embedding in the floor construction The seepage pan shall have seep holes or channels for drainage to the drainpipe The strainer shall be adjustable to floor thickness A clamping device for attaching flashing or waterproofing membrane shall be provided when required Drains shall be provided with threaded or caulked connection

J Unless otherwise specified herein traps shall be copper alloy adjustable tube type with slip joint inlet and swivel Traps shall be without a cleanout Tubes shall be not less than 20 gauge copper ally with walls 0 032 inch thick within commercial tolerances except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level Swivel joints shall be below the discharge level and shall be of metal to metal or metal to plastic type as required for the application Nuts shall have flats for wrench grip Outlets shall be internal pipe thread except that when required for the application the outlets shall have sockets for solderjoint connections The depth of the water seal shall be not less than 2 inches The interior diameter shall be not more than 1/8 inch over or under the nominal size and interior surfaces shall be reasonably smooth throughout A copper alloy UP~ trap assembly consisting of an adjustable P trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories The assembly shall be a standard manufactured until and may have a rubber gasketed swivel joint

K All fittings flanges roof drain bodies and valves shall be covered with permanently noncombustible one piece factory premolded insulated P V C fittings covers Factory precut 1 inch thick fiberglass insulation shall be applied to the fittings The ends of the insulation shall be tucked snugly into the throat of the fitting and the edge adjacent to the pipe covering tucked in fully insulating the pipe fitting The one piece P V C fitting cover shall be secured with stainless steel tack fastening All seam edges of the cover shall be sealed with pressure

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sensitive vapor barrier tape color to match The tape shall extend over the adjacent pipe insulation and overlap 2 inches beyond fitting cover

L Rigid pipe insulation insets shall be installed at each hanger location between pipe and pipe hangers of thickness equal to adjoining insulation Rigid pipe insulation inserts shall be of length as recommended by the manufacturer Insulation jacket over insert shall be same as adjoining piping

M Provide at each hanger location a 16 gauge galvanized metal covering protector shield Shields shall be not less than 12 inches long or three times the insulation O D whichever is the greater dimension The protector shield shall cover 120 degrees of the insulation surface arc

N Drops to hose end valves shall be insulated to a point 6 feet above the floor All exposed drops of insulated piping shall have PVC spun aluminum or fiberglass protectors furnished for the exposed end of the insulation at terminal points

O In cast iron bell and spigot pipe cleanouts shall consist of a cast iron ferrule and extra heavy brass tapered screw cleanout plug with square or hexagonal nuts

P In screw pipe cleanout shall consist of standard iron pipe size (I P S) brass plugs screwed into drainage fittings In copper tubing they shall consist of copper to copper to l P S with l P S brass plugs screwed into female threaded portion of the tee

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A All piping located in air plenums shall conform to NEPA 90A requirements The plumbing system shall be installed complete with necessary fixtures fittings traps valves and accessories Water piping shall be brought into the building under the site/civil section and left as a flanged or threaded connection 8 inches above the finish floor unless otherwise noted Drainage piping shall be extended 40 feet outside the building unless otherwise indicated A gate valve or full port ball valve and drain on the water service line shall be installed inside the building approximately 6 inches above the floor from point of entry Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place Sewer and water pipes shall be laid in separate trenches except when otherwise shown All exterior underground utilities shall be at least 12 inches below the average local frost depth as indicated on the drawings If trenches are closed or the pipes are otherwise covered before being connected to the service lines the location of the end of each plumbing utility shall be marked with a stake or other acceptable means Valves shall be installed horizontal or above

B Metallic pipe shall be used through the roof from at least 6 inches below the roof to the required point of termination above the roof An appropriate rubber boot shall be installed to completely seal the opening between pipe and roof

C Metallic pipe shall be used through the fire wall to a point at least 6 inches on both sides of the wall

D Metallic pipe shall be used through the floor/ceiling from at least 6 inches below the ceiling to at least 6 inches above the floor

E The piping shall be extended to fixtures outlets and equipment The cold water piping system shall be arranged and installed to permit faucets flush valves or other control valves which are supplied with integral stops shall be equipped with a shut off valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures Supply piping to fixtures faucets shall be anchored to prevent movement

F The work shall be carefully laid out in advance and unnecessary cutting of construction shall be avoided Damage to building piping wiring or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved

G Pipe openings shall be closed with caps or plugs during installation Fixtures and equipment shall be tightly covered and protected against dirt water chemicals and mechanical injury Upon completion of the work the fixtures materials and equipment shall be thoroughly cleaned adjusted and operated Safety guards shall be provided for exposed rotating equipment

H Pipe shall be accurately cut and worked into place without springing or forcing Care shall be taken not to weaken structural portions of the building Aboveground piping shall run parallel with the lines of the building unless otherwise indicated Branch pipes from service lines may be taken from top bottom or side of main using crossover fittings required by structural or installation conditions Supply pipes valves and fittings will be kept a sufficient distance from other work the other services to permit not less than 1/2 inch between finished covering on the different services Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines No water pipe shall be buried in or under floors unless specifically indicated or approved Changes in pipe sizes shall be made with reducing fittings Use of bushings will not be permitted Change in direction shall be made with fittings except that bending of pipe 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed The center line radius of bends shall be not less than 6 diameters of the pipe Bent pipe showing kinks wrinkles flattening or other malformations will not be acceptable

I Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and gate valve or full port ball valve ahead of hose bibb At other low points 3/4 inch brass plugs or caps shall be provided Disconnection of the supply piping at the fixture is an acceptable drain

J Allowance shall be made throughout for expansion and contraction of water pipe Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion evenly divided toward the ends Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping Flexibility shall be provided by installing one or more turns in the

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line so that piping will spring enough to allow for expansion without straining If mechanical grooved pipe coupling systems are provided the deviation from design requirements for expansion and contraction may be allowed pending approval of the ENGINEER

K Unions and flanges and mechanical couplings shall not be concealed in walls ceilings or partitions Unions shall be used on pipe sizes 2 1/2 inches and smaller flanges shall be used on pipe sizes 3 inches and larger

L Joints shall use fittings made for the purpose have clearances of 0 0001 to 0 0003 be brazed or soldered and be made with flux Tubes shall be cut square and reamed to remove burrs The outside surface of the tube to contact the fitting and inside surface of the fitting shall be cleaned with an abrasive material just prior to making connections Care shall be taken to present annealing of the tube or fittings when making connections Connections of 2 1/2 and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multiflame torch

M Connections between ferrous and copper pipe shall be made with dielectric unions or flanges Connecting joints between plastic and metallic pipe shall be made with transition fittings for the specific purpose

N Pipe sleeves shall be furnished and set in their proper and permanent location

O Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction Sleeves shall not be required for cast iron soil pipe passing through concrete slab on grade except where penetrating a membrane waterproof floor A modular mechanical type sealing assembly may be installed in lieu of a water proofing clamping flange and caulking and sealing of annular space between pipe and sleeve The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion protected carbon steel bolts nuts and pressure plates The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut After the seal assembly is properly positioned in the sleeve tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved Sleeves shall not be installed in structural members except where indicated or approved Rectangular and square openings shall be as detailed Each sleeve shall extend through its respective floor or roof and shall be cut flush with each surface except for special circumstances Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms lavatories kitchens and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor Unless otherwise indicated sleeves shall be of a size to provide a minimum of 1/4 inch clearance all around between bare pipe and inside of sleeve or between jacket over insulation and sleeves Sleeves in bearing walls shall be steel pipe or castiron pipe Sleeves for membrane water proof floors shall be steel pipe cast iron pipe or plastic pipe Membrane clamping devices shall be provided on pipe sleeves for waterproof floors Sleeves in nonbearing walls or ceilings may be steel pipe cast iron pipe galvanized sheet metal with lock type longitudinal seam or moisture resistant fiber or plastic Plastic sleeves shall not be used in nonbearing fire walls

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roofs or floor/ceilings Except as otherwise specified the annular space between pipe and sleeve or between jacket over insulation and sleeve shall be sealed as indicated and with sealants conforming to FS TT S00230 or FS TT S 001543 and with a primer backstop material and surface preparation Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated Sleeves through below grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides Fill annular space between pipe and sleeve with backing material and install sealants in the joint between the pipe and masonry wall as specified above Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant

P Pipes passing through roof or floor waterproofing membrane shall be installed through a 4 pound lead flashing or a 16 ounce copper flashing each within an integral skirt or flange Flashing shall be suitably formed and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement The flashing shall extend up the pipe a minimum of 10 inches For cleanouts the flashing shall be turned down into the hub and caulked after placing the ferrule Pipes passing through pitched roofs shall be flashed using lead or copper flashing with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal The annular space between the flashing and the bare pipe or between the flashing and the metaljacket covered insulation shall be sealed as indicated Flashing for dry vents shall be turned down into the pipe to form a water proof joint Pipes up to and including 10 inches in diameter passing through roof or floor water proofing membrane may be installed through a cast iron sleeve with caulking recess anchor lugs flashing clamp device and pressure ring with brass bolts Flashing shield shall be fitted into the sleeve clamping device Pipes passing through wall waterproofing membrane shall be sleeved as described above In addition a water proofing clamping flange shall be installed

Q Instead of turning the flashing down into a dry vent pipe or caulking and sealing the annular space between the pipe and flashing or metal jacket covered insulation and flashing counterflashing may be accomplished by utilizing the following

1 A standard roof coupling for threaded pipe up to 6 inches in diameter

2 A tack welded or banded metal rain shield around the pipe

R Where pipes fixtures drains floor drains cleanouts or similar items penetrate slab on grade floors except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing form a groove 1/4 inch to 1/2 inch wide by 1/4 inch to 3 /8 inch deep around the pipe fitting or drain Fill the groove with an approved sealant

END OF SECTION

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SECTION 15402
VENT PIPING SYSTEMS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install a complete waste and vent and chemical resistant waste and vent piping systems including all floor drains equipment and all soil waste drain and vent piping to the limits designated on the Drawings

B Related Sections
1 Division 1 General Requirements
2 Section 02233 Excavation and Backfill
3 Section 15052 Exposed Piping Installation

1 02 QUALITY ASSURANCE

A Requirements of Regulatory Agencies
1 Building Codes Comply with applicable requirements of all governing authorities and the following codes
a State of Maryland Uniform Construction Code
b National Standard Plumbing Code 1993
2 Permits CONTRACTOR shall obtain and pay for all required permits fees and inspections by authorities having jurisdiction

B Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified

1 ASTM D 1248 Polyethylene Plastics Molding and Extrusion Materials
2 ASTM D 2146 Polypropylene Plastic Molding and Extrusion Materials
3 ASTM D 2467 Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings Schedule 80
4 ASTM D 2665 PVC DWV Pipe and Fittings

C CONTRACTOR shall ensure that the manufacturer has at least five years experience in the manufacture of products listed in this Specification

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturers literature specifications and engineering data including dimensions size and material of the following
a Piping

2 Drawings on a 1/4 inch scale showing materials and dimensions of the complete vent piping system in plan and in section

B Record Drawings During progress of the Work keep an up to date set of Drawings showing field and Shop Drawing modifications Immediately upon completion of piping Work submit cloth or mylar tracings showing the actual in place installation of all piping and equipment installed under this Section at a scale satisfactory to the CONTRACTING OFFICER The Drawings shall show all piping on plans and in sections with all reference dimensions and elevations required for complete record drawings of the piping systems Two paper prints shall also be furnished The tracings shall be furnished not later than 30 days after completion of the Contract and prior to final payment

C Operation and Maintenance Manuals Comply with Section 01730

1 04 JOB CONDITIONS

A Protection Properly plug or cap the open ends of all pipe at the end of each days work or other stopping point throughout construction Equipment shall be tightly covered and protected against dirt water and chemical or mechanical injury

PART 2 PRODUCTS

2 01 PIPING

A Polyvinyl Chloride Pipe and Fittings
1 Pipe ASTM D 1785 Type 2110
2 Weight Schedule 40 or 80
3 Fittings ASTM D 2665 drainage type
4 Joints
a Chemical weld with manufactures recommended solvent

2 02 MATERIAL SELECTION

A All exposed vent piping run within the interior of a building shall be schedule 40 PVC

PART 3 EXECUTION

Not used

END OF SECTION

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SECTION 15836
UNIT HEATERS ELECTRIC

PART 1 GENERAL

1 01 DESCRIPTION

A Scope
1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install electric unit heaters complete with accessories required for proper operation

B Related Sections
1 Division 1 General Requirements
2 Division 16 Electrical

C Electrical power supply conduit and wiring is under Division 16 Electrical

1 02 QUALITY ASSURANCE

A Manufacturer s Qualifications Contractor shall ensure that manufacturer has a minimum of 5 years experience in producing substantially similar equipment and can show evidence of at least 5 installations in satisfactory operation

B Requirements of Regulatory Agencies Comply with applicable provisions of regulatory agencies below and others having jurisdiction
1 Underwriters Laboratories Incorporated
2 National Electric Code (NEC)
3 Local and State Building Codes and Ordinances
a The BOCA National Mechanical Code
b The BOCA National Building Code

C Reference Standards Comply with applicable provisions and recommendations of the following except as otherwise shown or specified
1 Air Moving and Conditioning Association (AMCA)
2 American Society of Heating Refrigeration Air Conditioning Association (ASHRAE)
3 National Electrical Manufacturers Association (NEMA)
4 National Fire Protection Association (NFPA)

1 03 SUBMITTAL

A Shop Drawings Submit for approval the following
1 Manufacturer s literature illustrations Specifications and engineering data showing
a Dimensions
b Capacities
c Materials of Construction wiring diagrams

d Finishes

2 Drawings showing fabrication methods assembly installation details and accessories

B Test Reports Submit the following test certifications for approval

1 UL Label

C Operation and Maintenance Data Submit complete manuals including

1 Copies of all Shop Drawings test reports maintenance data and schedules description of operation and related information all in conformance with Division 1

1 04 PRODUCT DELIVERY, STORAGE AND HANDLING

A Store equipment inside and keep clean and free from damage

B Handle to prevent damage during installation and storage

PART 2 PRODUCTS

2 01 DESIGN CONDITIONS

A Design conditions and unit capacities shall be as indicated on the equipment schedules on the Drawings

2 02 DETAILS OF CONSTRUCTION

A Horizontal Unit Heaters (EUH)

1 Casing

a Material Minimum 18 gauge die formed steel

b Finish Phosphate coated and finished with two coats of baked enamel

c Mounting Provided with wall mounted steel hanger bracket with corrosion resistant coating and mounting hardware

2 Heating Elements

a Construction Steel brazed to tubular heating element

b Automatic reset thermal overload protection

c Maximum Operating Temperature 400 F at 70 F ambient

3 Fans

a Type Broad blade axial flow type design

b Construction Aluminum

c Attached to steel hub

d Dynamically balanced

4 Motors

a Type Single speed totally enclosed continuous duty

b Mounting Resilient mounted

c Bearings Permanently lubricated

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DIVISION 16

ELECTRICAL

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SECTION 16050
GENERAL PROVISIONS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to complete the electrical Work

B Coordination

1 Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork walls partitions ceilings and panels

2 Contractor shall be responsible for the installation of all conduits inserts and other items to be built into walls partitions ceilings or panels Contractor shall provide detailed plans or sketches of the location of said conduits and other built in items as may be required Contractor shall keep himself fully informed of the construction where conduits and other built in items are to be installed Contractor shall install said conduits and other built in items in such a manner and within such time periods as will not unnecessarily delay the Work

3 Contractor shall coordinate with the local Electric Company and Telephone Company regarding the installation of the electrical and telephone services

4 The Contractor shall include in his bid all costs associated with providing the telephone service to the treatment plant

C General

1 Interpretation of Drawings

a Dimensions shown on the Drawings that are related to equipment are based on one manufacturer s equipment Coordinate the dimensions of the equipment furnished with the space allocated for that equipment

b The Drawings show the principal elements of the electrical installation They are not intended as detailed working drawings for the electrical Work but as a complement to the Specifications to clarify the principal features of the electrical systems

c It is the intent of this Section that all equipment and devices furnished and installed under this and other Sections be properly connected and interconnected with other equipment so as to render the installations complete for successful operation regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings

D Related Sections

1 Section 02233 Excavation and Backfill

2 Section 03300 Cast In Place Concrete

E Utilities

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1 Contractor shall provide a electric service to the facility It shall be the responsibility of this Contractor to make all necessary arrangements with the local Electric Company

2 In general the following work regarding the permanent service shall be performed by the local Electric Company

a Furnish and install riser pole and conduit and all primary cable and terminations

b Furnish and install padmount transformer

c Furnish metering cabinets

d The cost for the work under this paragraph shall be deemed included in the lump sum price bid for Item #11 No additional compensation will be due to the Contractor for this work as a result of actual charges to the Contractor by the local Electric Company

3 Electric Service

a In general the following work regarding the permanent service shall be performed by the Contractor

1) Furnish and install concrete transformer pad and ground grid

2) Furnish and install primary conduits complete with pull line

3) Furnish and install secondary service conductors and conduits from the transformer to the main service breaker

4) Furnish and install metering conduit and pedestal mounting hardware for meters

5) Install metering cabinets

F Temporary Power

1 Temporary light and power for construction purposes shall be provided in accordance with Section 01500 Temporary Construction

1 02 QUALITY ASSURANCE

A Requirements of Regulatory Agencies

1 Permits Comply with all permits required to commence work and upon completion of the Work obtain and deliver to the CONTRACTING OFFICER a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction

2 Codes Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code the National Electrical Safety Code and with local codes which apply Where discrepancies arise between codes the most restrictive regulation shall apply

3 Tests by Independent Regulatory Agencies Electrical material and equipment shall be new and shall bear the label of the Underwriters Laboratories Inc or other nationally recognized independent testing laboratory wherever standards have been established and label service regularly applies

4 Utilities

a Power Company Work in connection with the electric service and utility metering shall be done in strict conformance with the requirements of

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local Electric Company All work requiring inspection shall be coordinated in advance with the local Electric Company

b Telephone Company Work in connection with the telephone lines for the telephone service shall be done in strict conformance with the requirements of the Local Telephone Company

B Reference Standards Electrical material and equipment shall conform in all respects to the latest approved standards of the following

1 National Electrical Manufacturers Association (NEMA)
2 The American National Standards Institute (ANSI)
3 The Institute of Electrical and Electronic Engineers (IEEE)
4 Insulated Cable Engineers Association (ICEA)
5 National Electrical Code (NEC)
6 National Electrical Safety Code (NESC)
7 Underwriters Laboratories (UL)
8 American Society for Testing and Materials (ASTM)

C Wiring Coordinator

1 Contractor shall retain the services of a wiring coordinator The wiring coordinator shall prepare complete point to point interconnection wiring diagrams The diagrams shall include field wiring associated with the equipment
2 The point to point interconnection wiring diagrams shall be in accordance with the requirements specified under this Section and shall be similar to the detail shown on the Contract Drawings The point to point wiring diagrams shall be in addition to the loop diagrams developed under Division 13
3 The wiring coordinator shall be responsible to obtain all approved shop drawings as built drawings and any information necessary to complete the diagrams
4 The wiring coordinator shall attend the monthly progress and coordination meeting scheduled in accordance with the requirements specified in Section 13

D Wiring Coordinator Qualifications

1 The wiring coordinator shall have experience in the development of point to point wiring diagrams and shall have served in a similar role on a project of the size and complexity of the treatment facility

1 03 SUBMITTALS

A General

1 Conform to requirements of Section 01300 and the General Conditions
2 It is the intent of these specifications that similar equipment be by the same manufacturer for uniformity of products on the project Each equipment submitted shall include a single manufacturer

B Pre Submittal Conference

1 Contractor shall arrange for the wiring coordinator to attend the pre submittal conference specified under Division 13

2 The purpose of the wiring coordinator attendance at the conference shall be to verify qualifications and approach for the project as well as review the example wiring diagram

3 Contractor shall prepare the items listed below for presentation at the pre submittal conference The information shall be submitted to the CONTRACTING OFFICER three weeks prior to the date of the conference

a List of projects where the wiring coordinator developed point to point wiring diagrams

b Samples of previous diagrams that were developed for the listed projects

c Example wiring diagram proposed for the project with tentative list of drawings to be produced

d Development approach plan outlining how information will be exchanged and documented

C Shop drawings shall include the following information to the extent applicable to the particular item

1 List of components including manufacturer s names designations and catalog numbers for all products as specified under Division 16

2 Electrical ratings

3 Conformance to applicable standards or specifications of ANSI ASTM ICEA IEEE NEC NEMA NESC UL or other organizations

4 Dimensioned plan section and elevations showing means for mounting conduit connection and grounding

5 Materials and finish specification including paints

6 Schematics and internal wiring diagrams indicating all connection to components and numbered terminals for external connections

7 Equipment identification system for all equipment

1 04 PROJECT CLOSEOUT

A Operation and Maintenance Data

1 Conform to requirements of Section 01760 and the General Conditions

B Point to Point Diagrams

1 Contractor shall furnish to the CONTRACTING OFFICER point to point interconnection wiring diagrams The point to point wiring diagrams shall include the following information

a Field wiring between each piece of equipment panel instrument and other devices and wiring to control stations lighting panels and motor controllers

b Numbered terminal block identification for each wire termination

c Identification of the assigned wire numbers for all interconnections

d Identification of all wiring by the conduit tag in which the wire is installed

e Terminal junction and pull boxes through which wiring is routed

f Identification of all equipment and the shop drawing transmittal number for equipment from which the wiring requirements and termination information was obtained

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C Record Drawings

1 Conform to the requirements of Section 01730 and the General Conditions Contractor shall furnish to the CONTRACTING OFFICER mylar reproducible record drawings Record drawings shall include the following

a One line wiring diagram of the distribution system

b Actual in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors

c Layouts of the power and lighting arrangements and the grounding system

d Control schematic diagrams with terminal numbers and all control devices identified for all equipment

e Point to point interconnection wiring diagrams updated to reflect final as built equipment information and as installed field installation information

1 05 PRODUCT DELIVERY, STORAGE AND HANDLING

A Delivery of Materials Contractor shall instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site

B Storage and Handling of Materials Conform to the requirements of Section 01610 Transportation and Storage of Materials and Equipment

1 06 IDENTIFICATION OF EQUIPMENT

A All electrical items shall be identified Identification shall be in addition to the manufacturer s nameplates and shall serve to identify the item s function and the equipment or system which it serves or controls It shall be the responsibility of this Contractor to ensure all equipment is properly tagged in accordance with these specifications and the National Electrical Code

B All new equipment shall be identified by means of laminated phenolic nameplates incised to show one inch high black letters on a white background Labels shall be fastened by means of 3/16 inch diameter round head stainless steel self tapping screws In corrosive locations labels shall be fastened by means of a silicon based adhesive Equipment whose designations has been changed shall be relabeled accordingly

C Wires and cables shall be color coded and identified by means of wire markers Each control signal and status wire shall be identified by a unique number Number system shall reflect the actual designations used in the field and be documented on the point to point wiring diagrams Neatly coil all spare wiring at bottom of equipment and individually tag each spare wire and note its origin

D Raceways shall be identified by means of brass tags

E Pull junction and terminal boxes shall be identified with laminated phenolic nameplates Each box shall be identified by a unique number Number system shall reflect the actual designations used in the field and as documented on all wiring diagrams

F The text size and type of lettering unless specifically specified and the location of identifying labels or tags shall be approved by the CONTRACTING OFFICER

1 07 AREA CLASSIFICATIONS

A All materials and equipment to be provided shall conform to the area classification specified

B Wet Locations The following areas shall be considered wet locations
1 All outdoor areas
2 All indoor areas where designated on the drawings Materials equipment and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet locations Enclosures installed in wet locations shall meet NEMA 4 requirements unless specifically specified otherwise

C Materials equipment and incidentals in areas identified as corrosive shall meet NEC and NEMA requirements for corrosive locations Enclosures installed in corrosive locations shall meet NEMA 4X requirements unless specifically specified otherwise

D Dusty Locations All indoor locations not designated on the Drawings as wet or corrosive or hazardous shall be considered as a dusty location
Materials equipment and incidentals in dusty locations shall meet NEC and NEMA 12 requirements unless specifically specified otherwise

1 08 JOB CONDITIONS

A Existing Conditions
1 Contractor shall visit the site prior to submitting his bid in order to determine the conditions of the premises
2 Contractor shall examine the site prior to construction in order to compare them with the Drawings and Specifications

B Procedures for Installation
1 Contractor is cautioned to perform his work with due regard to safety

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SECTION 16111
RIGID CONDUIT

PART 1 GENERAL

1 1 DESCRIPTION

A Scope

1 CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install conduit and fittings to form complete coordinated and grounded raceway systems

2 Conduit routings for various systems within buildings and other areas may not be shown on the Drawings but shall be established by the CONTRACTOR based upon single line and interconnection diagram arrangements indicated on the Drawings It shall be the responsibility of the CONTRACTOR to provide for the proper installation of all conduits for each system

3 The conduit types and the installation methods shall be in conformance with the following

a Rigid steel conduit for exposed indoor conduit runs in noncorrosive areas Rigid steel conduit shall also be used for the Communication Systems regardless of the installation

b PVC coated rigid steel conduit for exposed exterior conduit runs for individual conduit runs direct buried in earth and for exposed interior conduit runs in corrosive locations

c Schedule 40 PVC and rigid steel conduit for concrete encased duct bank runs

d Rigid steel or Schedule 40 PVC conduit for conduit runs embedded in structural concrete slabs

B Coordination

1 Conduit runs where shown are diagrammatic

2 Coordinate conduit installation with piping ductwork lighting fixtures and other systems and equipment and locate so as to avoid interferences

C Related Sections

1 Section 16112 Flexible Conduit

2 Section 16114 Expansion/Deflection Fittings

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 NEC Article 346 Rigid Metal Conduit

2 NEC Article 347 Rigid Nonmetallic Conduit

3 UL Standard No 6 Rigid Metal Electrical Conduit

4 UL Standard No 514 Electrical Outlet Boxes and Fittings

5 UL Standard No 651 Schedule 40 and 80 PVC Conduit

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6 UL Standard No 886 Electrical Outlet Boxes and Fittings for Use in Hazardous Locations
7 ANSI C80 1 Specification for Zinc Coated Rigid Steel Conduit
8 ANSI C80 4 Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
9 NEMA TC2 Electrical Plastic Tubing Conduit and Fittings
10 NEMA TC3 PVC Fittings for Use with Rigid PVC Conduit and Tubing

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s catalog cuts for the conduit fittings and supports proposed for use
2 Construction details of conduit racks and other conduit support systems
3 Layout drawings showing proposed routing of exposed conduits conduits embedded in structural concrete and conduits directly buried in earth Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs
4 Conduit identification numbering system for the conduit systems

B Record Drawings include the actual routing of exposed and concealed conduit runs on record drawings

PART 2 PRODUCTS

2 1 MATERIALS

A Rigid Steel Conduit Elbows and Couplings
1 Material Rigid heavy wall mild steel hot dip galvanized smooth interior tapered threads and carefully reamed ends 3/4 inch NPS minimum size

B PVC Coated Rigid Steel Conduit Elbows and Couplings
1 Material Rigid heavy wall mild steel hot dip galvanized smooth urethane interior coating tapered threads carefully reamed ends 3/4 inch NPS minimum size with a factory exterior coating of 40 mil thick polyvinyl chloride
2 Color Color of coating shall be the same on all conduit and fittings

C Metallic Conduit Fittings and Outlet Bodies
1 Material and Construction Cast gray iron alloy cast malleable iron bodies and covers Outdoor units to be gasketed and watertight Gaskets to be of an approved type designed for the purpose Improvised gaskets not acceptable All units to be threaded type with five full threads Material to conform to ANSI C80 4 and be listed by UL The use of LB fittings shall be avoided and type LBD fittings applied wherever the use of fittings is unavoidable

D PVC Coated Conduit Fittings and Outlet Bodies
1 Material and Construction Cast gray iron alloy cast malleable iron bodies and covers with a factory coating of 40 mil thick polyvinyl chloride and smooth urethane interior

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coating All units to be threaded type with five full threads material shall conform to ANSI C80 4

2 Use Provide PVC coated conduit fittings and outlet bodies in all corrosive locations

E Non metallic Conduit and Fittings

1 PVC Plastic Conduit

a Material Schedule 40 PVC plastic NEMA Type EPC 40 PVD 90 C rated conforming to UL No 651

2 Non metallic Fittings Form elbows bodies terminations expansions and fasteners of same material and manufacturer as base conduit Provide cement by same manufacturer as base conduit

F Conduit Hubs

1 Material Threaded conduit hub vibration proof weather proof with captive O ring seal zinc metal with insulated throat and bonding screw

2 Use Provide for all conduit terminations to boxes cabinets and other enclosures located in areas designated as wet locations

G PVC Coated Conduit Hubs

1 Material Threaded conduit hub vibration proof weatherproof with captive O ring seal zinc metal with insulated throat and factory coating of 40 mil thick polyvinyl chloride and smooth urethane interior coating

2 Use Provide for all PVC coated conduit terminations to boxes cabinets and other enclosures located in areas designated as corrosive location

H Conduit Bushings and Locknuts

1 Insulated Busings

a Material Malleable iron body with plastic liner Threaded type with steel clamping screw Provide with bronze grounding lug as required

2 Locknuts

a Material Steel for sizes 3/4 inch thru 2 inch and malleable iron for sizes 2 1/2 inches through 4 inches

3 Use Provide for all conduit terminations to boxes cabinets and other enclosures except threaded type located in areas designated as dusty locations

I Conduit Tags

1 Material 19 gauge 1 1/2 inch diameter round brass with back filled legend

PART 3 EXECUTION

3 1 INSTALLATION

A Install in conformance with National Electrical Code requirements

B Supports

1 Rigidly support conduits by clamps hangers or Unistrut channels

2 Support single conduits by means of one hole pipe clamps in combination with one screw back plates to raise conduits from the support surface Support multiple runs of conduits of trapeze type hangers with steel horizontal members and threaded hanger rods Kindorff or approved equal Rods shall be not less than 3/8 inch diameter and shall be cadmium coated

3 For PVC coated rigid steel conduit runs supports and hardware shall be a factory applied PVC coating or stainless steel

C Fastenings Fasten raceway systems rigidly and neatly to supporting structures by the following methods

1 To Wood Wood screws
2 To Hollow Masonry Units Toggle bolts
3 To Brick Masonry Price expansion bolts or approved equal
4 To Concrete Phillips Hilti Corporation or approved equal anchors
5 To Steel Welded threaded studs beam clamps or bolts with lock washers or locknuts

D Exposed Conduit

1 Install parallel or perpendicular to structural members or walls
2 Wherever possible run in groups Provide conduit racks of suitable width length and height and arranged to suit field conditions Provide support at every ten feet minimum
3 Install on structural members in protected locations
4 Locate clear of interferences
5 Maintain 6 inches from hot fluid lines and 1/4 inch from walls
6 Install vertical runs plumb Unsecured drop length not to exceed 12 feet

E Conduit Embedded in Structural Concrete

1 Separation Three times outer diameter of larger conduit center to center
2 Minimum Slab Thickness
   a With No Crisscrossing of Conduit
      1) For conduits up to and including one and one quarter inch seven inches plus outer diameter of conduit
      2) For larger conduits five times outer diameter of conduit
   b With Crisscrossing of Conduits
      1) For conduits up to and including one and one quarter inch seven inches plus outer diameters of conduits
      2) For larger conduits six times outer diameter of larger conduit
3 Run conduit in center of slab
4 Before concrete is placed make the necessary location measurements of the conduit to be embedded so that the information is available to prepare record drawings

F Underground Conduits

1 Install individual underground conduits a minimum of 20 inches below grade unless otherwise indicated
2 Perform all excavation bedding backfilling and surface restoration including pavement replacement where required

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3 Make conduit connections watertight

G Empty Conduits
1 Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose
2 Identify each empty conduit with a durable tag showing the conduit number indicated on the Drawings

H Field Bends No indentations Diameter of conduit shall not vary more than 15 percent at any bend

I Joints
1 Apply conductive compound to all joints before assembly
2 Make up joints tight and ground thoroughly
3 Use standard tapered pipe threads for conduit and fittings
4 Cut conduit ends square and ream to prevent damage to wire and cable
5 Use full threaded couplings Split couplings not permitted
6 Use strap wrenches and vises to install conduit Replace conduit with wrench marks
7 Apply zinc rich paint to exposed threads and other areas of galvanized conduit system where the base metal is exposed

J Terminations
1 Install insulated bushings on conduits entering boxes or cabinets except when threaded hubs are used
2 Provide locknuts on both inside and outside of enclosure except when threaded hubs are used
3 Bushings not to be used in lieu of locknuts
4 Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas

K Moisture Protection
1 Plug or cap conduit ends at time of installation to prevent entrance of moisture or foreign materials
2 Make underground and embedded conduit connections watertight
3 Thruwall Seals and Conduit Sealing Bushings Install for all conduits passing through concrete slabs floors walls or concrete block walls
4 Drainage Pay particular attention to drainage for conduit runs Wherever possible install conduit runs so as to drain to one end and away from building Avoid pockets or depressions in conduit runs
5 Seal all conduit openings within control and instrumentation panels and distribution equipment with Duct Sealing Compound

L Corrosion Protection
1 Conduit Curb
a For conduits routed in concrete slabs or floors and stubups through the floor provide a two inch high concrete curb extending two inches from the outer

surface of the conduit penetrating the floor to prevent corrosion For floor mounted equipment the equipment pad shall be in lieu of the concrete curb

b Conduit stub ups shall be a 90 degree PVC coated rigid galvanized steel conduit elbow PVC coated elbow is to extend slightly above the top of the concrete curb or equipment pad Should the elbow not reach this height provide PVC coated conduit extension to accommodate requirements Provide coupling/fitting for transition from rigid galvanized steel conduit or PVC conduit in slab to PVC coated elbow

c For conduits stubbing up and terminating at equipment enclosure mounted on equipment pad provide insulated grounding bushing on the PVC coated elbow

d For conduits stubbing up and extending to boxes cabinets and other enclosures above the concrete curb in wet and dusty areas provide conduit coupling/fittings between the PVC coated elbow and rigid galvanized steel conduit for transition between the two conduit types

e For conduits stubbing up and extending to boxes cabinets and other enclosures above the concrete curb in corrosive areas continue the conduit system with PVC coated conduit

2 Dissimilar Metals

a Take every action to prevent the occurrence of electrolytic action between dissimilar metals

b Do not use copper products in connection with aluminum work and do not use aluminum in locations subject to drainage of copper compounds on the bare aluminum

c Back paint aluminum in contact with masonry or concrete with two coats of aluminum pigmented bituminous paint

3 PVC Coating Supports and fasteners for PVC coated conduit runs shall have factory applied 40 mil thick polyvinyl chloride coating

M Non metallic Conduit

1 Install in accordance with manufacturer s recommendations

2 Join sections in accordance with manufacturer s installation procedures for push fit bell and spigot type joints if applicable or with manufacturer s recommended cement

3 During installation provide expansion fittings for expansion and contraction to compensate for temperature variations Expansion fittings shall be watertight and of the type suitable for direct burial

4 Make transition to PVC coated rigid galvanized steel conduit before making turn up to enclosures

N PVC Coat Rigid Galvanized Steel Conduit

1 Install in accordance with manufacturer s recommendations

2 During installation install with manufacturers installation tools so as not to damage PVC coating

3 Should PVC coating be damaged during installation and exposing the steel conduit repair with manufacturers recommended touchup compounds

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3 2 TESTING

A Test conduits by pulling through each conduit a cylindrical mandrel not less than two pipe inside diameters long having an outside diameter equal to 90 percent of the inside diameter of the conduit

B Maintain a record by number of all conduits testing clear

3 3 IDENTIFICATION

A Tag conduits in accordance with Section 16050 General Provisions Tag all conduits at the ends and in all intermediate boxes chambers handholes and other enclosures Fasten tags to conduits with No 14 AWG solid insulated copper wire Where this method is not practical fasten to the adjacent masonry by means of expansion bolts

B Assign serial numbers to all conduits and a record of the conduit numbers and the cable content by cable designation size quantity origin of conductors and name of equipment served Submit conduit identification numbering system for approval Enter the approved conduit identification numbers on as built drawings

END OF SECTION

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SECTION 16112
FLEXIBLE CONDUITS
PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install flexible metallic conduit and fittings

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 NEC Article 351 Liquid Tight Flexible Metal Conduit
2 UL Standard No 360 Liquid Tight Flexible Steel Conduit

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s catalog cuts and technical information for flexible conduit and fittings proposed for use

PART 2 PRODUCTS

2 01 MATERIALS

A Flexible Conduit

1 Material Flexible galvanized steel core with smooth abrasion resistant liquid tight polyvinyl chloride cover Continuous copper ground built in for sizes 3/4 inch through 1 1/4 inch Material shall be UL listed

B Flexible Conduit Fittings

1 Material and Construction Malleable iron with cadmium finish Fittings shall adapt the conduit to standard threaded connections shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed

2 Use Provide on flexible conduit in areas designated as wet or dusty locations

C PVC Coated Flexible Conduit Fittings

1 Material and Construction Malleable iron with cadmium finish and 40 mil PVC exterior coating Fittings shall adapt the conduit to standard threaded connections

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shall have an inside diameter not less than that of the corresponding standard conduit size

2 Use Provide on flexible conduit in areas designated as corrosive locations

PART 3 EXECUTION

3 01 INSTALLATION

A Install at motors transformers and equipment which are subject to vibration or require movement for maintenance purposes Provide necessary reducer where equipment furnished cannot accept 3/4 inch size flexible conduit Limit flexible conduit length to three feet maximum

B Install in conformance with National Electrical Code requirements

END OF SECTION

SECTION 16114
EXPANSION/DEFLECTION FITTINGS
PART 1 GENERAL

1 1 DESCRIPTION

A Scope CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install conduit expansion and deflection fittings

1 2 QUALITY ASSURANCE

A Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 NEC Article 300 Wiring Methods
2 UL Standard 524 Electrical Outlet Boxes and Fittings
3 UL Standard 467 Electrical Grounding and Bonding Equipment

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s catalog cuts and technical information for expansion and deflection fittings proposed for use

2 Listing of locations where fittings are to be used

PART 2 PRODUCTS

2 1 MATERIALS

A Cast gray iron alloy or bronze end couplings malleable iron or hot dipped galvanized body stainless steel clamps and tinned copper braid bonding jumper Fitting to be watertight corrosion resistant UL listed and compatible with the conduit system

B Features

1 Expansion/Deflection Fittings
a Axial expansion or contraction up to 3/4 inch
b Angular misalignment up to 30 degrees
c Parallel misalignment up to 3/4 inch

2 Expansion Fittings
a Expansion/Contraction 8 inch total movement

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PART 3 EXECUTION

3 1 INSTALLATION

A Install fittings in conformance with the National Electrical Code

B Install expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction Install expansion fittings on exposed conduit runs exceeding 200 feet

C Install expansion/deflection fittings on embedded conduit runs crossing structural expansion joints In addition install expansion/deflection fittings for each conduit in each of the following conditions

1 At below grade penetrations of buildings
2 At manhole and handhole penetrations
3 At outdoor concrete equipment pads
4 Exposed runs crossing structural expansion joints

D Where required in non metallic conduit and duct systems provide necessary couplings to make transition to the threaded metallic fitting

END OF SECTION

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SECTION 16124
INSTRUMENTATION CABLE
PART 1 GENERAL

1 1 DESCRIPTION

A Scope
1 Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install instrumentation cable
2 The types of cable include the following
a Shielded instrument cable
b Multi conductor telephone cable

1 2 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s technical information for shielded instrumentation cable proposed for use

PART 2 PRODUCTS

2 1 MATERIALS

A Single Shielded Pair Instrument Cable
1 Tinned copper stranded conductors #18 AWG minimum twisted with aluminum polyester shield stranded tinned 20 AWG copper drain wire and overall chrome vinyl jacket Rated for 300 volts minimum

B Multipaired Shielded Instrument Cable
1 Tinned copper 7 strand XLPE insulated conductors #18 AWG minimum twisted in pairs with aluminum mylar shield over each pair silicone rubber fiberglass fire barrier tape tinned copper drain wire aluminum mylar overall shield Hypalon outer jacket

C Multiconductor Shielded Instrument Cable
1 Tinned copper stranded conductors #18 AWG minimum with overall aluminum polyester shield with 85 percent tinned copper braid shield and overall teflon jacket

D Multiconductor Telephone Cables
1 Phones Solid copper #22 AWG 4 conductor polyethylene insulated and PVC jacket rated 300 volts minimum

E Cable Terminals
1 Fork type copper compression terminals with nylon insulation for termination of cable at all terminal blocks

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PART 3 EXECUTION

3 1 INSTALLATION

A Install all cable complete with proper terminations at both ends

B Install in conduit separate from power cables unless otherwise noted

C Ground shield on shielded cables at one end only and as recommended by instrument manufacturer

D Identify all conductors in accordance with Section 16050 General Provisions

E Install and terminate vendor furnished cable in accordance with vendor equipment requirements and cable manufacturer s specific recommendations

F Install in conformance with the National Electrical Code

3 2 TESTING

A Test shielded instrumentation cable shields with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground

B Connect shielded instrumentation cables to a calibrated 4 20 milliamp DC signal transmitter and receiver Test at 4 12 and 20 milliamp transmitter settings

END OF SECTION

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SECTION 16130
OUTLET BOXES
PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install outlet boxes for mounting wiring devices and lighting fixtures

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified
1 NEC Article 370 Outlet Switch and Junction Boxes and Fittings
2 UL Standard No 514 Electrical Outlet Boxes and Fittings

PART 2 PRODUCTS

2 01 MATERIALS

A Device Boxes
1 Material Cast gray iron alloy or cast malleable iron with zinc electroplate finish in wet locations and zinc coated sheet steel in dusty locations Cast boxes shall be hub type and include external mounting lugs In corrosive locations boxes shall include a factory applied 40 mil PVC coating Where conduit is installed concealed in dusty locations boxes shall be steel galvanized and shall include suitable extension rings and covers as required
2 Device Cover Plates
a Stainless steel Type 302 alloy for indoor finished areas
b Gasketed spring door type for wet and corrosive locations Plates in corrosive locations shall include a factory applied 40 mil PVC coating
c Integral with device for hazardous locations
d Stainless steel screws and hardware

PART 3 EXECUTION

3 01 INSTALLATION

A Fasten boxes rigidly and neatly to supporting structures

B For units mounted on masonry or concrete walls provide suitable ½ inch spacers to prevent mounting back of box directly against wall

C Leave no open conduit holes in boxes Close unused openings with capped bushings

D Label each circuit in boxes and identify with durable tag

E Install in conformance with National Electrical Code

END OF SECTION

ORIGINAL Red

SECTION 16131
PULL AND JUNCTION BOXES
PART 1 GENERAL

1 1 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install pull junction and terminal boxes

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified
1 NEC Article 370 Outlet Switch and Junction Boxes and Fittings
2 UL Standard No 50 Electrical Cabinets and Boxes

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s technical information for pull and junction boxes proposed for use

PART 2 PRODUCTS

2 1 MATERIALS

A Pull junction and terminal boxes Provide boxes based upon environmental conditions of the location and as required for the area classifications specified in Section 16050 General Provisions
1 Material and Construction (dusty locations)
a Welded and galvanized sheet steel of USS gauge
b Oil resistant gasket
c Lift off hinges and quick release latches
d Boxes with any dimension 24 inches and smaller shall be 14 gauge Boxes with any dimension larger than 24 inches shall be 12 gauge except use 10 gauge on boxes with any dimension of 36 inches or more
2 Material and construction (wet and corrosive hazardous locations)
a Cast gray iron alloy or cast malleable iron bodies and covers Galvanized finish
b Neoprene gaskets Gaskets to be of an approved type designed for the purpose Improvised gaskets not acceptable
c Stainless steel cover screws
d External mounting lugs
e Drilled and tapped conduit holes
f Boxes where conduits enter a building below grade shall have 1/4 inch drain hole at the bottom of the box
g Threaded connections for explosion proof boxes

ORIGINAL REQ

3 Large boxes not generally available in cast construction may be fabricated of copper free aluminum alloy or stainless steel code gage sheet metal for non hazardous locations
4 In corrosive locations all boxes shall include a factory applied 40 mil PVC coating or boxes may be constructed with non metallic thermoplastic or fiberglass reinforced polyester material
5 All boxes shall be identified in accordance with Section 16050 General Provisions

B Terminal Blocks
1 Material and Construction
a NEMA rated nylon modular terminal blocks
b 600 volt rated
c Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection
d Power terminals shall be copper and rated for the circuit ampacity

PART 3 EXECUTION

3 1 INSTALLATION

A Mount boxes so that sufficient access and working space is provided and maintain a minimum of 1/4 inch from walls

B Securely fasten boxes to walls or other structural surfaces on which they are mounted Provide independent galvanized steel supports where no walls or other structural surface exists

C Install pull boxes in conduit runs containing more than three 90 degree bends runs exceeding 200 feet where indicated on the Drawings and where required to conform with the National Electrical Code

D Provide removable flame retardant insulating cable supports in all boxes with any dimension exceeding 3 feet

E Field apply PVC touch up to scratched PVC boxes damaged as a result of installation All touch up work shall be in strict conformance with manufacturer s recommendations

F Size junction and pull boxes in accordance with the requirements of the National Electrical Code

G Provide terminal blocks in junction boxes where indicated on the drawings or where cable terminations or splices are required

END OF SECTION

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SECTION 16133
RECEPTACLES
PART 1 GENERAL

1 01 DESCRIPTION

A Scope CONTRACTOR shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install receptacles

B Related Sections
1 Section 16130 Outlet Boxes

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified
1 National Electrical Code
2 UL Standard #1010 Electrical Receptacle Plug Combinations for use in Hazardous Locations

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s technical information for receptacles proposed for use

PART 2 PRODUCTS

2 01 MATERIALS

A Receptacles
1 Duplex grounding receptacle two pole three wire 125 volt AC 20 ampere
2 Single grounding receptacle corrosion resistant two pole three wire 25 volt AC 20 ampere

B Ground Fault Receptacles
1 Duplex receptacle two pole three wire 125 volt AC 20 ampere

C Surge Suppression Receptacles
1 Duplex grounding surge suppression receptacle two pole three wire 125 volt AC 20 ampere capable of absorbing a transient surge 6 000 volts minimum Receptacle to include power on indicator light

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PART 3 EXECUTION

3 01 INSTALLATION

A Install receptacles at locations indicated on the Drawings in outlet or device boxes in accordance with Section 16130 in non hazardous locations

B Install receptacles with ground pole in the down position

C Mount receptacles 18 inches above finished floor in non hazardous locations and 4 feet 6 inches above finished floor in hazardous locations unless otherwise noted

D Install in conformance with National Electrical Code

END OF SECTION

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SECTION 16135
SNAP SWITCHES
PART 1 GENERAL

1 1 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install snap switches for lighting and other systems

B Related Sections

1 Section 16130 Outlet Boxes

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 National Electrical Code
2 UL Standard #20 General Use Snap Switches

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s technical information for switches proposed for use

PART 2 PRODUCTS

2 1 MATERIALS

A Switches

1 Single pole AC toggle switch quiet type 120/277 volt AC 20 ampere Ivory specification grade

2 Single pole 3 way AC toggle switch quiet type 120/277 volt AC 20 ampere Ivory specification grade

3 Two pole AC toggle switch quiet type 120/277 volt AC 20 ampere Ivory specification grade

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PART 3 EXECUTION

3 1 INSTALLATION

A Install wiring devices in outlet or device boxes in accordance with Section 16130

B Mount wall switches 4 feet 6 inches above finished floor unless otherwise noted

C Install switches in conformance with National Electrical Code

END OF SECTION

SECTION 16321
DRY TYPE TRANSFORMERS
PART 1 GENERAL

1 01 DESCRIPTION

A Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install dry type transformers

B Related Sections

1 Section 03300 Cast In Place Concrete for concrete pad

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 ANSI C89 1 Specialty Transformers
2 ANSI C89 2 Dry Type Transformers for General Applications
3 UL Standard #506 Specialty Transformers
4 UL 1561 including UL K factor listed
5 National Electrical Code

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s technical information for transformers proposed for use

2 Listing of the transformers to be furnished with their ratings and proposed locations identified

PART 2 PRODUCTS

2 01 MATERIALS

A General

1 Type Low temperature rise dry type

2 Rating KVA primary voltage and connection secondary voltage and connection frequency and number of phases shall be as indicated on the Drawings

3 Taps Full capacity two 2 1/2 percent primary taps above normal and two 2 1/2 percent primary taps below normal

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Page

4 Sound Level ANSI C89 1 standard

5 Enclosure UL listed for either indoor or outdoor use

6 Insulation Class 220 degrees C 115 degrees C rise

7 Identification Identify all transformers in accordance with Section 16050 General Provisions identifying the transformer number and voltages

PART 3 EXECUTION

3 01 INSTALLATION

A Install transformers on walls or floors Install floor mounted transformers on raised concrete base at locations shown on the Drawings Provide sufficient access and working space for ready and safe operation and maintenance

B Mount transformers so that vibrations are not transmitted to the structural parts of the building or to other equipment Make connections to transformer with flexible conduit

C Adjust tap settings to provide proper voltage at panelboards

D Ground transformer properly and install in conformance with the National Electrical Code

END OF SECTION

SECTION 16360
DISCONNECT SWITCHES
PART 1 GENERAL

1 1 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install disconnect switches

B Related Sections

1 Section 16135 Snap Switches for disconnect switches on 120 volt single phase circuits

1 2 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 National Electrical Code
2 UL #98 Enclosed Switches
3 NEMA KS 1 Enclosed Switches

1 3 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s technical information for disconnect switches proposed for use

PART 2 PRODUCTS

2 1 MATERIALS

A Single Throw Circuit Disconnect Switches

1 Type Fused or Unfused horsepower rated heavy duty single throw quick make quick break mechanism visible blades in the OFF position and safety handle

2 Rating Voltage and number of poles as required for motor or equipment circuits being disconnected Switches shall bear a UL label

B Enclosure

1 Enclosures shall be NEMA 12 at a minimum and shall be provided based upon location in accordance with NEMA requirement as required for the area classifications specified in Section 16050 General Provisions

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C Identification

1 Identify all enclosures in accordance with Section 16050 General Provisions

PART 3 EXECUTION

3 1 INSTALLATION

A Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance

B Securely fasten equipment to walls or other structural surfaces on which they are mounted Provide independent galvanized steel supports where no wall or other structural surface exists

C Install in conformance with National Electrical Code

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SECTION 16390
GROUNDING SYSTEMS

PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install complete grounding for the electrical systems

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified
1 NEC Article 250 Grounding
2 UL Standard #467 Electrical Grounding and Bonding Equipment

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following
1 Manufacturer s technical information for grounding materials proposed for use
2 Listing of grounding connector types identifying where they are to be used
3 Layouts of each structure ground grid
4 Test point construction details
5 Results of ground resistance tests at each test point

PART 2 PRODUCTS

2 01 MATERIALS

A Bare Ground Cable
1 Material Soft drawn bare copper stranded cable conforming to ASTM B8 and B189 No 8 AWG minimum size

B Ground Rods
1 Material Copperclad rigid steel rods 3/4 inch diameter 10 feet long

C Grounding Connectors
1 Material pressure connectors to be copper allow castings designed specifically for the items to be connected and assembled with Durium or silicone bronze bolts nuts and washers Welded connections to be by exothermic process utilizing molds cartridges and hardware designed specifically for the connection to be made

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PART 3 EXECUTION

3 01 STRUCTURE GROUND SYSTEM

A Provide ground grids around the following structures

B Install #4/0 bare copper cable around the exterior perimeter of structures minimum 2 feet 6 inches below grade unless otherwise shown on Drawings

C Install sufficient ground rods (minimum of 4) to provide a resistance to ground of less than 5 ohms for each ground grid

D For structures with steel columns install #4/0 ground cable from grid to each column around the perimeter of the structure Connect cable to steel using exothermic welds

E Connect grids to a continuous underground water pipe system when practical

F Provide accessible test points for measuring the ground resistance of each grid

G Weld all buried connections except for test points

3 02 EQUIPMENT GROUNDING

A Ground all electrical equipment in compliance with the National Electrical Code

B Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where necessary for mechanical protection

C Connect ground conductors to conduit with copper clamps straps or with grounding bushings

D Connect to piping by welding or brazing Use copper bonding jumpers on all gasketed joints

E Connect to equipment by means of lug compressed on cable end Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding Do not use holddown bolts Where grounding provisions are not included drill suitable holes in locations designated by the CONTRACTING OFFICER

F Connect to motors by bolting directly to motor frames not to sole plates or supporting structures

G Connect to service water piping by means of copper clamps Use copper bonding jumpers on all gasketed joints

H Scrape bolted surfaces clean and coat with a conductive oxide resistant compound

3 03 TESTING

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A Test the completed ground systems for resistance to ground using an electrical ground resistance tester The grounding system maximum resistance shall not exceed 5 ohms under normally dry conditions when measured by the resistance tester Resistance values above 5 ohms shall be brought to the CONTRACTING OFFICER attention

B Test all grounded cables and metal parts for continuity of connection

++ END OF SECTION ++

SECTION 16470
LIGHTING
PART 1 GENERAL

1 01 SUMMARY

A The Contractor shall supply and provide all materials fabrication drawings installation testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of lighting equipment

B This section covers the requirements for the functional design performance materials construction features testing quality and handling of the equipment or systems described herein

C It is not the intent of this section and associated drawings to specify all details of design fabrication and construction It shall be the responsibility of the Contractor to provide equipment and systems that have been designed fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service

D The work includes supply erection complete installation and testing of the following

1 Interior Building Lights

2 Exterior Building Lights

1 02 RELATED SECTIONS

A Related work and/or equipment that is specified in other sections of the contract documents includes but is not limited to the following

Section 16500 General Provisions
Section 13120 Pre Engineered Metal Building and Accessories

1 03 SYSTEM DESCRIPTION

The lighting equipment includes interior and exterior lighting for the building MCC/control room interior lighting is switch controlled and used on an as required basis Interior process area lighting is controlled by circuit breakers in the panelboard The exterior light is controlled by a photoelectric eye that turns the light on at dusk and off at sunrise The lights will all operate on 120 VAC electrical service

1 04 SUBMITTALS

A Contractor shall submit in the manner and within the time limit as set forth in the Contract documents drawings showing outline and overall dimensions connection details weights

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anchorage details and parts lists if applicable for all equipment and materials furnished under this section

B Review of the drawings by the Engineer shall not relieve the Contractor of the entire responsibility for the engineering design workmanship and material under the Contract documents

C The drawings shall include but will not be limited to the following details

1 Overall dimensions and details of the location of all connections supports and accessories and a bill of materials

1 05 QUALITY ASSURANCE

A Contractor shall have a quality assurance program which shall ensure that the equipment and services provided shall properly reflect the CONTRACTING OFFICER s requirements The program shall cover as a minimum the following areas

1 Design and procurement control
2 Control of purchased material
3 Inspection and test performance and status
4 Handling and storage
5 Corrective action

PART 2 PRODUCTS

2 01 EQUIPMENT

A Contractor shall provide fluorescent and high pressure sodium lighting fixtures for interior use as shown on drawing

B Each interior light fixture shall run on 120 VAC electrical supply

C Building lights shall be arranged as shown on the drawings

D For emergency lighting the Contractor shall provide wall mounted emergency battery pack sized for 1 1/2 hours of operation to allow safe movement of personnel in case of power loss

E Provide brackets supports anchors frames fast starters and ballasts required for a complete operable system

F The Contractor shall provide all rapid start cool white fluorescent lamps for all fixtures

G All lighting materials shall conform to the requirements of the NBFU and shall have appropriate Underwriters Laboratories acceptance

H Contractor shall provide high pressure sodium flood light to be installed outside the building as shown on the drawings Lights shall operate on 120 VAC

I Outdoor light shall be automatically controlled by a photo electric eye so that it turns on at dusk and off at sunrise

J Exterior light shall be waterproof and suitable for extreme weather service

K Each basic fluorescent fixture shall be equipped with the necessary number and type of ballasts to operate only the lamps with the particular basic unit Single lamp fixtures shall contain one single lamp ballast two lamp fixtures shall contain one two lamp ballasts

L Ballast protectors shall be of the thermally actuated automatic reset built in type

2 02 MATERIALS

A All materials and equipment shall be suitably grounded and conform with National Electrical Code Standards

B Light fixtures and accessories shall be painted galvanized white metal or treated to ensure a service life of ten years

C Contractor shall provide materials and accessories whether or not specifically described of best grade of commercial manufacturer

PART 3 EXECUTION

3 01 ERECTION/INSTALLATION

A The equipment shall be installed and or erected in accordance with the requirements of the Contract documents and the manufacturer s instructions and recommendations

B All work shall be performed by competent trained workmen skilled in the field to which they are executing the work Workmen shall be health and safety trained for work in hazardous area

C All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections

D All work shall conform to the National Electrical Code standards

E The furnishing and installation of the lighting fixtures or lighting equipment must be executed in a manner that will insure completion coincident with the completion of the construction of the project unless otherwise required by the contract specifications

F Lighting fixture installation shall be level plumb and square and fastened rigidly in place

ORIGINAL REQ

G Wiring between fluorescent lampholders and associated operating and starting equipment shall be of sizes not smaller than the sizes of the leads furnished with the approved types of ballasts and shall have equal or better insulating and heat resisting characteristics All other wiring within fluorescent lighting fixtures or from the fixture to the splice with the building wiring shall conform to the requirements of the latest issue of the NEC Unless otherwise specified or shown on drawings all wiring in conjunction with incandescent fixture shall also conform to the requirements of the latest issue of the NEC and shall not be less than No 16 gauge Wiring shall be protected with tape or tubing at all points where abrasion is liable to occur Wiring shall be concealed within fixture construction except where the fixture design or mounting dictates otherwise

H Multiple section fluorescent lighting fixtures shall be internally wired and connected to accomplish the switching arrangement required by the electrical drawings Wiring shall conform to the requirements of the latest issue of the NEC

3 02 TESTING AND INSPECTIONS

A Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the contract documents

B Acceptance tests after the equipment is completely installed may be performed by the Engineer to demonstrate performance requirements as specified herein The field tests will be governed by provisions of applicable industry and institute standards

END OF SECTION

SECTION 16480
PANELBOARDS
PART 1 GENERAL

1 01 SUMMARY

A Section includes lighting and appliance branch circuit and distribution panelboards

B Related Division and Section

1 Division 1 General Requirements

2 Section 16010 Basic Electrical Requirements

1 02 REFERENCES

A Sections Referenced

1 FS W C 375 Circuit Breakers Molded Case Branch Circuit and Service

2 FS W P 115 Power Distribution Panel

3 NEMA AB 1 Molded Case Circuit Breakers

4 NEMA PB 1 Panelboards

5 NEMA PB 1 1 Instruction for Safety Installation Operation and Maintenance of Panelboards Rated 600 Volts or Less

6 NEMA PB 1 2 Application Guide for Ground Fault Protective Devices for Equipment

1 03 SUBMITTALS

A In accordance with Section 01300 Submittals

B Submit Shop Drawings and product data for equipment and component devices

C Include outline and support point dimensions voltage main bus capacity integrated short circuit ampere rating circuit breaker arrangement and sizes

1 04 SPARE PARTS

A Keys Furnish 2 each to Contractor

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PART 2 PRODUCTS

2 01 BRANCH CIRCUIT PANELBOARDS

A Lighting and appliance branch circuit panelboards NEMA PB1 circuit breaker type

B Enclosure NEMA PB 1 Type 1

C Cabinet size 4 1/2 in deep 14 in wide for 240 volt and less panelboards except where branch circuit breakers with ratings in excess of 100 amps are required 5 3/4 in deep and 20 in (minimum) wide for 480 volt panelboards and for any panelboard requiring branch circuit breakers with ratings in excess of 100 amps

D Provide surface cabinet front with concealed trim clamps concealed hinge and flush lock all keyed alike Furnish in manufacturer s standard gray enamel for surface mounting

E Provide panelboards with copper bus ratings as scheduled on Drawings Provide copper ground bus in all panelboards

F Minimum integrated short circuit rating 10 000 amps For 240 VAC and 14 000 amps for 480 volt panels

G Molded case circuit breakers NEMA AB 1 bolt on type thermal magnetic trip circuit breakers with common trip handle for all poles Provide circuit breakers that are Underwriters Laboratories (U/L) listed as type SWD for lighting circuits Where required provide lockable hardware for mounting on circuit breaker handles Provide U/L Class A ground fault interrupter circuit breakers where scheduled on Drawings

PART 3 EXECUTION

3 01 FIELD QUALITY CONTROL

A Measure steady state load currents at each panelboard feeder Should the difference between phases at any panelboard exceed 20 percent rearrange circuits in the panelboard to balance the phase loads within 20 percent Take care to maintain proper phasing for multi wire branch circuits

B Visual and mechanical inspection Inspect for physical damage proper alignment anchorage and grounding Check proper installation and tightness of connections for circuit breakers fusible switches and fuses

END OF SECTION

SECTION 16492
MANUAL MOTOR STARTERS
PART 1 GENERAL

1 01 DESCRIPTION

A Scope Contractor shall provide all labor materials equipment and incidentals as shown specified and required to furnish and install manual motor starters

1 02 QUALITY ASSURANCE

A Reference Standards Comply with applicable provisions and recommendations of the following except where otherwise shown or specified

1 NEMA Standard ICS2 110 General Standards for Manual and Magnetic Controllers
2 National Electrical Code

1 03 SUBMITTALS

A Shop Drawings Submit for approval the following

1 Manufacturer s technical information for manual motor starters proposed for use
2 Listing of the manual motor starters to be furnished with their location and equipment to be controlled and identified

PART 2 PRODUCTS

2 01 MATERIALS

A Manual Motor Starters

1 Type Toggle operated horsepower rated with thermal overload protection Where indicated on the Drawings manual motor starters rated 600 volt 3 pole 20 amp without overload protection shall be provided to be used as disconnects

2 Enclosure Enclosures shall be provided based upon location in accordance with NEMA requirements and as required for the area classifications specified in Section 16050 General Provisions

3 Identification Identify all starters in accordance with Section 16050 General Provisions identifying the equipment controlled

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PART 3 EXECUTION

3 01 INSTALLATION

A Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance

B Securely fasten equipment to walls or other surfaces on which they are mounted Provide independent galvanized steel supports where no wall or other surface exists

C Install in conformance with the National Electrical Code

END OF SECTION

DESIGN CALCULATIONS

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 1 of 3 Project Name Southern Maryland Wood Project Location Hollywood, MD

Subject Pump Calculation (Head Loss Calculation) Prepared By SH Date 9/17/97
Checked By EW Date 9/19/97

I AOP Feed Pump (P-401, P-401A)

A Pipe Length from P-401 to AOP Reactor (ME-401) = 44'

Q = 75 gpm

V in 3" pipe = 3 31 fps

Head Losses

(1) In Pipe h_L = 44' x 1 28'/100' = 0 5632'

(2) Fittings

3" Elbow = 4 K = 0 54 h_f = 0 092' x 4 = 0 3

3" Tee (thru) = 5 K = 0 36 h_f = 0 0611' x 5 = 0 30

(3) Valves

3' Ball Valve = 1 C_v = 324 ΔP = 0 0536 psi = 0 1238'

3" Globe Valve - 1 K = 6 1 h_f - 1 0359

3" Ball " = 2 K = 0 05 h_f = 0 01698

3" Check (swing) " = 1 K = 1 8 h_f = 0 3057

(4) ΔP in Carbon units = 10 psi maximum
= 23 1'

(5) Static Mixer

Assume ΔP = 2 psi = 4 62'

Subtotal h_L = 7 3411'

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OHM Remediation Services Corp	COMPUTATION SHEET	Project Number ____ Page 2 of 3
		Project Name ____
		Project Location ____

Subject ____ Prepared By ____ Date ____

Checked By EW Date 9/19/97

B Pipe Length from Carbon units to Treated Water Tank (T-404) = 12' 2" PVC (horizontal) 10' vertical

75 gpm in 2" PVC V = 7.32 fps

Head Losses

(1) In pipe $h_f = 22' \times 8.82'/100' = 1.94'$

(2) Fittings

4" Tee thru = 1 K = 0.34 $h_f = 0.2824'$

4"x2" reducer = 1 K = 0.2296 $h_f = 0.1907'$

4" Elbow = 3 K = 0.51 $h_f = 1.2767'$

2" " = 1 K = 0.57 $h_f = 0.4734'$

2"x4" Expander = 1 K = 0.56 $h_f = 0.4651$

(3) Valves

2" globe valve = 1 K = 6.5 $h_f = 5.3984'$

(4) Flowmeter

2" Flowmeter

Assumed $\Delta P = 2$ psi = 4.61

Sub Total $\Delta P = 14.64'$

Total = 14.64' + 7.27 ≅ 22'

+ 23' Carbon unit

45'

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OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 3 of 3 Project Name Southern Maryland Wood Project Location Hollywood, MD

Subject _____ Prepared By SH Date 9/17/97
Checked By EW Date 9/19/97

II Process Feed Pump (P-201)

A Pipe Length from P-201 to ICP (Flash Tank) = 15' + 4' ≃ 20'

Q = 75 gpm in 3 PVC

V = 3.31 fps

Head Losses

(1) In Pipe $h_L = 20' \times 1.28'/100' = 0.256'$

(2) Fittings

15" x 3' Expander = 1 K = 0.56 $h_f = 0.0951'$

3" Elbow = 2 K = 0.54 $h_f = 0.092' \times 2 = 0.1834'$

3" Tee (Through) = 1 K = 0.36 $h_f = 0.0611'$

(3) Valves

3" Ball c Valve = 1 Cv = 324 $\Delta P = 0.0536$ PSI = 0.123

3" Globe " = 1 K = 6.1 $h_f = 1.0359'$

(4) Static head

Top of ICP = 165'
Ground Elev = 149' } 16'

Total h_L = 17.76'

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OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ ORIGINAL Red
		Project Name SMWT
		Project Location Hollywood, MD

Subject Thermal Desorption Water Supply pump SIZING (P-404)

Prepared By MM Date 9/4/97

Checked By EW Date 9/19/97

C-1 distance = 640' (125) = 800 ft {ASSUMING NO ELBOWS}

13' HEAD FROM ELEVATION DIFFERENCE

+ 45 gpm

2" Line (TDW)

FLOW	FT HEAD LOSS PER 100 FT
40 gpm	4 1' } 2" PVC PIPE
50 gpm	6 2'

INTERPOLATING 5' 45 GPM → 515' HEAD LOSS PER 100 FT 2" PIPE

$$\left(\frac{515 \text{ ft HEAD}}{100 \text{ ft PIPE}}\right)(800 \text{ FT PIPE}) = 412 \text{ FT HEAD (VISCOUS DRAG)}$$

$$+ 130 \text{ FT HEAD (AZ)}$$

$$542 \text{ FT } (125) \cong 70 \text{ FT HEAD}$$

∴ PUMP RATED AT

$\boxed{45 \text{ GPM @ } 70 \text{ FT HEAD}}$

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ ORIGIN Project Name SMWT Project Location Hollywood, MD

Subject EQ TANK TRANSFER PUMP (P-100) SIZING Prepared By MEM Date 9/11/97 Checked By GW Date 9/19/97

- Pump is gravity fed from 3' PVC line 60 FT IN LENGTH AND 4 FT TDH

1) ELEVATION HEAD 13'

2.) VISCOUS PIPE LOSS THRU 80' OF 2' PVC @ 25 GPM

20 GPM 1.1 FT/100 FT
30 GPM 2.4 FT/100 FT } 25 GPM = 1.75 FT/100 FT

8(1.75 FT) = 14 FT VISCOUS PIPE LOSS

∴ (14 + 13) 1.25 ≃ 20 FT

P-100 DOUBLE DIAPHRAGM PUMP
25 GPM @ 20 FT TDH

⇒ WARREN RUPP Sand PIPER
FLAP VALVE
SAI-A TYPE 4

TV-4-A
or TV-4-SS

AIR REQ (SEE FOLLOWING SHEET

20 SCFM + 35 PSI

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Southern Maryland Wood Treatment Site
Process System Compressed Air Requirements

Tag No	Description	Req PSIG (max)	Req SCFM (max)
F 304	Continuous Backwash Sand Filter	25	4
ME-401	AOP/UV Reactor	100	2
ME 502	Filter Press	80	10
T-402/403	Carbon Changeout	30	100
P 100	TDU Condensate Pump	35	20
P 101	Influent Dewatering/Stormwater Pump	60	50
P 102	DNAPL/Sludge Pump	65	10
BF 101 102 103 104	Bag Filter	60	20
P 301	Primary Sludge Pump	25	12
P 501	Sludge Transfer Pump	100	70
	INSTRUMENTATION	trace	trace

TOTAL PSIG 150
TOTAL SCFM * (1 25) 372.5

ACFM = SCFM*(14 7/(14 7+150))

31 2 ACFM
Power Requirement 100 HP

EW
9/18/97

[redacted]

IDEX CORPORATION

P-100

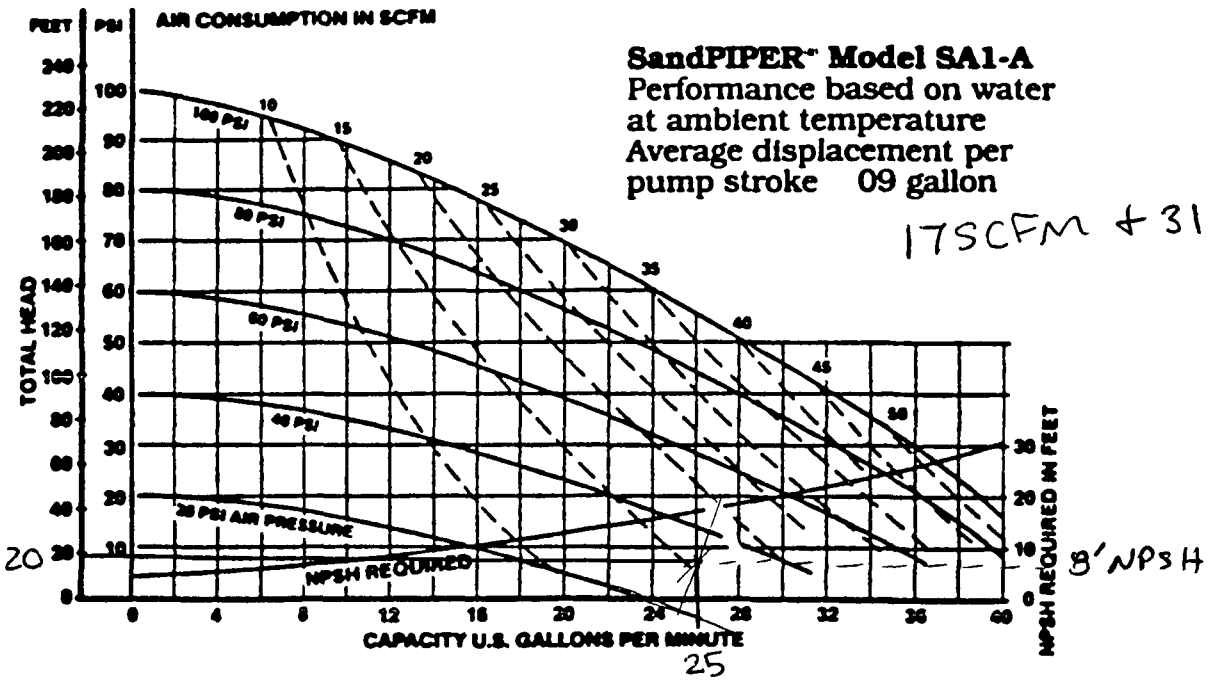
INTAKE/DISCHARGE PIPE SIZE	CAPACITY	SOLIDS-HAI
1" *(25mm)* NPT(F)	0 to 42 gallons per minute *(0 to 159 liters per minute)*	Up to nearly 1

25 GPM @ 20 FT TDH

PERFORMANCE CURVES

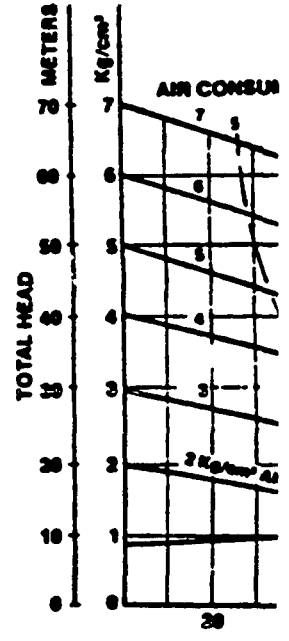
(SandPIPER® pumps are designed to be powered only by compres.

Temperature Limit. 212°F - 100°C MAXIMUM



SandPIPER® Model SA1-A
Performance based on water
at ambient temperature
Average displacement per
pump stroke 09 gallon

17 SCFM + 31 PSI



MATERIALS OF CONSTRUCTIO

IDEX CORPORATION

P-101

INTAKE/DISCHARGE PIPE SIZE	CAPACITY	AIR VALVE	SOLIDS
1½" (38mm) Flanged	0 to 115 gallons per minute *(0 to 435 liters per minute)*	No-lube, non-stall design	1

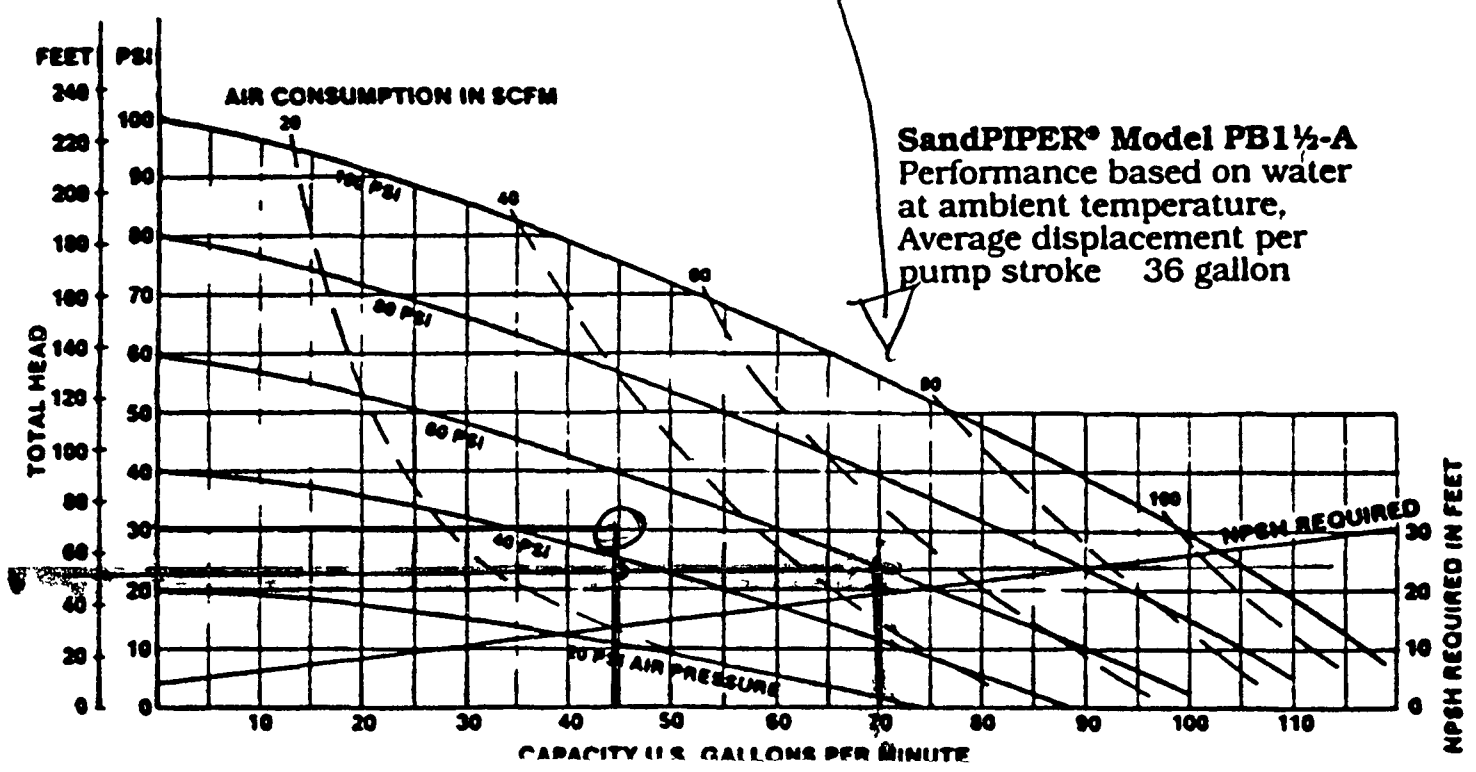
#5 GPM @ 70FT

PERFORMANCE CURVES

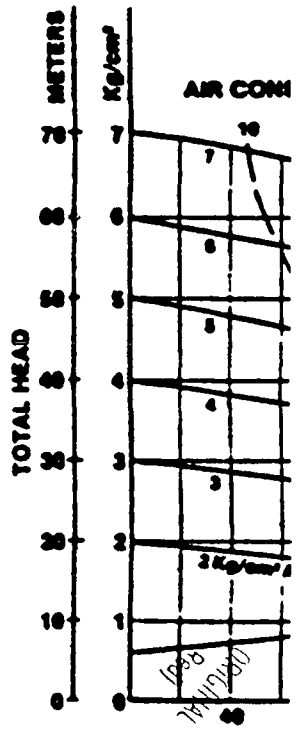
(SandPIPER® pumps are designed to be powered only by compres

Temperature Limit POLY 40°F (5°C) to 150°F (65°C)
PVDF 10°F (-13°C) - 200°F (93°C)

60 psig & 30 scfm



SandPIPER® Model PB1½-A
Performance based on water at ambient temperature,
Average displacement per pump stroke 36 gallon



PT(M) (38m

(0 to 95 liters per minute)

P-102

PERFORMANCE CURVES

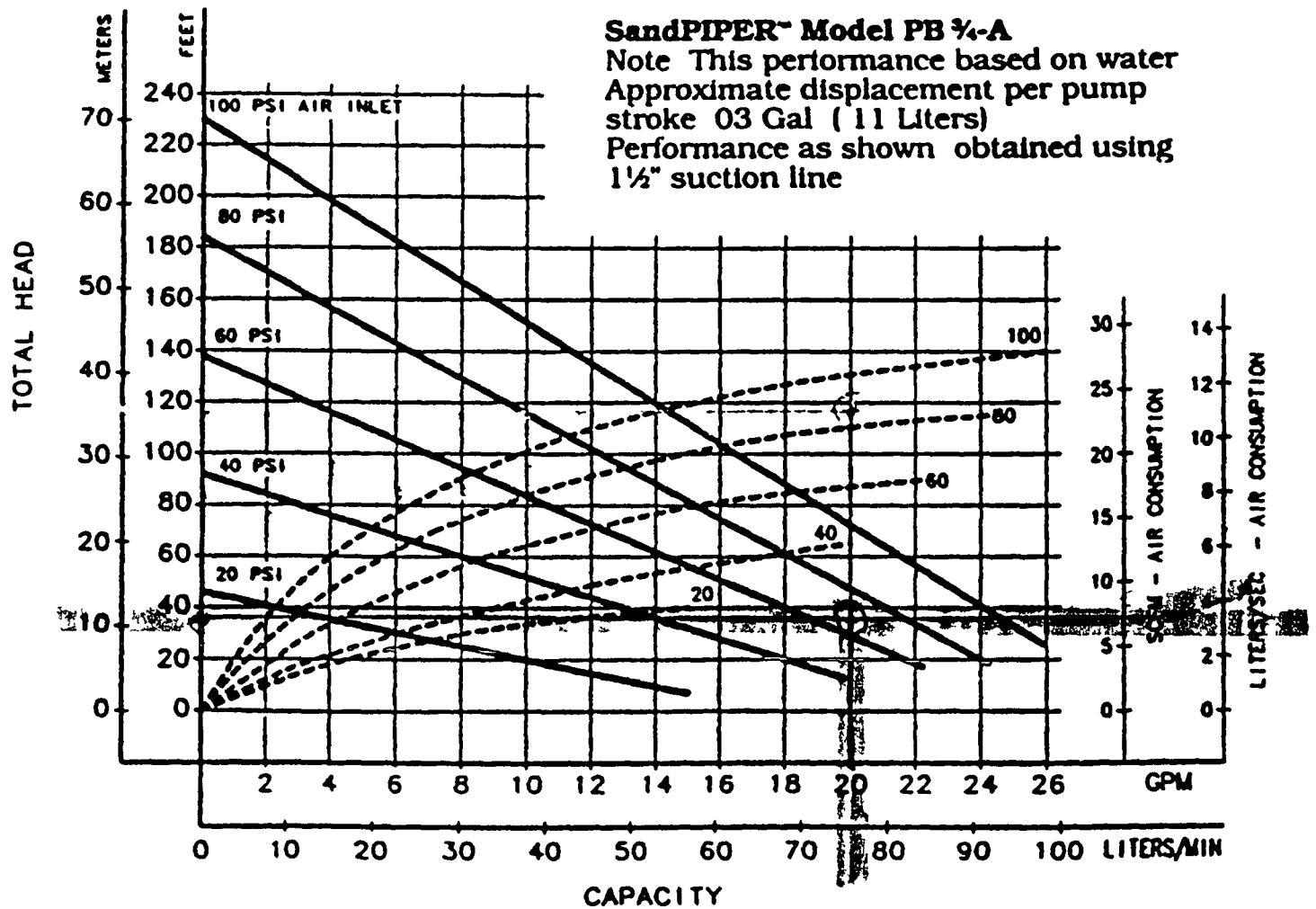
(SandPIPER pumps are designed to be powered only by compressed air)

Temperature Limit. 40°F *(5°C)* to 150°F *(65°C)* Polypropylene

10°F (-13°C) to 200°F *(93°C)* PVDF

20 gpm @ 35 ft

8 SCFM + 65 PSI



MATERIALS OF CONSTRUCTION

INTAKE/DISCHARGE PIPE SIZE	CAPACITY	SOLIDS-HA
1" *(25mm)* NPT(F)	0 to 42 gallons per minute *(0 to 159 liters per minute)*	Up to nearly

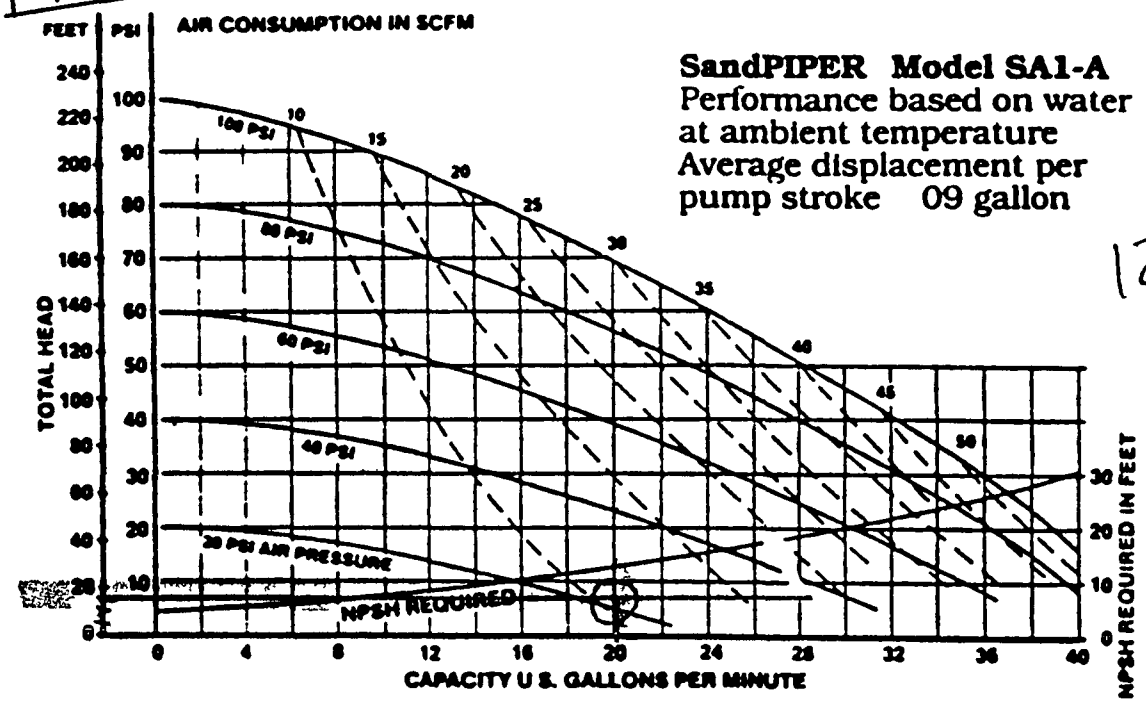
20 gpm @ 15 ft

P-301

PERFORMANCE CURVES

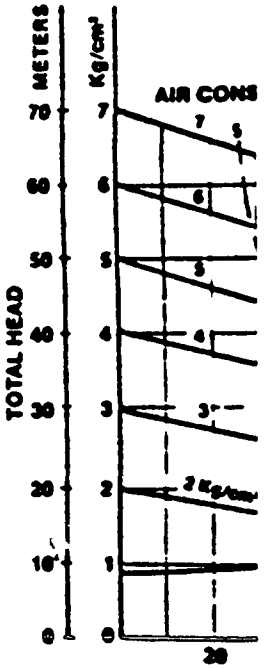
(SandPIPER™ pumps are designed to be powered only by compre

Temperature Limit 212°F - 100°C MAXIMU



SandPIPER Model SA1-A
Performance based on water at ambient temperature
Average displacement per pump stroke 09 gallon

12 scfm
25 psi



MATERIALS OF CONSTRUCTI

SA1-A	Manifold Porting								

INTAKE/DISCHARGE PIPE SIZE	CAPACITY	SOLIDS-HANDLING
2" *(50mm)* NPT(F)	0 to 140 gallons per minute *(0 to 530 liters per minute)*	Up to nearly 2" *(50mm)*

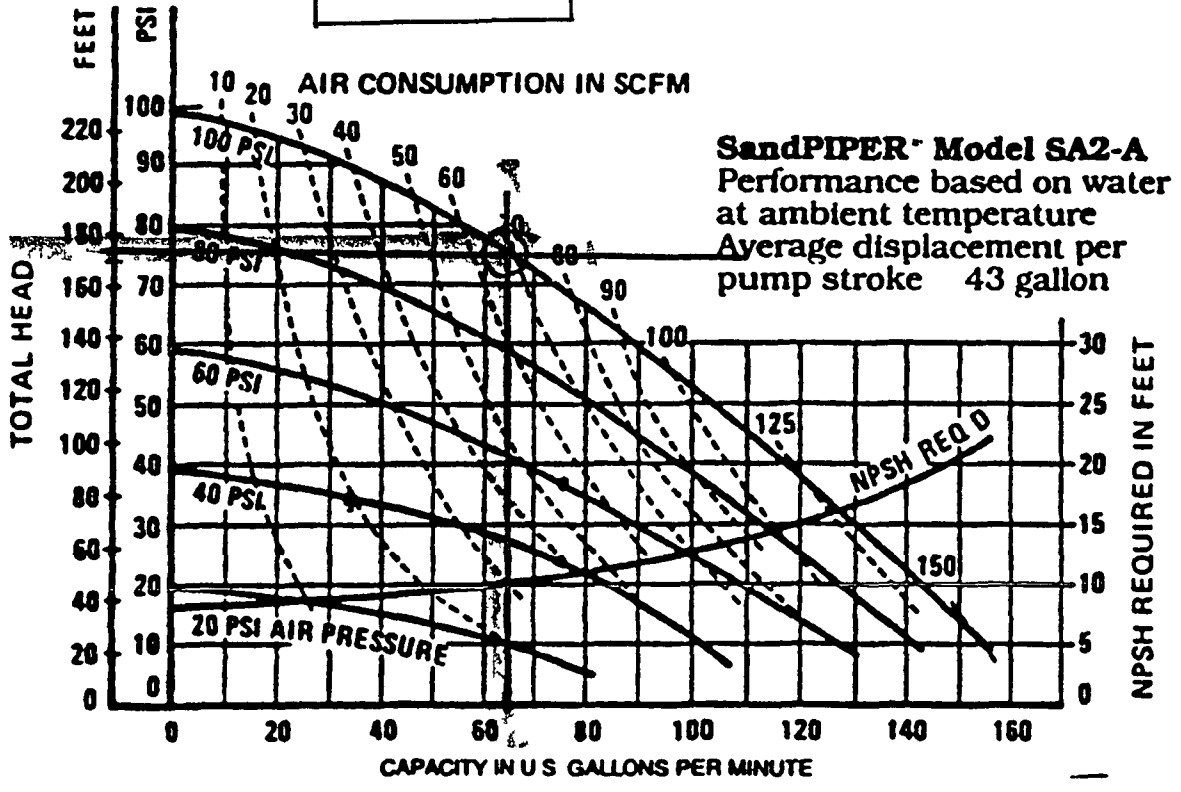
65 gpm
175 ft (up to 100 psi max)

P-501

PERFORMANCE CURVES

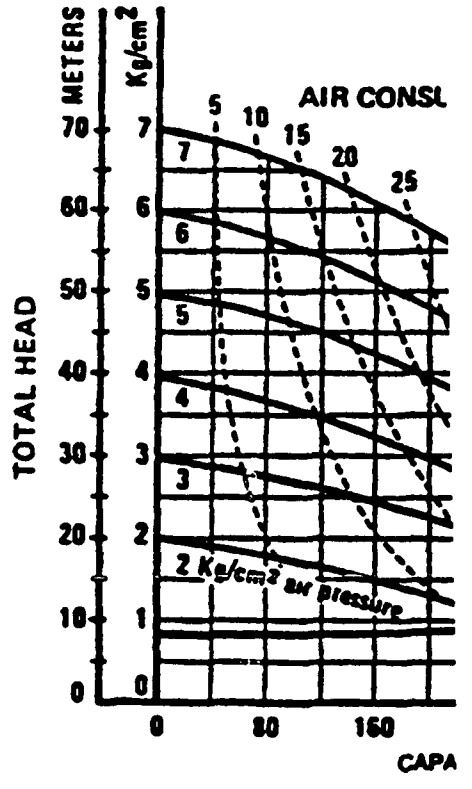
(SandPIPER pumps are designed to be powered only by compressed air)

Temperature Limit 212°F - *100°C* MAXIMUM



SandPIPER® Model SA2-A
Performance based on water at ambient temperature
Average displacement per pump stroke 43 gallon

70 SCFM +
100 PSI



MATERIALS OF CONSTRUCTION

	Manifold									

ORIGINAL

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ Project Name SMWT Project Location Hollywood, MD

Subject AIR REQUIREMENT FOR VENT LINE
Prepared By MEM Date 9/10/97
Checked By ___ Date ___

VENT AIR

~1 SCFM FOR EACH UNIT, 6 units ⇒ 6 SCFM @ 0.070 psig

REQ FOR SANDFILTER - 4 SCFM @ 25 psig [MAX]

PRESSURE DROP THRU 55 gal CARBON LKUP @ 100 SCFM
→ ~ 10" WC (0.3613 psig)

PRESSURE DROP THRU 100' OF 4" PVC VENT PIPING:
⇒ 0 psig

PRESSURE DROP THRU 100' OF 2" PVC VENT PIPING ✓
⇒ 0.070 psig

6 scfm, 0.070 psig + 0.3613 psig = 0.4313 psig
+ 4 scfm @ 25 psig from Sand Filter

F-111B 7/05/94

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ ORIGINAL Red1 Project Name Maryland Wood Project Location Hollywood, MD

Subject NaOH Requirements Prepared By MJ Date 9/17/97
Checked By EW Date 9/19/97

Raise pH of water from pH of 5.0 to pH of 7.5 with NaOH for optimal Fe^{+2} and Mn^{+2} oxidation

Assumptions:

1 Max flow - 75 GPM

2 No buffering effect

$[OH^-]$ required $= 10^{-5} - 10^{-7.5} = 10^{-5} - 3.16 \times 10^{-8}$

$= 9.968 \times 10^{-6} \frac{moles}{L} \left(= \frac{equiv}{L}\right)$

$9.968 \times 10^{-6} \frac{equiv.}{L} \times 40{,}000 \frac{mg}{equiv} = 0.3987 \, mg/L$

@ 75 GPM = Q:

$0.3987 \frac{mg}{L} \times \frac{75 \, gal}{min} \times \left[\frac{2.2 \, lbs}{kg} \times \frac{1 \, kg}{10^6 \, mg} \times \frac{1 \, L}{0.26 \, gal} \times \frac{144}{da} \right.$

$= 0.364 \, lbs/day$

@ 12.69 lbs/gal and 50% solution:

$50\% \, NaOH \, req'd = \frac{0.364 \, lbs}{day} \Big| \frac{1 \, gal}{12.69 \, lbs} = 0.029 \frac{ga}{day}$

$= 0.0012 \frac{gal}{hr}$

F-111B 7/05/94

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ ORIGINAL Project Name So. Maryland Wood Project Location Hollywood, MD

Subject NaOH Requirements Prepared By MT Date 9/17/97
Checked By ___ Date ___

@ 10.65 lbs/gal and 25% NaOH solution

$$25\% \text{ NaOH req'd} = \frac{0.364 \text{ lbs}}{\text{day}} \Big| \frac{1 \text{ gal}}{10.65 \text{ lbs}} = 0.032 \frac{\text{gal}}{\text{day}}$$

$$= 0.0014 \frac{\text{gal}}{\text{hr}}$$

25% NaOH storage capacity.

@ 0.032 gal/day,

25% NaOH req'm't = 0.032 gal/day × 30 days/month

= 0.96 gal/month

5-gal container of 25% NaOH will last

$$\frac{5 \text{ gal}}{1 \text{ gal}} \Big| \frac{1 \text{ month}}{} = 5 \text{ months}$$

TABLE 1

SPECIFIC GRAVITIES AND CONCENTRATIONS OF CAUSTIC SODA SOLUTIONS AT 60 F[2]

% NaOH by wgt	Sp Gr 60°/60 F	Degrees Baume at 60 F (Am Std)	Total Wgt. Soln lbs./gal	Caustic Soda (NaOH)		Each Gal Water @ 60 F	
				gpl	lbs / gal	Requires lbs NaOH	Forms gals soln
0 50	1 006	0 81	8.38	5 03	0 04	0 04	0 999
1 00	1 011	1 60	8 43	10 11	0 08	0 08	0 999
1 50	1 017	2 39	8.48	15 25	0 13	0 13	0 999
2 00	1 022	3 17	8 52	20 45	0 17	0 17	0 998
2 50	1 028	3 93	8 57	25 70	0 21	0 21	0 998
3 00	1 033	4 69	8 62	31 00	0 26	0 26	0 998
3 50	1 039	5 45	8 66	36 37	0 30	0 30	0 997
4 00	1 045	6 19	8 71	41 78	0 35	0 35	0 997
4 50	1 050	6 93	8 76	47 26	0 39	0 39	0 997
5 00	1 056	7 66	8 80	52.79	0 44	0 44	0 997
5 50	1 061	8 39	8 85	58 38	0 49	0 49	0 997
6 00	1 067	9 10	8 90	64 02	0 53	0 53	0 997
6 50	1 073	9 81	8 94	69 72	0 58	0 58	0 997
7 00	1 078	10 51	8 99	75 47	0 63	0 63	0 997
7 50	1 084	11 21	9 04	81 28	0 68	0 68	0 998
8 00	1 089	11 89	9 08	87 15	0 73	0 72	0 998
8 50	1 095	12.57	9 13	93 07	0 78	0 77	0 998
9 00	1 101	13 25	9 18	99 05	0 83	0 82	0 999
9 50	1 106	13 91	9 22	105 08	0 88	0 88	0 999
10 0	1 112	14 57	9 27	111 17	0 93	0 93	0 999
10 5	1 117	15 23	9 32	117 32	0 98	0 98	1 000
11 0	1 123	15 87	9 36	123 52	1 03	1 03	1 001
11 5	1 129	16 51	9 41	129 78	1 08	1 08	1 001
12.0	1 134	17 15	9 46	136 09	1 13	1 14	1 002
12 5	1 140	17 77	9 50	142 46	1 19	1 19	1 003
13 0	1 145	18 40	9 55	148 89	1 24	1 25	1 004
13 5	1 151	19 01	9 60	155 37	1 30	1 30	1 005
14 0	1 156	19 62	9 64	161 91	1 35	1 36	1 005
14 5	1 162	20 22	9 69	168 50	1 40	1 41	1 006
15 0	1 168	20 82	9 73	175 14	1 46	1 47	1 008
15 5	1 173	21 41	9 78	181 84	1 52	1 53	1 009
16 0	1 179	21 99	9 83	188 60	1 57	1 59	1 010
16 5	1 184	22.57	9 87	195 41	1 63	1 65	1 011
17 0	1 190	23 14	9 92	202 28	1 69	1 71	1 013
17 5	1 195	23 71	9 97	209 20	1 74	1 77	1 014
18 0	1 201	24 27	10 01	216 18	1 80	1 83	1 015
18 5	1 207	24 82	10 06	223 21	1 86	1 89	1 017
19 0	1 212	25 37	10 11	230 29	1 92	1 96	1 019
19 5	1 218	25 91	10 15	237 43	1 98	2 02	1 020
20 0	1 223	26 45	10 20	244 62	2 04	2 08	1 022
20 5	1 229	26 98	10 24	251 87	2.10	2 15	1 024
21 0	1 234	27 51	10 29	259 17	2 16	2.22	1 026
21 5	1 240	28 03	10 34	266 52	2 22	2 28	1 028
22.0	1 245	28 55	10 38	273 93	2.28	2.35	1 030
22.5	1 251	29 06	10 43	281 39	2.35	2 42	1 032
23 0	1 256	29 56	10 47	288 90	2 41	2 49	1 034
23 5	1 262	30 06	10 52	296 47	2 47	2 56	1 036
24 0	1 267	30 56	10 56	304 08	2.54	2 63	1 038
24 5	1 272	31 05	10 61	311 75	2 60	2 71	1 041
25.0	1 278	31 53	10 65	319 48	2.66	2 78	1 043
25 5	1 283	32.01	10 70	327 25	2 73	2 85	1 046
26 0	1 289	32 49	10 74	335 08	2.79	2.93	1 049
26 5	1 294	32.96	10 79	342 95	2 86	3 01	1 051

To convert NaOH to equivalent Na_2O multiply by 0 7748

ORIGINAL Fed

TABLE 1 (CONTINUED)

SPECIFIC GRAVITIES AND CONCENTRATIONS OF CAUSTIC SODA SOLUTIONS AT 60 F[2]

% NaOH by wgt	Sp Gr 60°/60 F	Degrees Baume at 60 F (Am Std)	Total Wgt Soln lbs /gal	Caustic Soda (NaOH)		Each Gal Water @ 60 F	
				gpl	lbs / gal	Requires lbs NaOH	Forms gals soln
27 0	1 300	33 42	10.83	350 88	2 93	3 08	1 054
27 5	1.305	33 88	10 88	358 86	2.99	3 16	1 057
28 0	1 310	34.34	10 92	366 89	3 06	3 24	1 060
28 5	1 316	34 79	10 97	374 97	3 13	3.32	1 063
29 0	1 321	35 24	11 01	383 10	3 19	3 41	1 066
29 5	1.326	35 68	11 06	391 28	3 26	3 49	1 069
30 0	1 332	36 12	11 10	399 51	3 33	3 57	1 073
30 5	1.337	36 55	11 15	407 79	3 40	3 66	1 076
31 0	1 342	36 98	11 19	416 11	3 47	3 75	1 080
31 5	1 348	37 40	11 24	424 49	3 54	3 83	1 083
32.0	1 353	37 82	11 28	432 92	3 61	3 92	1 087
32 5	1 358	38 23	11 32	441 39	3 68	4 01	1 091
33 0	1 363	38 64	11 37	449 91	3 75	4 11	1 095
33 5	1 369	39 05	11 41	458 48	3 82	4 20	1 099
34 0	1 374	39 45	11 45	467 09	3 89	4 30	1 103
34 5	1 379	39 85	11 50	475 75	3 97	4 39	1 107
35 0	1 384	40 24	11 54	484 46	4 04	4 49	1 111
35 5	1 389	40 63	11 58	493 21	4 11	4 59	1 116
36 0	1 394	41 02	11 63	502 01	4 19	4 69	1 120
36 5	1 400	41 40	11 67	510 86	4 26	4 79	1 125
37 0	1 405	41 78	11 71	519 75	4 33	4 90	1 130
37 5	1 410	42 15	11 75	528 68	4 41	5 00	1 135
38 0	1 415	42.52	11 80	537 66	4 48	5 11	1 140
38 5	1 420	42 88	11 84	546 68	4 56	5 22	1 145
39 0	1 425	43 25	11 88	555 75	4 63	5 33	1 150
39 5	1 430	43 60	11 92	564 86	4 71	5 44	1 156
40 0	1 435	43 96	11 96	574 01	4 79	5 56	1 161
40 5	1 440	44 31	12 01	583 20	4 86	5 68	1 167
41 0	1 445	44 65	12.05	592 43	4 94	5 79	1 173
41 5	1 450	44 99	12 09	601 71	5 02	5 91	1 179
42 0	1 455	45 33	12 13	611 03	5 09	6 04	1 185
42.5	1 460	45 67	12.17	620 39	5 17	6 16	1 191
43 0	1 465	46 00	12 21	629 78	5 25	6 29	1 198
43 5	1 469	46 33	12 25	639 22	5 33	6 42	1 204
44 0	1 474	46 65	12.29	648 70	5 41	6 55	1 211
44 5	1 479	46 97	12.33	658 21	5 49	6 68	1 218
45 0	1 484	47 29	12.37	667 77	5 57	6 82	1 225
45 5	1 489	47 60	12.41	677 36	5 65	6 96	1 233
46 0	1 493	47 91	12.45	686 98	5 73	7 10	1 240
46 5	1 498	48 22	12.49	696 65	5 81	7 25	1 248
47 0	1 503	48 52	12 53	706 35	5 89	7 39	1 255
47 5	1 508	48 82	12 57	716 09	5 97	7 54	1 263
48 0	1 512	49 11	12.61	725 86	6 05	7 70	1 272
48 5	1 517	49.41	12 65	735 67	6 13	7 85	1 280
49 0	1 521	49 70	12 68	745 51	6 22	8 01	1 289
49 5	1 526	49 98	12 72	755 38	6 30	8 17	1 298
50.0	1 531	50 26	12.76	765 29	6 38	8 34	1 307
50 5	1 535	50 54	12.80	775.23	6 46	8 51	1 316
51 0	1 541	50 82	12.84	785 20	6 55	8 68	1 326
51 5	1 544	51 09	12 87	795 21	6 63	8 85	1 335
52 0	1.549	51.36	12.91	805 24	6 71	9 03	1.345
52 5	1 553	51 63	12 95	815 31	6 80	9 22	1 356
53 0	1 557	51 89	12.98	825 41	6 88	9 40	1 366

To convert NaOH to equivalent Na_2O multiply by 0 7748

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 1 of 4 Project Name SAIWT Project Location Hollywood, MD

Subject $KMnO_4$ FEED RATE — Prepared By MSM — Date 9/9/97
Checked By [illegible] — Date 9/19/97

Design Flow 75 GPM — mol wt KMnO4 = 158 0339
Groundwater Flow 45 GPM

$KMnO_4$ + Metals Oxidation

$$3Fe^{2+} + KMnO_4 + 7H_2O \rightleftharpoons 3Fe(OH)_{3(s)} + MnO_{2(s)} + K^+ + 5H^+$$

3(55 85) 158 04

&

$$3Mn^{2+} + 2KMnO_4 + 2H_2O_{(s)} + 2K^+ + 4H^+$$

3(54 94) 2(158 04)

A	B	C	D	E	F	G	H	I	J
Fe conc mg/L	Mn conc mg/L	Q gal/min	KMnO4 req for Fe (mg/L)	KMnO4 req for Mn (mg/L)	KMnO4 conc Total (mg/L)	KMnO4 req (lb/d)	% KMnO4	Feed Rate gal/d	Feed Rate gal/h
184	13	75	173 56	24 930	198 489	178 8984124	4	536 2662	22 3444
154	13	75	145 26	24 930	170 192	153 3937437	4	459 8134	19 1589
96	0 28	75	90 55	0 537	91 089	82 09890411	4	246 0998	10 2542
[illegible]									
184	13	45	173 56	24 930	198 489	107 3390474	4	321 7597	13 4067
154	13	45	145 26	24 930	170 192	92 03624624	4	275 8880	11 4953
96	0 28	45	90 55	0 537	91 089	49 25934246	4	147 6599	6 1525

Where

[Column D] $KMnO_4$ req for Fe^{2+} $\left(\frac{\text{Mol wt } KMnO_4}{3 \text{ Mol wt } Fe^{2+}}\right)$(Fe conc [Col A]), in mg/L

[Column E] $KMnO_4$ req' for Mn^{2+} $\left(\frac{2 \text{ Mol wt } KMnO_4}{3 \text{ mol wt } Mn^{2+}}\right)$(Mn Conc (Col B]) in mg/L

[Column F] Total $KMnO_4$ req = ($KMnO_4$ req' for Fe^{2+}) + ($KMnO_4$ req' for Mn^{2+}) in mg/L

[Column G] $KMnO_4$ usage = Total $KMnO_4$ req [Col F] x Q [Col C] x conv units *, in lb/day

[Column I] @% Solution indicated [Col H] $KMnO_4$ usage (lb/day) [Col G] [1/% sol] [1 gal / 8 3411] = Feed Rate [gal/day]

[Column J] Feed Rate [gal/h] = Feed Rate [gal/day] [Col I] [1 day / 24 h]

$$* \text{ Conversion units} \equiv \frac{1L}{0\ 26 \text{ gal}} \left| \frac{2\ 2 \text{ lb}}{10^6 \text{ mg}} \right| \frac{1440 \text{ min}}{\text{day}}$$

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19441 Page ___ of ___ Project Name [illegible] Project Location [illegible]

Subject 50% Hydrogen Peroxide Requirements Prepared By MJ Date 9/17/97
Checked By [illegible] Date 9/19/97

50% H_2O_2

Assumptions:

1) H_2O_2 dosage - 600 ppm @ 75 gpm

$$\frac{600\ ppm}{120} = 5\ lbs/1000\ gal$$

$$\frac{5\ lbs}{1000\ gal} \Big| \frac{75\ gal}{min} \Big| \frac{1440\ min}{day} \Big| \frac{30\ days}{month} = 16{,}200\ lbs/m$$

$$\frac{16{,}200\ lbs}{month} \Big| \frac{gal}{10\ lbs\ H_2O_2} = 1620\ gal/month$$

If 960 gal tank is used for storage

$$H_2O_2\ delivery = \frac{1620\ gal}{month} \Big| \frac{}{960\ gal} = 1.7\ times/m$$

$$= 2\ times/m$$

F-111B 7/05/94

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 3 of 4 Project Name SMWT Project Location Hollywood, MD

ORIGINAL

Subject Polymer Feed Rate — Prepared By MEM — Date 9/9/97
Checked By CW — Date 9/19/97

I) @ Q = 75 gpm

1) Assume Feed Conc = 5 mg/L

Polymer requirement = $(5\ mg/L)(75\ \frac{gal}{min})(\frac{1\ L}{0.26\ gal})(\frac{2.2\ lb}{10^6\ mg})(\frac{1440\ min}{day})$

= 4.57 lb/day

Dilution Water Req @ 0.25% Soln

$(4.57\ lb/day)(\frac{1}{0.0025})(\frac{1\ gal}{8.34\ lb\ H_2O})$ @ 5 mg/L

= 219.18 gal/day
= 6575.54 gal/30 day
= 9.13 gal/h

- 55 gal drum will, which holds approx 480 lbs, is used for storage, one drum will last ~ 105 days ⇒ replacement needed ~ every 3½ months @ peak flow. Storing for this length of time will require mixing to avoid stratification (supply top-mounted drum mixer) when dispensing
- Use of 5 gal pail (43.6 lb) for storage would provide ~10 days of polymer at peak flow, and could be mixed more easily.

2) Assume Feed Conc = 2 mg/L

Poly Req'd = $2\frac{mg}{L}\left|\frac{75\ gal}{min}\right|\frac{1\ L}{0.26\ gal}\left|\frac{2.2\ lb}{10^6\ mg}\right|\frac{1440\ min}{day} = 1.83\ \frac{lb}{day}$

Dilution Water Req = $1.83\ \frac{lb}{day}\left|\frac{1}{0.0025}\right|\frac{1\ gal}{8.34\ lb\ H_2O}$ @ 2 mg/L

= 87.7 gal/day
= 2630.2 gal/30 day
= 3.65 gal/h

II @ Q = 45 gpm

1) Feed Conc = 5 mg/L ⇒ Poly Req = 2.74 lb/day + Dilution Water Req'd = 131 gal/day ; 3944 gal/30 day ; 5.5 gal/h

2) Feed Conc = 2 mg/L ⇒ Poly Req = 1.10 lb/day + Dilution Water Req'd = 52.6 gal/day = 1577 gal/30 day = 2.19 gal/h

ORIGINAL Red

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ Project Name SMWT Project Location Hollywood, MD

Subject Sludge Production Prepared By NEM Date 9/9/97
Checked By EW Date 9/10/97

Design Flow 75 GPM
Groundwater Flow 45 GPM

mol wt KMnO4 = 158 0339
mol wt Fe(OH)3 = 106 847
mol wt MnO2 = 86 74
mol wt Fe2+ = 55 85
mol wt Mn2+ = 54 94

Sludge Production Stoichiometry

$$3Fe^{2+} + KMnO_4 + 7H_2O \rightleftharpoons 3Fe(OH)_{3(s)} + MnO_{2(s)} + K^+ + 5H^+$$

+

$$3Mn^{2+} + 2KMnO_4 + 2H_2O \rightleftharpoons 5MnO_{2(s)} + 2K^+ + 4H^+$$

A	B	C	D	E	F
Fe conc mg/L	Mn conc mg/L	Q gal/min	Sludge lb/day	Vol @ 1% gal/day	Vol @ 2% gal/day
184	13	75	347 88	4171 168	2085 584
154	13	75	296 18	3551 321	1775 661
96	0 28	75	166 09	1991 466	995 733
184	13	45	208 73	2502 701	1251 350
154	13	45	177 71	2130 793	1065 396
96	0 28	45	99 65	1194 880	597 440

Where

[Column D] $\text{Sludge (lb/day)} = \left[\frac{(3 \text{ mol wt } Fe(OH)_3)}{(3 \text{ mol wt } Fe^{2+})}\right][\text{col A}] + \frac{(5 \text{ mol wt } MnO_2)}{(3 \text{ mol wt } Mn^{2+})}[\text{col B}] / (\text{col C})(1440 \frac{\text{min}}{\text{day}})(8.34 \frac{\text{lb}}{\text{gal}})(\frac{1 \text{ L}}{10^6 \text{ mg}})$

[Column E]
[Column F] $\text{Sludge Vol (gal/day)} = [\text{col D}] \cdot \left(\frac{1}{\%\text{ Solids } (0.01 \text{ or } 0.02)}\right)\left(\frac{1 \text{ gal } H_2O}{8.34 \text{ lb}}\right)$ or 8.51

Assume 96 ppm Fe and 1½ % solids in sludge =
1493 gallons/day sludge
3000 gallon holding tank = 2 days storage
increase to 6000 gallons holding = 4 days storage

(EW) 9/18/97

106

9/18 Backwash Filter

Basis Rosedale 4 stage unit, $3K

Total Effective Filter Area = 13.2 ft² (3 x 4.4 ft²/unit)

9 gallons discharged / backwash (ie 1 housing vol)

1. Backwash Rate

Say each filter is backwashed on 10 min cycle, and each unit is backwashed separately

∴ Backwash rate = $\frac{9 \text{ gallons}}{2.5 \text{ min}}$ = 3.6 gpm

say 4 gpm

2 Filter capacity. Assume 1/4" coating over filter area

∴ 3 operating continuously ≡ 3 x 4.4 x $\frac{1/4}{12}$

= 0.275 ft³/3 unit

∴ Capacity for removal in 25 GPM TDU stream is 0.275 ft³ x 100 #/ft³ x 0.3 solids

8.25 #

∴ 8.25 # removed in 10 min cycle

or

concentration = $\frac{8.25/10}{25 \times 8.33}$ x 100 = 0.4 %

(EW) 9/18/95 ORIGINAL
2 of

3 Sludge Holding

- Need 2D hold up
- Already have 1500 g/D metals sludge (96 ppm Fe basis)

At 4 gpm w/o 4% solids, over 2D

$\equiv 4 \times 1440 \times 2 = \underline{\underline{11520}}$ gall w/o 4%

Total liquid in 2D

	gall	% solids
Metals sludge	3000	1.5
Backwash	11500	0.4
	14,500	

Assume concentrate mix is 1.5%

∴ Tank min capacity.

$= 3000 + 11500 \times \frac{0.4}{1.5}$

3072

$= \underline{\underline{6000}}$ gall (min)

Go w/ 7500 gall tank

ORIGINAL

OHM Remediation Services Corp

COMPUTATION SHEET

Form No 0048
Midwest Tech Servs
Rev 08/89

Proj No	Client	Location	Subject

Preparer's Initials	Date	Reviewer's Initials	Date	Approver's Initials	Date
EW				EW	9/19/97

4. Filter Press Loading

gal	% solids	#s (in 2 days)
3,000	15	375 #
11,500	04	385 #

Total pounds 760 # solids

In 30% cake = 2500 # cake

@ 100 #/ft = 25.33 ft³

Assume 2-3 cycles every 2 days.

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page ___ of ___ Project Name SMWP Project Location Hollywood, MS

Subject PRODUCT TANK BERM CALCULATIONS (T-102) Prepared By MEM Date 9/10/97
Checked By _____ Date _____

TANK DIMENSIONS: D X L
54" X 12'

If 4' of space on each side, berm will have dimensions of: L X W
14' X 20

Berm is to contain 110% of total volume

2000 gal (110%) = 2,200 gal = 294 1 ft³

L X W X H = 294 1 ft³

14' X 20' X H = 294 1

$\boxed{H = 1'}$

F-111B 7/05/94

OHM Remediation Services Corp

COMPUTATION SHEET

Form No 0048
Midwest Tech Servs
Rev 08/89

Page ___ of ___

Proj No	Client	Location	Subject
10991	Maryland Wood	Hollywood, MD	Heaters and A/C

Preparer's Initials	Date	Reviewer's Initials	Date	Approver's Initials	Date
MRJ	8/8/97			EW	9/19/97

Control Room A/C (wall unit)

Size of room - 10' x 10' x 8' high

A/C requirement = 40 BTU's/hr

$10\,ft \times 10\,ft \times \frac{40\,BTU}{0.8\,(eff)}/ft^2 = 5{,}000\,BTUs$

5,200 BTU/hr A/C (White-Westinghouse, Grainger Catalog 388, page 3545) requires 6.2 amps at 115 V/1 phase.

Plant Heaters

Size of plant (80 ft x 40 ft) - 100 ft² (control room)

= 3,100 ft²

Use electric unit heaters (480 V/3 phase, Using 40 BTUs/ft² (for pre-engineered bldg and efficiency factor of 1.0 for electric heaters (0.8 for gas heaters), temp range 0°F to 55-60°F in winter time

Total heat demand = 40 BTU/hr x 3,100 ft²

= 124,000 BTU/hr

ORIGINAL

OHM Remediation Services Corp

COMPUTATION SHEET

Form No 0048
Midwest Tech Servs
Rev 08/89

Proj No	Client	Location	Subject
19991	Maryland Wood	Hollywood, MD	Heaters & A/C

Preparer's Initials	Date	Reviewer's Initials	Date	Approver's Initials	Date
CMG	9/8/97			EW	9/19/97

From Grainger Catalog No 388, page 3484
Q Mark heater rated for 34,130 BTU/hr (10 kW)
@ 480 V/3 phase will draw 12 amps/phase

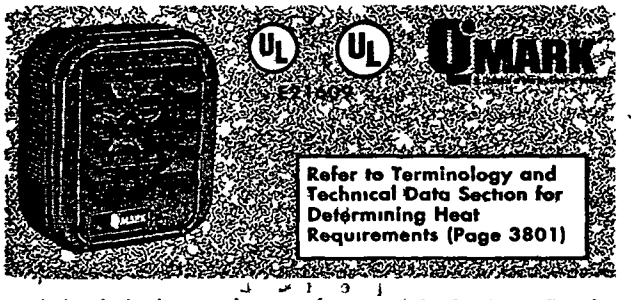
$$\text{No. units reqd} = \frac{124{,}000 \text{ BTU/hr}}{34{,}130 \text{ BTU/hr}} \approx 4 \text{ units}$$

$$\frac{124{,}000 \text{ BTU/hr} \times 1737 \text{ Watts}}{60 \text{ min/hr} \times \text{BTU/min}} = 35{,}898 \text{ Watts}$$

$$\cong 40 \text{ kW}$$

$$\frac{40 \text{ kW}}{10 \text{ kW/unit}} = 4 \text{ unit heaters}$$

ELECTRIC UNIT HEATERS AND ACCESSORIES



Refer to Terminology and Technical Data Section for Determining Heat Requirements (Page 3801)

Steel sheathed tube type heat ng elements with aluminum fins for faster heat dissipation Widely spaced to resist dirt clogging 24V contactors on all models except 3 and 5 KW 208 and 240V units which have contactors with line voltage holding coils Select proper duty controls on facing page

Pull through design draws air across heating element for more uni form air distribution

D e formed steel housing two-tone neutral gray/statuary bronze fin ish

Automatic reset l near thermal cut-out shuts off power to element if overheating occurs Fan delay feature eliminates cold drafts ele ments heat up before fan cuts in fan continues to distribute heat after elements shut off

Quiet dynam cally balanced fans totally enclosed permanently lubricated fan motors with automatic reset thermal protection, and vibration isolators Motors are same voltage as heaters

Individually adjustable louvers for directing air flow choice of optional diffusers for heat concentration and coverage when units are used in vertical position see listing on facing page

Versatile units can be mounted vertically or horizontally in factories warehouses garages stores, shipping rooms power sta tions and aircraft hangars (as primary, supplementary spot or dual-system heating Completely self-contained easy to install

Rugged construction for long life, minimum maintenance

Mou t on wall ceil ng or bu ldng support members All units have recessed fasteners for suspension mounting using 5/16-18 thread ed rods (not supplied)—Optional wall/ceiling brackets simplify mounting see listing on facing page

Meets UL and Canad an UL, NEC and OSHA requirements QMark brand

Heater controlled by thermostat *sold separately on page 3483*

UNIT HEATER SPECIFICATIONS AND ORDERING DATA

Volts 60 Hz	Phase*	Amps Pe Ph.	Fa CFM	Horiz. Ai Throw	Vert. Mtg. Ht.†	Vert. Floor Coverage†	Temp Rise °F	D mensions (in.) H	W	D	QMark Mod l	Stock No.	List	Each	Shpg. Wt.
3KW 10,239 BtuH MODELS															
208	1	14 5	350	12 ft.	9 ft.	18 ft.	27	16	14	7 /	MUH-03-81	**4E297**	$463 00	**$262 75**	25 0
208 / 240	1	11.0 / 12.5	350	12	9	18	27	16	14	7 /	MUH-03-21	**4E298**	463 00	**262.75**	25 0
480	3	3 6	350	12	9	18	27	16	14	7 /	MUH-03-41	**4E299**	412.00	**360 25**	25 0
5KW 17,065 BtuH MODELS															
208	1-3	24-14	350	12	9	18	45	16	14	7½	MUH-05-81MG	**2E580**	$472.00	**$307 00**	25 0
208 / 240‡	1-3	21 12	350	12	9	18	45	16	14	7½	MUH-05-21MG	**2E581**	472.00	**307.00**	25 0
480	3	6	350	12	9	18	45	16	14	7 /	MUH-05-41	**2E582**	564.00	**391 75**	29 0
7.5KW 23,891 BtuH MODELS															
208	1-3	36-21	650	18	14	26	37	21 /	19	7½	MUH-07-8	**2E583**	$732.00	**$423.00**	40 0
208 / 240‡	1-3	31 18	650	18	14	26	37	21 /	19	7½	MUH-07-2	**2E584**	732.00	**423.00**	40 0
480	3	9	650	18	14	26	37	21¾	19	7 /	MUH-07-4	**2E585**	835 00	**489.25**	40 0
10KW 34,130 BtuH MODELS															
208	1-3	48-28	650	18	14	26	49	21 /	19	7½	MUH 10-8	**2E586**	$789.00	**$454.50**	40 0
208 / 240‡	1-3	42-24	650	18	14	26	49	21¾	19	7½	MUH 10-2	**2E587**	789.00	**454.50**	40 0
480	3	12	650	18	14	26	49	21¾	19	7½	MUH 10-4	**2E588**	884.00	**507 00**	40 0
15KW 51,195 BtuH MODELS															
208	1-3	72-42	910	35	20	35	52	21¾	19	12¾	MUH 15-8	**3E307**	$1324.00	**$749.50**	55 0
208 / 240‡	3	36	910	35	20	35	52	21¾	19	12¾	MUH 15-2	**3E308**	1324.00	**749 50**	55 0
480	3	18	910	35	20	35	52	21¾	19	12¾	MUH 15-4	**3E309**	1427 00	**820 00**	52.0

(*) Dual-rated models are field convertible. (†) Dia f area covered, without optional diffuser (see below). (‡) Operation on 208V will result in 25% lower BtuH.

QMARK UNIT HEATER ACCESSORY SELECTION GUIDE

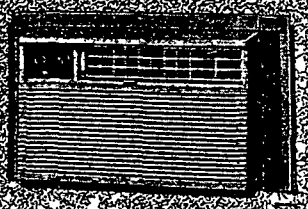
Stock No.	QMark Model	Contactor Coil Voltage	Thermostat: Built In	Thermostat: Wall Mount	Thermostat: Heat Recovery	Mounting Bracket	Diffuser: Louver	Diffuser: Radial
4E297	MUH03-81	—	2E569	2E347	3UG63	6X966	2E589	2E591
4E298	MUH03-21	—	2E569	2E347	3UG63	6X966	2E589	2E591
4E299	MUH03-41	24	2E569	2E347	3UG63	6X966	2E589	2E591
2E580	MUH05-81MG	208	2E569	2E347	3UG63	6X966	2E589	2E591
2E581	MUH05-21MG	208-240	2E569	2E347	3UG63	6X966	2E589	2E591
2E582	MUH05-41	24	2E569	2E096	3UG63	6X966	2E589	2E591
2E583	MUH07-8	24	2E569	2E096	3UG63	6X966	2E590	2E592
2E584	MUH07-2	24	2E569	2E096	3UG63	6X966	2E590	2E592
2E585	MUH07-4	24	2E569	2E096	3UG63	6X966	2E590	2E592
2E586	MUH10-8	24	2E569	2E096	3UG63	6X966	2E590	2E592
2E587	MUH10-2	24	2E569	2E096	3UG63	6X966	2E590	2E592
2E588	MUH10-4	24	2E569	2E096	3UG63	6X966	2E590	2E592
3E307	MUH15-8	24	2E569	2E096	3UG63	6X967	2E590	2E592
3E308	MUH15-2	24	2E569	2E096	3UG63	6X967	2E590	2E592
3E309	MUH15-4	24	2E569	2E096	3UG63	6X967	2E590	2E592

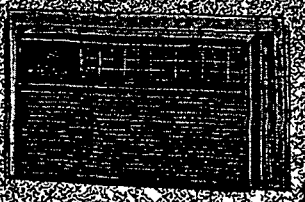
FOR REPLACEMENT PARTS—SEE PAGE A2 IN FRONT OF CATALOG

Replacement Parts Available 1-800-323-0620

ROOM AIR CONDITIONERS

White-Westinghouse





All compact models fit windows up to 38" wide.

Intermediate models fit windows from 30-40" wide with 17½" min. opening height.

ROOM A/C SIZE SELECTION GUIDE

Find the amount of space you want to cool by calculating square footage of rooms (length x width) If room is to be occupied by more than 2 people add 600 BtuH per person Add multiple rooms together to determine total BtuH needed The total BtuH of two small units will provide better cold air circulation than one large unit

Square Footage	BtuH Required	Square Footage	BtuH Required
100	5 000	600	12,000
200	6,000	1100	18,000
300	8,000	1300	21 000
400	9 000	1500	23 000
500	10 000	2000	29 000

WHITE-WESTINGHOUSE LIMITED WARRANTY

Warranty handled on site for 1 year, 5-year warranty on sealed system, 1 year on all other parts. NOTE: Certain commercial installations may void manufacturers' warranty. Text of warranty available on request. See "Manufacturers' Warranties" on page opposite inside back cover.

Plug Types

[A] COMPACT

Ideal for smaller rooms Easy to install operate and service

- Easy to install mounting kit
- Rigid slide-out filter
- 13 / minimum window opening height required
- Whisper Cool design for optimum quiet and comfort
- Pleated quick mount kit

[B] CUSTOM COMPACT

Ideal for smaller rooms Easy to install operate and service

- Woodgrain front
- Adjustable louvers
- Pleated quick mount kit included
- 13 ½ minimum window opening height required
- Power thrust/exhaust

[C] CUSTOM INTERMEDIATE

Higher cooling capacity added to the attractive styling comfort and convenience of the Custom Compact series

- Snap off woodgrain front panels
- Removable filter
- Modular slide out chassis
- Pleated quick mount kit included
- Power thrust/exhaust

AIR CONDITIONER SPECIFICATIONS

Stock No	Watts	Side Louvers	Dehum. Pts./H	Slide-Out Chassis	Exhaust	No. of Air Directions	Max. Wall Thick (in.)	Cool/Fan Speeds	High CFM	Uses Receptacle Stock No.
4E986	635	Yes	1 1	No	Yes	4	5½	3/3	175	5A078
4E987	575	Yes	1 0	No	Yes	4	5½	3/3	175	5A078
4E988	650	Yes	1 6	No	Yes	4	5½	3/3	175	5A078
4E989	845	Yes	2.0	No	Yes	4	5½	3/3	250	5A078
3H411	1060	Yes	3 0	Yes	Yes	4	7	3/3	260	5A078
3H360	1385	Yes	3 5	Yes	Yes	2	7	3/3	310	5A078

AIR CONDITIONER ORDERING DATA

Key	BtuH	Volts	Amps	EER	Plug Type	Dimensions (in.) H	W	D	White-Westinghouse Model	Stock No.	List	Each	Shpg. Wt.
A	5200	115	6.2	8.2	I	12¼	19⅛	15¼	WAC053T7A	**4E986**	$386 00	**$279 25▲**	61 0
B	5300	115	5 4	9.2	I	12 /	19⅛	15¼	WAC056T7A	**4E987**	450 00	**307.50▲**	68.0
	6200	115	6.0	9.5	I	12 /	19¼	15¼	WAC067W7A	**4E988**	545 00	**356 50▲**	71 0
	8000	115	7.5	9 5	I	12 ¼	19 ⅛	15¼	WAC086T7A	**4E989**	615 00	**421 25▲**	74.0
C	10 600	115	9.2	10 0	I	14¾	24	22	WAL117P1A	**3H411**	752 00	**526.50▲**	109 0
	12,000	115	11 7	9.5	I	14⅜	24	22	WAL125P1A	**3H360**	836.00	**560 00▲**	112.0

(✓) Denotes energy efficient product. (▲) Net prices, not subject to discounts.

ORIGINAL

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 1 of 9 Project Name Southern Maryland Wood Project Location Hollywood, Maryland

Subject Berm Height for NaOH Tank

Prepared By SH Date 9/19/97

Checked By GW Date 9/19/97

NaOH Tank will contain 960 gallons

125% of 960 gallons = 1,200 gallons = 160.4 ft^3

Berm Dimensions

$$(8'-4')\times(8'-4')H = 160.4\ ft^3$$

$$H = 2.31' = \underline{2'-4''}$$

F-111B 7/05/94

ORIGINAL Red

OHM Remediation Services Corp	COMPUTATION SHEET	Project Number 19991 Page 1 of 1 Project Name Southern Maryland Wood Project Location Hollywood, Maryland

Subject Berm Height for H_2O_2 Tank

Prepared By SH Date 9/19/97

Checked By [illegible] Date 9/19/97

H_2O_2 Tank will contain 960 gallons

125% of 960 gallons = 1,200 gallons = 160.4 ft^3

Berm Dimensions

$$8' \times 9' \times H = 160\ ft^3$$

$$\boxed{H = 2'-3''}$$

F-111B 7/05/94

ORIGINAL
Red

FIELD INSTRUMENT LIST AND CUT SHEETS

ORIGINAL Red

SOUTHERN MARYLAND WOOD TREATMENT SITE
HOLLYWOOD, MARYLAND

FIELD INSTRUMENT LIST

1 QTY 2 - FLOW SWITCH, TAG # FS-201, FS-301
IN LINE, VANE ACTUATED, NEMA 4 HOUSING, 1-1/2" NPT,
BRASS BODY, 5A @ 120 VAC
W E ANDERSON # V4-2-U

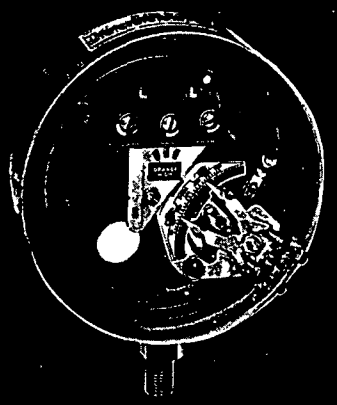
2 QTY. 2 - FLOAT SWITCH, TAG # LSHH-101, LSH-102
TOP MOUNT, NEMA 4 HOUSING, 1-1/2 NPT BRASS BODY,
5A @ 120 VAC
W E ANDERSON L4-TOP

3 QTY 1 - CONTINUOUS LEVEL TRANSMITTER, TAG # LIC-201
HYDROSTATIC HEAD MEASURING, 316SS DIAPHRAGM, 4/20MA
OUTPUT, NEMA 4 ENCLOSURE, 1/4" NPT C S CONNECTION
RANGE 0-12 FT WATER
ROSEMOUNT # 1151DP4EMB

4 QTY. 2 - PH SENSOR & ANALYZER, TAG # AE/AIT-201 AND
AE/AIT-401 RETRACTABLE PH SENSOR 0-14 PH, 1-1/2 NPT
CONNECTION (INCL BALL VALVE 316SS)
ROSEMOUNT #385-02-06-11-54
ANALYZER MICROPROCESSOR BASED, NEMA 4X HOUSING,
110 VAC WALL OR PIPE BRACKET
ROSEMOUNT # 5404 AND 23545-00

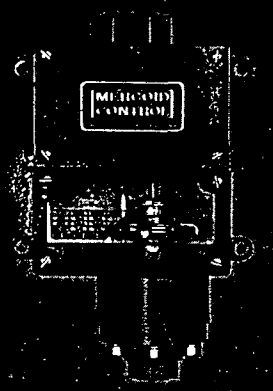
5 QTY 3 - MULTI STAGE FLOAT LEVEL SWITCH, TAG # LCS-302,
LCS-501, LCS-401 FLOAT ACTUATED, 316SS SHAFT, 316SS
FLOATS, NEMA 4 HOUSING, 2 NPT PROCESS CONNECTION
SIGMA # 1503S (3 STAGE LCS-302, LCS-401)
SIGMA # 1502S (2 STAGE LCS-501)

6 QTY 3 - SOLENOID VALVE, TAG # SV-101, SV-102, SV-301
BRONZE BODY, 1/2" NPT N/C, 110 VAC COIL
GOYEN # 12-BW2



Mercoid®

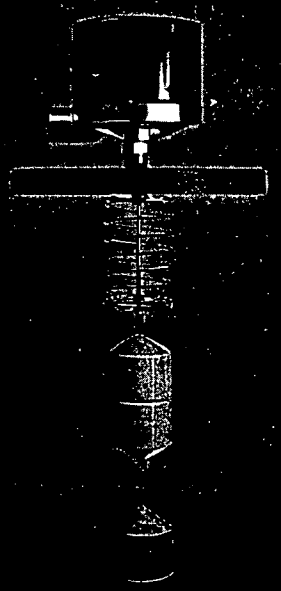
PRESSURE, TEMPERATURE and LIQUID LEVEL CONTROLS



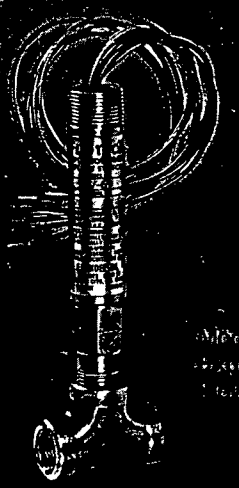
Series 1000 Pressure Switch

FLOW and LEVEL SWITCHES

TECHNICAL INFORMATION SELECTION CHARTS

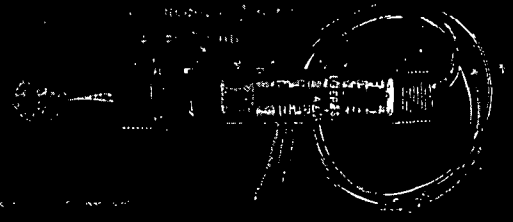


Series B190 Level Control



Model V8 Explosion Proof Flow Switch

Model V42L Flotel Explosion Proof Flow Switch



MERCOID DIVISION DWYER INSTRUMENTS, INC. Michigan City Indiana 46360
W. E. ANDERSON DIVISION DWYER INSTRUMENTS, INC. Michigan City Indiana 46360

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DWYER INSTRUMENTS INC

Mercoid Division produces a broad range of pressure tem perature and liquid level controls for use in heavy indus trial petrochemical and electric utility plants Mercoid products are in constant daily use throughout the world

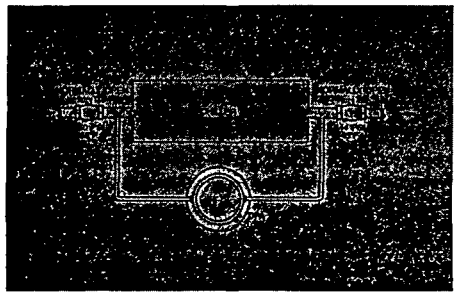
Established in 1916 Mercoid has been serving industry for over 69 years Our recent combination with Dwyer Instru ments Inc who celebrated their 50th anniversary in 1981 has produced an even stronger and more resourceful com pany to serve your instrumentation and control needs

W E Anderson division established 1945 has been a part of Dwyer Instruments since 1978 Anderson products in clude the Flotect Explosion Proof Flow Switches and Explosion Proof Level Switches appearing in this bulletin

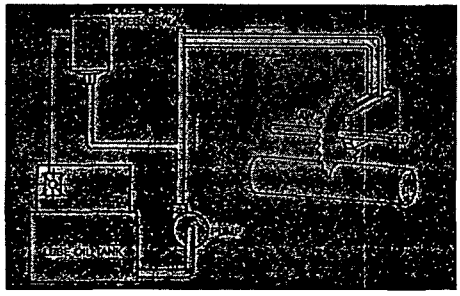
W E Anderson products are stocked in our Michigan City headquarters as well as at several Dwyer Instruments field warehouses listed below

Please contact the sales office nearest you for any service sales or engineering help you may require

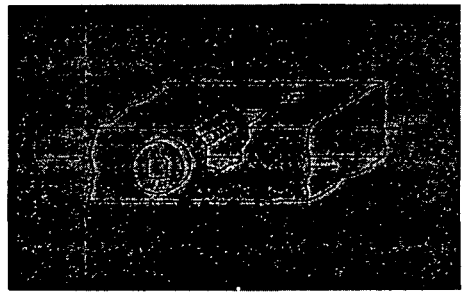
How to use Mercoid Pressure, Temperature and Liquid Level Switches



Type DPA differential pressure switch pro tects water chiller If ice builds up inside water chiller or if tubes become restricted differential pressure across chiller increases Differential pressure switch type DPA senses the increase and actuates an alarm DPA uses brass bellows suitable for water service Switch is typically set between 10 and 20 psid

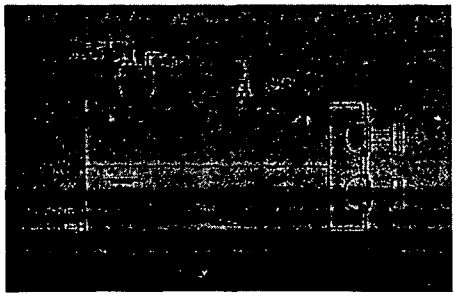


Pressure switch model CS 150 senses loss of lubricating oil to saw blade in saw mill and actuates an alarm Since only a small amount of oil is used the sawdust can be recovered and used as a fuel The pressure switch (CS 150) sounds an alarm if the oil pressure is lost pre venting severe damage to the saw blade

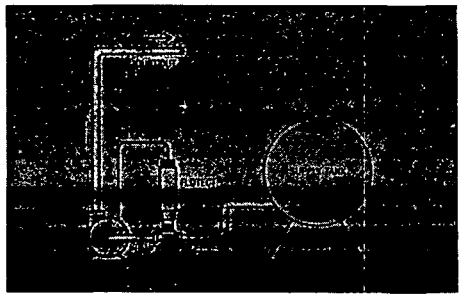


Mercoid M 51R duct temperature switch pro vides high temperature cut-off on textile dry ing unit Hot air from dryer flows past model M 51 If temperature reaches set point bi metal element rotates actuating switch to shut down dryer Unit will not re start until M 51 manual reset is actuated M 51 is mounted in a special well to prevent fouling by textile particles

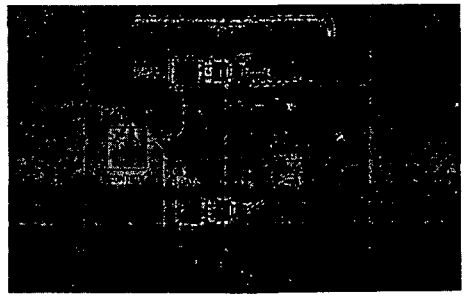
How to use Anderson Flow and Float Switches



Mercoid model 123 level controls provide high and low alarm on large de-aerator tank Liquid level in external piping equals level in tank When level rises to high limit float in upper model 123 is lifted actuating switch to sound high level alarm When level drops to low limit lower model 123 sounds low level alarm



W E Anderson Flotect switch stops pump when flow stops When the liquid in this supply tank is exhausted the W E Anderson V 6 Flotect switch senses the loss of flow and stops the pump motor preventing pump cavitation and saving energy



Reliable float switches monitor and control liquid level In this holding tank application the lower L 4 indicates to the operator that a tank fill cycle is required the L 4 can also control the necessary valve or pump to provide an automatic fill cycle When the level of the liquid reaches the upper L-4 the switch activates another indicator lamp or terminates the automatic fill cycle

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ORIGINAL Rev

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Introduction to Pressure and Temperature Switches

What are they?

A pressure switch is a device which utilizes air gas or liquid pressure to actuate an electric switch at a pre-set actuation point A temperature switch is a device which utilizes air gas or liquid temperature to actuate an electric switch at a pre set actuation point The electric switches may be used to start or stop motors or fans open or close dampers or louvers light a warning signal sound alarms etc

How do pressure switches work?

When a change in pressure occurs the sensing element moves transmitting force to a switch Sensing elements used by Mercoid include bourdon tubes bellows and di aphragms Switches may be mercury type (either tilting or magnetic) and snap action type The switch may be de signed to actuate on either increasing or decreasing pressure

Bourdon tube or bellows motion is resisted by the switch "movement" which transmits tube motion to the electric switch only when tube position corresponds to a pre set actuation point Actuation points are adjusted by moving pointers linked to the movement

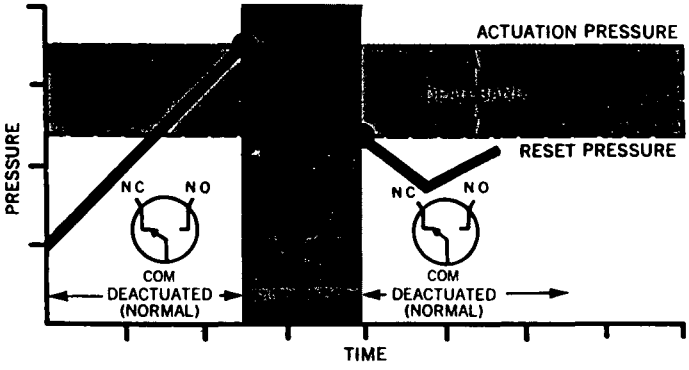
Diaphragm motion is resisted by a calibrated spring This spring determines the range of pressure within which the diaphragm motion will actuate the electric switch The actuation point is set by adjusting the compression or ten sion of the spring

How do Temperature Switches work?

Temperature switches can be divided into two general groups Filled Systems and Bi Metals The filled system switches use a bulb filled with liquid or gas and connected by capillary tubing to a pressure switch Changes in bulb temperature cause the liquid or gas inside the bulb to expand or contract The resulting change in internal pres sure is sensed by the pressure switch Bi metal systems use bi metal sensors to directly actuate an electric switch

What is the Dead Band?

When a change in pressure or temperature occurs causing the sensing element to move and actuate the switch some of that pressure or temperature must be removed before the switch will reset for another cycle



Pressure plot illustrating dead band

The dead band is the pressure or temperature that must be removed before the switch resets for another cycle *after* the set point has been reached and the switch actuated

A dead band is inherent in a snap switch It results from two things The spring rate of the range spring at the chosen set point and the de actuation travel of the switch lever Thus the dead band is different at each set point When the set point is at the lowest end of the pressure switch range (or filled system temperature switch range) the dead band is minimum Conversely when the set point is at the highest end of the pressure or temperature switch range dead band is maximum

For example A pressure switch is set to actuate when an increasing pressure reaches 100 PSI When the pressure in the system being monitored builds up to 100 PSI the switch actuates and causes a corrective action to occur The pres sure then begins to drop The switch remains actuated however until the pressure drops to approximately 95 PSI This difference of 5 PSI is the dead band It is the overlap or pressure difference between the set point at which the switch actuates when pressure increases and the point at which the switch resets when pressure drops

In many applications it is desirable to be able to adjust the dead band to a value considerably greater than the mini mum Some pressure and temperature switches (such as Mercoid s model DA) allow this adjustment

Considerations in Selecting a Pressure Switch

Sensing element – Bourdon tube elements generally offer great sensitivity but lower rated pressures than di aphragms Diaphragms are usually less expensive but may develop leaks – especially at high temperatures Steel bour don tubes can be welded directly to the pressure connection reducing chances for leaks even in the event of fire Material of sensing element and other wetted parts must be compati ble with the media to be controlled

Electric Switch – Electric switch must have ample capacity to handle electric current to be switched Extra capacity should be available if load is inductive Hermetically sealed mercury switches are preferable when the environment will be very humid Snap switches must be used for food process ing and other areas where mercury is not allowed

Range Selection – We recommend selection of the range which has a set point (actuation point) as close as possible to the middle of the total adjustment range

Considerations in selecting a Temperature Switch

Temperature switch selection is very similar to pressure switch selection Filled systems are available with either Bourdon tube or diaphragm elements Bi metal switches are usually cheaper than filled systems but may not be as sensitive The electric switch must have ample capacity to handle the load and should have extra capacity if the load is induct ve Range should be selected so that the set point will be as close as possible to the middle of the range Material of sensing element and other wetted parts must be compatible with the media to be controlled If a sensing element is to be inserted in a pipe with high velocity liquid flow a heavy duty protective well should be used to protect the element

ORIGINAL

Introduction to Float Operated Level Switches and Vane Operated Flow Switches

What Are They?

A float operated level switch is a device which utilizes the force developed by a float immersed in a liquid to actuate an electric switch at the point of immersion The electric switch may be used to start or stop pumps open or close valves actuate a warning lamp sound an alarm etc

A vane operated flow switch is a similar device which uti lizes the force exerted on a vane inserted in a flowing fluid to actuate an electric switch at a predetermined rate of flow

WE Anderson flow and level switches and Mercoid level switches are suitable for application with a variety of process fluids The flow switches are available with a wide range of flow actuation points for all standard pipe sizes Most Anderson switches are explosion proof and U L listed Most Mercoid switches are also U L listed

How Do They Work?

When fluid moving in the indicated direction of flow im pinges upon the flow switch vane the vane swings on the pivot point until the vane stop hits the switch body This moves the magnet keeper away from the magnet on the inside of the switch body Without the magnetic attraction provided by the keeper the switch actuation lever swings by the force of gravity thus actuating the snap switch With the cessation or a decrease in flow below the deactuation point gravity allows the vane to return to a vertical position The magnet is again attracted to the keeper moving the switch actuation lever and deactuating the snap switch The switch is therefore deactuated in the no flow condition The actua tion/deactuation points are functions of the area of the vane exposed to liquid flow the pipe diameter and characteristics of the fluid

The operation of the WE Anderson level switch is similar to that of the flow switch described except that the movement of the magnet keeper is dependent upon displacement of a float at the end of a lever arm which substitutes for the vane The float is displaced as the liquid rises to the level of the float in the tank As with the flow switch the weight of the float and arm provides the restoring force to deactuate the switch when the tank liquid level falls below the position of the switch

Mercoid magnetic level switches use a magnet keeper which travels up and down inside an armature tube in response to float level changes

What is the Dead Band?

When the flow or level switch is actuated by movement of the vane or float some of the force required to actuate the switch must be removed before the switch will deactuate The dead band is the amount of flow or the difference in level that must be removed before the switch deactuates For a given vane size and/or liquid, the dead band is essentially a function of the mechanical movement of the vane or float and the switch actuation mechanism

Considerations in Selecting a Flow Switch

Model Selection – For the higher flows encountered in pipe sizes of 1½ or larger the V4 Flow Switch provides the least resistance to flow (pressure drop) with a wide selection of actuation points For pipe sizes from ½ to 1¼ the smaller V6 Flow Switch can be utilized assuming that the specified actuation and deactuation flow rates are satisfactory For very low flows the V6 Low Flow Switch with a field adjusta ble actuation point is recommended The V6 Low Flow Switch differs slightly in its operation as increasing flow displaces a piston against a return spring and this move ment is magnetically coupled to the switch actuating lever The operating piston does result in a higher pressure drop than for the standard V6 or V4

Actuation/Deactuation Points – The V6 and V6 Low Flow switch actuation/deactuation points are fixed to those val ues given in the specifications However the V4 can be supplied for a wide range of actuation and deactuation points for various fluids and pipe diameters For a given V4 vane area the deactuation flow is approximately 55% of the actuation flow and the actuation flow rate increases with an increase in pipe diameter or a decrease in specific gravity of the fluid If the actuation/deactuation points offered in the standard V4 2 multi layer vane flow switch do not meet your requirements include the following information with your order 1 Desired actuation and/or deactuation flow rate 2 Pipe diameter and schedule 3 Type of fluid and 4 Its specific gravity Preferably request an Application Data Sheet return it to us and we will fabricate the proper V4 vane for your application

Maximum PSI Rating – All Anderson flow switches are rated for pressures up to 2000 psig except the V6 Low Flow which has a rating of 1450 psig

Installation – Install both V4 and V6 Flow Switches with the index arrow on the switch body pointing in the direction of flow V 4 models only must be vertical The V4 is installed in a 1½ threadolet welded to the pipe The shape of the vane will vary the length being limited by the pipe diameter and the width being limited by the opening of the mounting provided in the pipe Some V4 vane configurations may require a threadolet up to 2½ in size The V6 Flow Switches are supplied with installation tees for plumbing directly in line

Considerations in Selecting a Level Switch

Model Selection – Level switches are available in many different configurations For sump level control a top mounted displacer control such as Model B190 may be ap propriate For control of level at a single point in a tank a side mounted insertion type control such as Model 500 or L4 could offer advantages

For a single point high or low level alarm Model L4 or L6 might be more economical

Dead Band – If the switch will be used for direct control of a pump a wide dead band may be required to prevent false or repeated operation by waves For alarm only purposes a narrow dead band might be better Mercoid/Anderson level switches offer fixed or adjustable dead bands from less than an inch up to several feet

Maximum PSI Rating – Pressure ratings of floats should be well above the safety valve pressure setting on pressurized tanks Mercoid/Anderson level switches are available with floats or displacers suitable for pressures from 100 psi up to 2000 psi

Corrosion – Floats are usually constructed of thin material and will fail with very little corrosion damage It's essential to select floats which are not attacked by the process media

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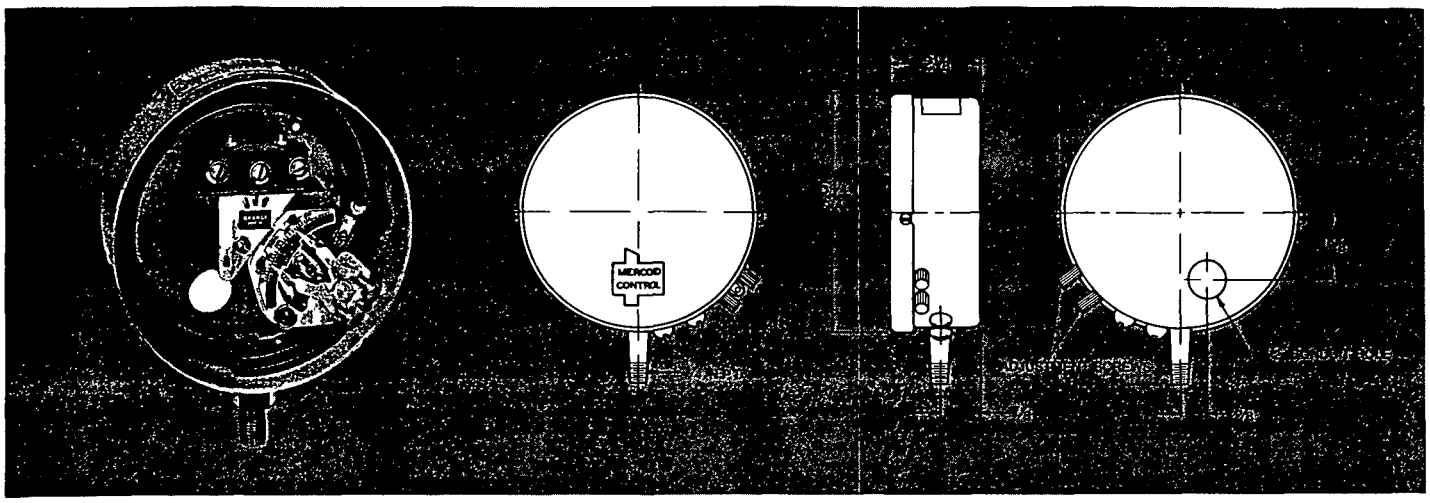
SERIES
DA

Bourdon Tube Pressure Switches

Visible setpoint, adjustable deadband, pressure ranges to 8000 PSI, U L , C S A listed



Customers tell us that this is the best pressure switch made Our most popular Model DA combines extremely high sensitivity and repeatability with easily adjustable set and reset points through non interactive external adjustments Visible calibrated dial for set points and on/off indicator to indicate switch actuation are included Choose either high current snap switch or hermetically sealed contact mercury switch

FEATURES

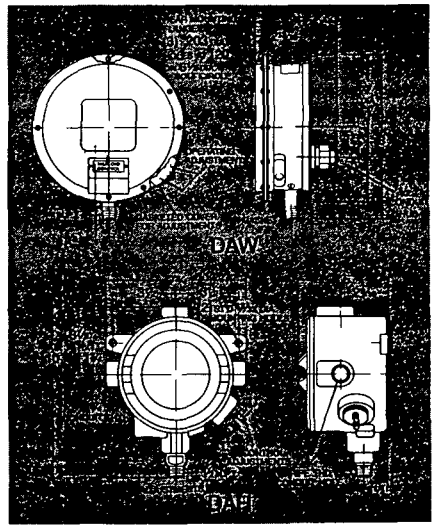
- Equipped with two external adjustments One sets high pressure operating point the other sets reset point Deadband or the difference between set and reset points is adjustable over the full scale
- Visible calibrated dial
- Visible operation on/off indication
- SPDT snap action or sealed mercury switches
- Minimum deadband obtainable at any point in range
- Pressure Ranges vacuum to 8000 psig
- U L and C S A listed

PHYSICAL DATA

Max. temperature 180°F For higher temperature media applications a remote connection or siphon (pigtail) should be used
Pressure connection / NPT (½ on ranges 15S & 16S)
Housing *pressed steel with transparent cover*
Wiring connections 3 screw type
Wetted parts same as Bourdon tube material
Weight 4 lb (std) 6 lb (wea-proof) 8 lb (exp-proof)
Max. Press. Max adjustment operating range

Suggested Specification

Pressure switch shall be Mercoid Series DA operated by a (brass) (type 316 stainless steel) (type 403 stainless steel) Bourdon tube actu ating a (mercury switch) (snap switch) Switch shall have deadband adjustable up to a max imum of 100% of switch range Switch shall have calibrated dial and two pointers indicat ing set and reset points Switch shall have vis ible on/off indication Set points shall be adjustable without removing switch cover or shutting down process



Bourdon Tube Material	Adjustable Operating Range (PSIG)	MERCURY SWITCH SPDT 15A @ 120V 7A @ 240V AC/DC		SNAP ACTION SWITCH SPDT 15A @ 120/240VAC	
		Minimum Dead Band	Model Number	Minimum Dead Band	Model Number
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Options Weather resistant housing add W' after DA and change '31 to 33 e g DAW 33 153 2 **Explosion-proof housing** add H after DA e g DAH 31 153 2 Additional features available on special order including other electrical ratings and circuits lower minimum differentials special housings diaphragm seals and F M listing For severe vibration a special Delrin Bushed Movement is available

ORIGINAL Red

High Current Capacity* or Extra Low Deadband Mercury Switches (SPST)*

Bourdon Tube Material	Adjustable Operating Range (PSIG)	MERCURY SWITCH - SPST - HIGH CURRENT 10A @ 120V, 5A @ 240V AC/DC			MERCURY SWITCH - SPST - LOW DEADBAND 2A @ 120VAC, 2A @ 240VAC, 2.5A @ 120VDC		
		Minimum Deadband	OPEN on inc. Model Number	CLOSE on inc. Model Number	Minimum Deadband	OPEN on inc. Model Number	CLOSE on inc. Model Number
BRASS	0-30" Hg Vac	2" Hg Vac	DA-591-2-2	DA-591-3-2	1" Hg Vac	DA-591-2-2	DA-591-3-2
	0-20 psig	1 psig	DA-591-2-3A	DA-591-3-3A	0.5 psig	DA-591-2-3A	DA-591-3-3A
	0-60 psig	2 psig	DA-591-2-5	DA-591-3-5	1 psig	DA-591-2-5	DA-591-3-5
	0-100 psig	3 psig	DA-591-2-7	DA-591-3-7	2.0 psig	DA-591-2-7	DA-591-3-7
	10-200 psig	5 psig	DA-591-2-8	DA-591-3-8	3.5 psig	DA-591-2-8	DA-591-3-8
	10-300 psig	6 psig	DA-591-2-9	DA-591-3-9	3.0 psig	DA-591-2-9	DA-591-3-9
	30" Hg Vac-75	7 psig	DA-591-2-26E	DA-591-3-26E	3.5 psig	DA-591-2-26E	DA-591-3-26E
	10-150 psig	5 psig	DA-591-2-24E	DA-591-3-24E	3.0 psig	DA-591-2-24E	DA-591-3-24E
TYPE 316 STAINLESS STEEL	10-300 psig	10 psig	DA-591-2-9E	DA-591-3-9E	5.0 psig	DA-591-2-9E	DA-591-3-9E
	30-400 psig	10 psig	DA-591-2-21E	DA-591-3-21E	10 psig	DA-591-2-21E	DA-591-3-21E
	75-800 psig	20 psig	DA-591-2-22E	DA-591-3-22E	35 psig	DA-591-2-22E	DA-591-3-22E
	100-1000 psig	100 psig	DA-591-2-11E	DA-591-3-11E	45 psig	DA-591-2-11E	DA-591-3-11E
	200-2500 psig	210 psig	DA-591-2-13E	DA-591-3-13E	110 psig	DA-591-2-13E	DA-591-3-13E
TYPE 403 STAINLESS STEEL	500-5000 psig	500 psig	DA-521-2-15S	DA-521-3-15S	200 psig	DA-521-2-15S	DA-521-3-15S
	800-8000 psig	750 psig	DA-521-2-16S	DA-521-3-16S	400 psig	DA-521-2-16S	DA-521-3-16S

*Also available in Weather proof (DAW 33) or Explosion proof (DAH 31) Housings

Weather proof Models

Bourdon Tube Material	Adjustable Operating Range (PSIG)	MERCURY SWITCH - SPDT 1A @ 120V, 2A @ 240V AC/DC		SNAP ACTION SWITCH 15A @ 120/240 VAC	
		Minimum Deadband	Model Number	Minimum Deadband	Model Number
BRASS	0-30" Hg Vac	2" Hg Vac	DAW-33-153-2	9" Hg Vac	DAW-7033-153-2
	0-20 psig	1 psig	DAW-33-153-3A	1 psig	DAW-7033-153-3A
	0-60 psig	3 psig	DAW-33-153-5	6 psig	DAW-7033-153-5
	0-100 psig	5 psig	DAW-33-153-7	16 psig	DAW-7033-153-7
	10-200 psig	8 psig	DAW-33-153-8	16 psig	DAW-7033-153-8
	10-300 psig	10 psig	DAW-33-153-9	25 psig	DAW-7033-153-9
	30" Hg Vac-75	7 psig	DAW-43-153-26E	10 psig	DAW-7043-153-26E
	10-150 psig	6 psig	DAW-43-153-24E	11 psig	DAW-7043-153-24E
TYPE 316 STAINLESS STEEL	10-300 psig	10 psig	DAW-43-153-9E	28 psig	DAW-7043-153-9E
	30-400 psig	30 psig	DAW-43-153-21E	52 psig	DAW-7043-153-21E
	75-800 psig	75 psig	DAW-43-153-22E	120 psig	DAW-7043-153-22E
	100-1000 psig	100 psig	DAW-43-153-11E	190 psig	DAW-7043-153-11E
	200-2500 psig	210 psig	DAW-43-153-13E	400 psig	DAW-7043-153-13E
TYPE 403 STAINLESS STEEL	500-5000 psig	500 psig	DAW-23-153-15S	900 psig	DAW-7023-153-15S
	800-8000 psig	750 psig	DAW-23-153-16S	1500 psig	DAW-7023-153-16S

Explosion proof Models

Bourdon Tube Material	Adjustable Operating Range (PSIG)	MERCURY SWITCH - SPDT 1A @ 120V, 2A @ 240V AC/DC		SNAP ACTION SWITCH 15A @ 120/240 VAC	
		Minimum Deadband	Model Number	Minimum Deadband	Model Number
BRASS	0-30" Hg Vac	2" Hg Vac	DAH-31-153-2	9" Hg Vac	DAH-7031-153-2
	0-20 psig	1 psig	DAH-31-153-3A	1 psig	DAH-7031-153-3A
	0-60 psig	3 psig	DAH-31-153-5	8 psig	DAH-7031-153-5
	0-100 psig	4 psig	DAH-31-153-7	16 psig	DAH-7031-153-7
	10-200 psig	5 psig	DAH-31-153-8	16 psig	DAH-7031-153-8
	10-300 psig	6 psig	DAH-31-153-9	25 psig	DAH-7031-153-9
	30" Hg Vac-75	7 psig	DAH-41-153-26E	11 psig	DAH-7041-153-26E
	10-150 psig	5 psig	DAH-41-153-24E	11 psig	DAH-7041-153-24E
TYPE 316 STAINLESS STEEL	10-300 psig	10 psig	DAH-41-153-9E	28 psig	DAH-7041-153-9E
	30-400 psig	30 psig	DAH-41-153-21E	52 psig	DAH-7041-153-21E
	75-800 psig	75 psig	DAH-41-153-22E	120 psig	DAH-7041-153-22E
	100-1000 psig	100 psig	DAH-41-153-11E	190 psig	DAH-7041-153-11E
	200-2500 psig	210 psig	DAH-41-153-13E	400 psig	DAH-7041-153-13E
TYPE 403 STAINLESS STEEL	500-5000 psig	500 psig	DAH-21-153-15S	900 psig	DAH-7021-153-15S
	800-8000 psig	750 psig	DAH-21-153-16S	1500 psig	DAH-7021-153-16S

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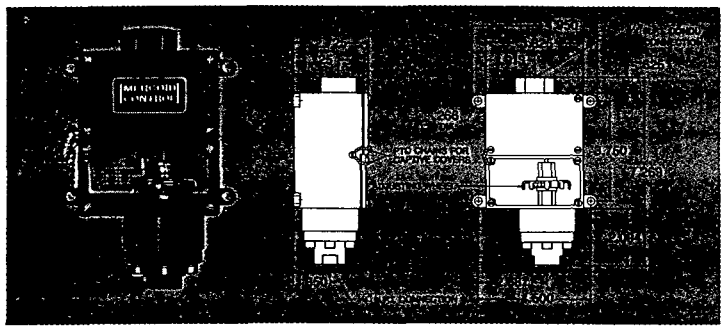
SERIES 1000

Diaphragm Operated Pressure Switches

Visible setpoint, fixed deadband, pressure ranges to 1400 PSI, UL listed



Aluminum Pressure Chamber Polymide Diaph. Model Number	316 Stainless Steel Pressure Chamber Teflon Diaphragm Model Number	Adjustable Operating Range PSIG	Approx. Deadband (Fixed) PSIG	Max. Pressure
1003W-A1-D	1003W-B3-D	5-40	2	600 psig
1004W-A1-D	1004W-B3-D	10-70	4	3000 psig
1005W-A1-D	1005W-B3-D	25-200	8	3000 psig
1006W-A1-D	1006W-B3-D	50-350	15	3000 psig
1007W-A1-D	1007W-B3-D	75-550	30	3000 psig
1008W-A1-D	1008W-B3-D	100-900	50	3000 psig
1009W-A1-D	1009W-B3-D	200-1400	75	3000 psig

Deadband 10 15 / larger when using 316SS diaphragm Change A1 to B2 for 316 stainless steel diaphragm and pressure chamber e g 1003W B2 D Values shown are for mid scale

PHYSICAL DATA

Temperature Limits 170 F
Pressure Connection ¼ NPT
Electrical Rating ⅛ HP 12A @ 125VAC (resistive)
¼ HP 12A @ 250VAC (resistive)
0 5A @ 125VDC (resistive)
Wiring Connections 3 screw type common normally open and normally closed
Set Point Adjustment Thumb wheel type inside housing – isolated from electrical chamber – visible scale
Housing Die-cast copper free aluminum Weather proof
Diaphragm Polymide Teflon or 316 stainless steel optional
Calibration Spring Plated Steel
Mounting 4 holes to accept ¼ bolts
Weight 3 lbs
Installation Any position

Extremely rugged construction provides excellent reliability in chemical petroleum and industrial plants Bellville spring movement permits mounting of control in any position and helps prevent contact chatter New design also provides high over pressure protection Weather proof housing is standard

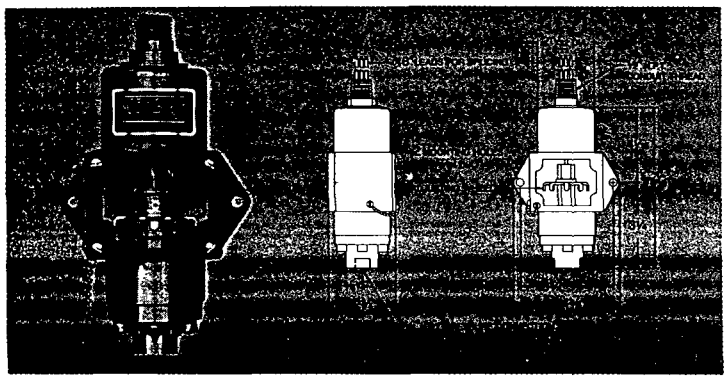
Suggested Specification

Pressure switches shall be diaphragm operated with fully adjustable set point Switch shall have visible set point indicator protected by clear polycarbonate window Electrical terminals shall be isolated from set point adjustment Units shall be Mercoid Corp Model 100 (_) W (_ _ _)

SERIES 1000E

Explosion-Proof Diaphragm Operated Pressure Switches

Visible setpoint, fixed deadband, pressure ranges to 1400 PSI, UL listed



Aluminum Pressure Chamber Polymide Diaph. Model Number	316 Stainless Steel Pressure Chamber Teflon Diaphragm Model Number	Adjustable Operating Range PSIG	Approx. Deadband (Fixed) PSIG	Max. Pressure
1003E-A1-J	1003E-B3-J	5-40	2.5	600 psig
1004E-A1-J	1004E-B3-J	10-70	5	3000 psig
1005E-A1-J	1005E-B3-J	25-200	10	3000 psig
1006E-A1-J	1006E-B3-J	50-350	18	3000 psig
1007E-A1-J	1007E-B3-J	75-550	35	3000 psig
1008E-A1-J	1008E-B3-J	100-900	50	3000 psig
1009E-A1-J	1009E-B3-J	200-1400	90	3000 psig

Deadband 10 15 % larger when using 316SS diaphragm Change A1 to B2 for 316 stainless steel diaphragm and pressure chamber e g 1003E B2 J Values shown are for mid scale

PHYSICAL DATA

Temperature Limits 170 F
Pressure Connection ¼ NPT
Electrical Rating ⅛ HP 12A @ 125VAC (resistive)
¼ HP 12A @ 250VAC (resistive)
0 5A @ 125VDC (resistive)
Wiring Connections 3 each 18 leads color coded Normally open Normally closed and Common
Set Point Adjustment Thumb wheel type inside housing – isolated from electrical chamber – visible scale
Housing Die cast copper free aluminum Explosion proof and weather proof
Diaphragm Polymide Teflon or 316 stainless steel optional
Calibration Spring Plated Steel
Mounting 4 holes to accept ¼ bolts
Weight 2 lbs
Installation Any position

Same rugged construction as used in Model 1000W plus explosion proof design are combined in this new unit UL listed for Class I Groups A B C & D Class II Groups E F & G Bellville Spring Movement permits mounting of control in any position and helps prevent contact chatter High over pressure protection and vibration resistance are also featured

Suggested Specification

Pressure switches shall be diaphragm operated with fully adjustable set point They shall be weather proof and explosion proof Switches shall have visible set point indicator protected by clear polycarbonate window Switches shall have factory installed explosion proof seal with 18 leads Units shall be Mercoid Corp Model 100(_)E(_ _ _)

ORIGINAL

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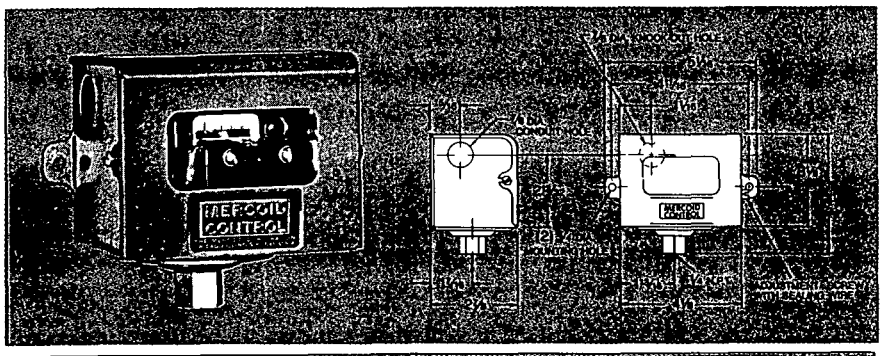
SERIES AP

Diaphragm Operated Pressure Switches

Visible setpoint adjustment U L and C S A listed, compact, low cost



PHYSICAL DATA

Temperature Limits –30 F to 150 F
Pressure connection ½ NPT female
Electrical Rating
Mercury SPDT 4A @ 120V 2A @ 240V AC/DC
Snap SPDT 15A @ 120VAC 8A @ 240VAC
Conduit Opening ½ conduit
Wiring Connections 3 screw type common normally open and normally closed
Set Point Adjustment Screw type – adjustable from outside cover
Housing and Cover Painted steel
Wetted Parts Steel solder Buna N/Nylon (316SS Teflon available)
Weight 2 lbs net
Installation Mercury switch unit – vertical snap switch unit – any position

Reliable and convenient series AP pressure switch is a compact low cost switch for instrument air or other low pressure applications Visible set point and external adjustment add convenience Used on air noncorrosive gas or liquid service compatible with wetted parts

Suggested Specification

Pressure switches shall be Mercoid Series AP (_ _ _) operated by Buna N diaphragm Set point shall be visible and shall be externally adjustable without shutting down process Deadband shall be fixed Switch shall incorporate (hermetically sealed mercury switch) (SPDT snap switch)

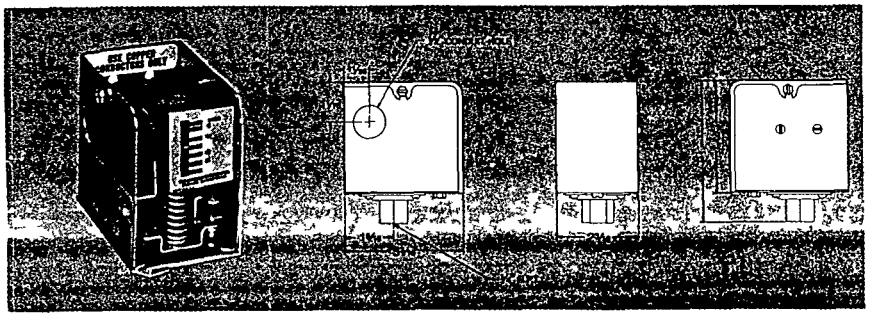
SERIES AP SWITCHES – OPERATING RANGES AND DEAD BANDS

Model Number	Operating Range	Switch Type SPDT	Switch Dead Band Low	Switch Dead Band High	Maximum Pressure
AP-153-33	10" vac–50" wc	Mercury	5" wc	6" wc	15 psig
AP-153-37	1-30 psig	Mercury	0.4 psig	0.75 psig	60 psig
AP-153-39	10-125 psig	Mercury	2 psig	6 psig	160 psig
AP-7021-153-33	10" vac–50" wc	Snap	8" wc	10" wc	15 psig
AP-7021-153-37	1-30 psig	Snap	0.75 psig	1.5 psig	60 psig
AP-7021-153-39	10-125 psig	Snap	3 psig	7 psig	160 psig

SERIES CS

Low Cost Diaphragm Operated Pressure Switches

Visible set points, fixed deadband



PHYSICAL DATA

Temperature Limits –30 F to 150 F
Pressure Connections ¼ NPT
Electrical Rating SPDT AC 15A @ 120V 8A @ 240V / HP @ 120V / HP @ 240V
Conduit Opening ½
Wiring Connections 3 screw type common normally open and normally closed
Set Point Adjustment Screw type inside cover
Housing Galvanized steel
Diaphragm Buna N/Nylon
Calibration Spring Plated steel
Weight ½ lb
Installation Any position

Model CS combines advanced design and precision construction with small size and low price Unit is ideal for instrument panels small compressors and general industrial applications Visible set point and easy to wire SPDT snap switch reduce installation time Operates in any position and is vibration resistant

Suggested Specification

Pressure switches shall be operated with Buna N/Nylon reinforced diaphragm Units shall have fixed deadband Set point(s) shall be easily adjustable Set point(s) shall be visible on calibrated scale(s) Motion of diaphragm shall be transmitted to the switch button via a direct mechanical linkage Switches shall be Mercoid Model (CS-_ _)

Model CS – Fixed Deadband

Model No	Adjustable Operating Range	Fixed Deadband Maximum	Adjustable Deadband	Max Pressure
CS-1	1-30" Hg vac	1.5" Hg	No	30 psig
CS-3	1-60" wc	7" wc	No	30 psig
CS-10	1-10 psig	0.4 psig	No	30 psig
CS-30	1-30 psig	1.0 psig	No	30 psig
CS-150	10-150 psig	5 psig	No	175 psig

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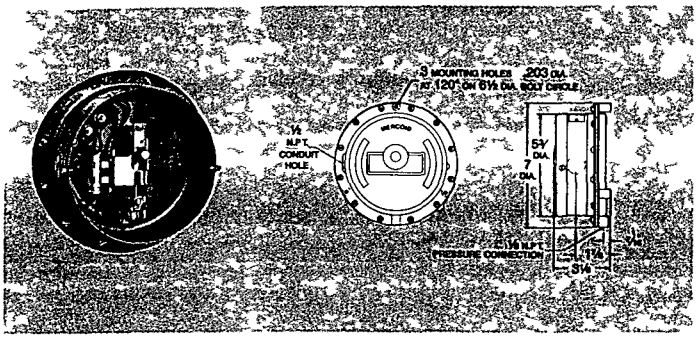
SERIES
PQ

Ultra Sensitive Pressure Switches

Large diaphragm, magnetic mercury switch, U L and C S A listed



Model No	Operating Range	Maximum Fixed Dead Band	Maximum Surge Pressure
PQ-3-X1	0-0 1 w c	0 01" w c	1 0" w c
PQ-3-X2	0 1-1 0 w c	0 02" w c	10 0" w c
PQ-3-X2 6	0 1-6 0" w c	0 02" w c	10 0" w c
PQ-3-X3	1 0 30 w c	0 1-0 2" w c	60 0" w c
PQ-3-X4	0-0 1 w c (vac)	0 01 w c	1 0" w c
PQ-3-X5	0 1-1 0 w c (vac)	0 01-0 02 w c	10 0" w c
PQ-3-X6	1 0-30 w c (vac)	0 1-0 2" w c	60 0" w c

PHYSICAL DATA

Temperature Limits −10 to 180 F
Pressure Connections ⅛ N P T Female
Electrical Rating 0 3A @ 115 VAC 0 15A @ 230VAC 0 9A @ 24VAC 0 15A @ 115VDC 0 07A @ 230VDC
Conduit Opening ½
Wiring Connections Two screw type common and normally open Contacts close on increase of pressure (or decrease of vacuum)
Set Point Adjustment Internal screw
Housing Painted steel
Diaphragm Nylon reinforced Buna N
Calibration Spring Plated steel
Weight 4½ Lbs
Installation Must be Vertical

An ultra sensitive pressure switch Model PQ is designed for use on air or non corrosive gas applications Large diaphragm operates special magnetic mercury switch Operating point is adjustable over entire range Unit is also available in weather proof or explosion proof housing

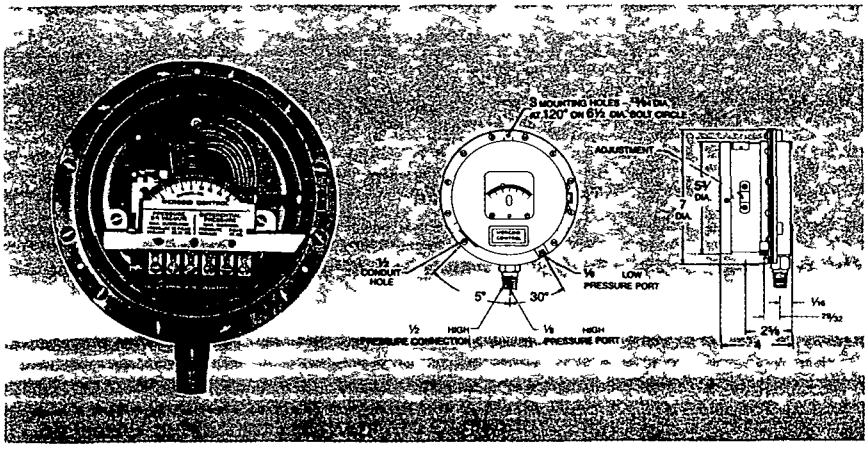
Suggested Specification

Pressure switch shall be Mercoid Model PQ (_ _ _) operated with Nylon reinforced Buna N diaphragm Units shall have fixed deadband Diaphragm pressure element shall operate a magnetic mercury switch Contacts shall be hermetically sealed and mercury wetted

SERIES
PG

Differential Pressure Switches

External adjustment, visible dial, U L and C S A listed, F M approved



Model No	Adj Oper Range	Maximum Deadband	Switch Type ①	Electrical Rating Either AC or DC	Housing NEMA
PG-163-1	1 30 water	0 19	SPDT	4A @ 120V 2A @ 240V	1
PG-163-2	0 6-5 psid	0 08 psid	SPDT	4A @ 120V 2A @ 240V	1
PG-3-1	1 30 water	0 19	SPST	6A @ 120V 3A @ 240V	1
PG-3-2	0 6-5 psid	0 08 psid	SPST	6A @ 120V 3A @ 240V	1
PGW-163-1	1 30 water	0 19	SPDT	4A @ 120V 2A @ 240V	IIIR
PGW-163-2	0 6-5 psid	0 04 psid	SPDT	4A @ 120V 2A @ 240V	IIIR
PGW-3-1	1 30 water	0 19	SPST	6A @ 120V 3A @ 240V	IIIR
PGW-3-2	0 6-5 psid	0 08 psid	SPST	6A @ 120V 3A @ 240V	IIIR

① SPDT switches have 3 terminals common normally open and normally closed
SPST switches have 2 terminals common and normally open (closes on pressure increase)

PHYSICAL DATA

Max Pressure HP Connection 20 psig
Max Pressure LP Connection 30 water range 2 psig
Max Pressure LP Connection 5 psid range 10 psig
Temperature Limits 0 180 F
Pressure Connections High Pressure (Back)
Low Pressure (Front)
Electrical Rating See Chart Below
Conduit Opening ½ conduit
Wiring Connections SPDT switches have 3 terminals common normally open and normally closed SPST switches have 2 terminals common and normally open (closes on increase)
Switch Type Mercury
Set Point Adjustment Screw type external visible
Housing Heavy gauge steel
Diaphragm Fairprene
Calibration Spring Plated steel
Weight 7 lbs **Installation** Vertical

Large diaphragm sensitivity and time proven dependable design are combined in model PG differential pressure switches Visible dial reduces "start up time and helps prevent calibration errors External adjustment allows set point change without removal of cover Unit is listed by U L FM and CSA

Suggested Specification

Differential pressure switches shall be Mercoid Model PG (_ _ _) diaphragm operated with 6 diaphragm to actuate a hermetically sealed contact mercury switch Unit shall have visible set point dial and shall be adjustable without removing cover

ORIGINAL (Red)

SERIES BB

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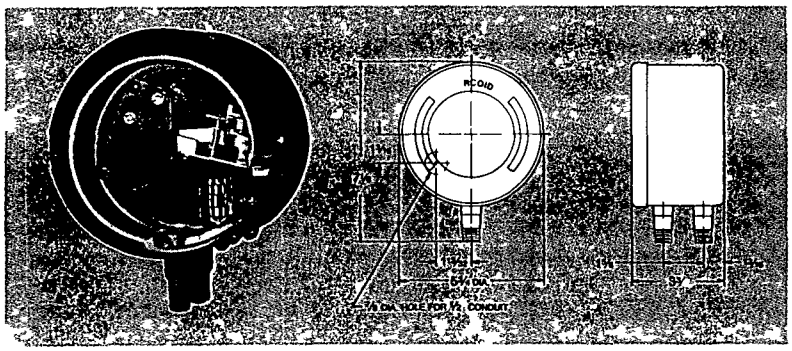
Bourdon Tube Differential Pressure Switches

Stainless steel bourdon tubes, adjustable deadband, high pressure



Model No	Adj Operating Range PSID	Maximum Total Pressure PSI	Deadband Min	Deadband Max
BB 521 3 6S	3-40	5 100	3	40
BB 521 3 8S	4 120	10 200	4	120
BB 521 3 9S	6-180	10 300	6	180
BB 521 3 10S	15-360	25 600	15	360
BB 521 3 11S	20-600	50 1000	20	600
BB 521 3 12S	40 900	100 1500	40	900
BB 521 3 13S	50 1500	300 2500	50	1500
BB 521 3 15S	125-3000	500 5000	125	3000
BB 521 3 16S	500 5000	1000 8000	500	5000

PHYSICAL DATA

Temperature Limits – 10 to 180 F
Pressure Connections /4 N PT male except range 15S and 16S are /2 N PT male
Electrical Rating 5A @ 120VAC 2 5A @ 240VAC
Conduit Opening /2 conduit
Wiring Connections Two screw type common and normally open (SPST) Switch contacts close on increase of differential pressure
Set Point Adjustment Thumbwheel
Housing Painted steel with transparent cover
Bourdon Tube Type 403 stainless steel (Type 316SS available on special order)
Weight 4 Lbs
Installation Must be Vertical

Welded stainless steel bourdon tubes reduce chance of leakage (even in the event of fire) in model BB differential pressure switches Units are ideal for checking differential pressure (head) across high pressure pumps and filters Hermetically sealed mercury wetted contacts help ensure reliable operation Extra sensitive (fixed deadband) units are available on special order as are weather proof and explosion proof enclosures

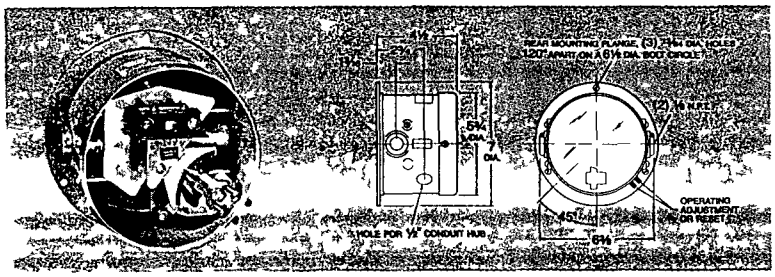
Suggested Specification

Differential pressure switches shall be operated by welded type 403 stainless steel bourdon tubes No elastomeric or plastic O rings diaphragms or packing shall be used in pressure containment Contacts shall be hermetically sealed and mercury wetted Units shall be Mercoid Corp Catalog No BB (_ _ _)

SERIES DP

Double Bellows Differential Pressure Switches

Visible set points, adjustable deadband high pressure range



FEATURES

External adjustment
Visible calibrated dial
Adjustable deadband
SPDT snap switch
316 Stainless Steel or Brass Bellows
Working pressure Ranges to 600 psig
Flanged steel housing

PHYSICAL DATA

Maximum Temperature 180 F
Pressure connections /8 N PT female
Electrical Rating 15A @ 120/240/440VAC SPDT snap switch
Wiring Connections three screw type – Common NO NC
Weight 5 lbs

Two opposed bellows combine maximum sensitivity and resistance to vibration with moderate cost in the model DP differential pressure switch Set and reset points are easily changed through non interactive external controls Visible set point indicators assure ease of adjustment

Options

Weather proof housing add W after DPA e g DPAW 7033 153 61 Explosion proof housing hermetically sealed mercury switches available Bourdon tube type differential pressure switches available for Ranges to 5000 psid

Suggested Specification Differential pressure switch shall be operated by two opposing bellows of (brass) (type 316 stainless steel) Bellows shall actuate a SPDT snap switch via direct mechanical linkage High and low pressure set points shall be visible and externally adjustable Switch shall be Mercoid Corporation Catalog No DPA _____ for required operating range

Model Number	Bellows Materials	Range PSID	Rated Pressure	Minimum Dead Band Adjustment (PSID)
DPA 7033 153 61	Brass	0-10	50 psig	1.5
DPA 7033 153 62		0-20	100 psig	2.5
DPA 7033 153 63		0-30	300 psig	5.0
DPA 7043 153 62S	316 Stainless Steel	0-20	100 psig	3.0
DPA 7043 153 63S		0-30	300 psig	5.0
DPA 7043 153 65S		0-80	600 psig	20.0

Temperature Switches

Bulb and capillary type in 10 standard ranges C S A listed

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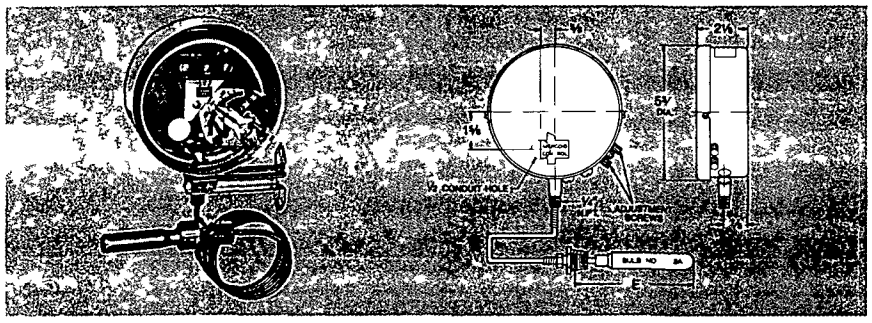
SERIES DA-7035

PHYSICAL DATA

Maximum ambient temperature 180 F
Maximum bulb temperature See chart
Bulb connection ¾ N P T male
Electrical rating 15A @ 120/240VAC SPDT
Housing Pressed steel with transparent cover
Maximum bulb pressure 300 psi
Capillary length 6 standard
Weight 5 lbs

FEATURES

Snap action switch standard
C S A listed
Vapor pressure activated Bourdon tube
Visible dial calibrated in F and C
Visible on/off indication
Operating ranges to 530 F
Adjustable deadband



Model Number	Min Deadband When set at Hi	Med	Lo	Max Temp Not to Exceed	Bulb No Material	Bulb Length "E"	Adjustable Operating Range F
DA 7035 153 1A	16°	23	38	120	2 Copper	4¼	60 30°
DA 7035 153 2A	7°	10	17°	240	2 Copper	4¼	0-75
DA 7035 153 3	9	11	18	120	2A Copper	12⅜	25-100°
DA 7035 153-4	8	11	22°	170	2A Copper	12⅜	50 150
DA 7035 153 5	7°	10	18	220	2 Copper	2⅞	100-200°
DA 7035 153-6	7°	11	22°	285	2 Copper	2⅞	140-250°
DA 7035 153 7A	10°	14	23	320	2 Copper	2⅞	200 300°
DA 7035 153 8	8	11	21	400	2 Copper	2⅞	250 380
DA 7035 153-8A	9	15	25	440	2 S S	4⅞	280-415
DA 7035 153 9	9	17°	32°	550	2 S S	4⅞	370 530

Model DA 7035 temperature switches use the same time proven Bourdon tube and switching mecha nism used in our DA pressure switch Bourdon tube provides high sensitivity and long life Fully adjust able deadband makes the unit suitable for a wide range of control applications Visible calibrated dial and external adjustments make changing set points simple and fast

Suggested Specification

Temperature switch shall be bulb and capillary type operated by vapor pressure acting on a Bour don tube Switch shall have adjustable deadband Deadband shall be adjustable up to a maximum of 100% of switch range Switch shall have calibrated dial and two pointers indicating high and low set points Switch shall have visible on/off indicator Switch shall be Mercoid Corp catalog No DA 7035 153 _____ for required operating range

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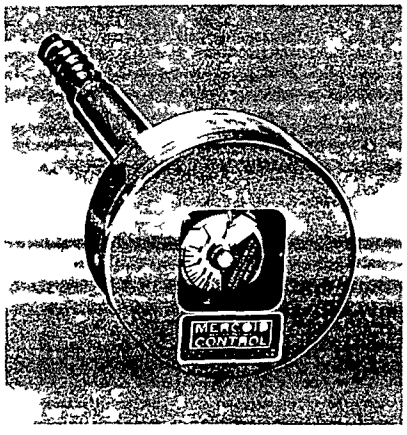
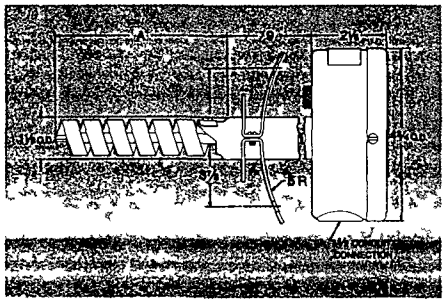
SERIES M-51

Bi-Metal Air Temperature Switches

Double adjustable, heavy duty, U L listed, universal mounting, automatic reset





FEATURES

U L listed
Automatic or Manual reset
SPST mercury switch (SPDT switches available)
Visible dial shows duct temperature
Two adjustments one sets high temperature set point the other sets low temperature reset

Designed for use as a limit switch fan control or alarm switch Model M 51 is used on all types of air conditioning ducts furnaces ovens dryers etc Unit may also be used with damper control system to prevent spread of fire through ducts Adjustments for both set and reset points Visible dial shows duct temperature and switch set points

Suggested Specification

Temperature switch shall be direct acting bi metal type with fully adjustable set and reset points Switch shall have visible dial and shall indicate duct temperature and switch settings Dial shall be calibrated in degrees F Switch shall be U L listed Switch shall be Mercoid Catalog No M 51 _____

PHYSICAL DATA

Max Ambient Temperature 180 F
Max Bi Metal Temperature See chart
Mounting reversible flange for flat or curved surfaces
Dial Calibration Degrees F
Housing Steel with glass fronted cover
Electrical Rating 10A @ 120V 5A @ 240V AC/DC Motor Rating 120/240V AC Single phase ¾ Hp 120/240V D C ⅓ Hp (SPST mercury switch)
Weight 5 Lbs

Switch Action on Temp Rise	Adj Range F	Minimum Dead Band	Dimension	Reset	Model Number
OPENS	25 125	12°	[illegible]	Automatic	M 51 A
OPENS	25 125	12°	[illegible]	Manual	M 51 A
OPENS	50 500	20°	[illegible]	Automatic	M 51 A
OPENS	50 500	20°	[illegible]	Manual	M 51 A

ORIGINAL Redj

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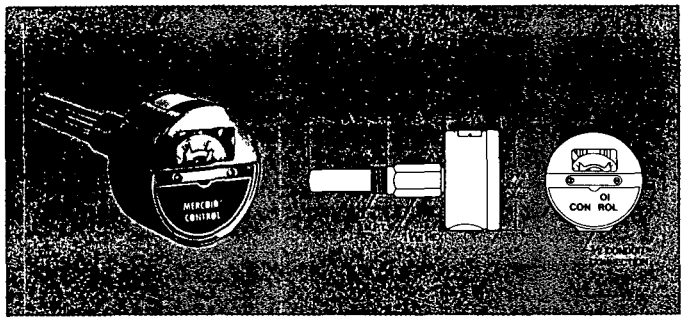
SERIES FM

Immersion Temperature Control

Visible setpoint adjustment U L and C S A listed, adjustable deadband



* Also FM approved

	Copper Well Model No.	Type 304SS Well Model No.	Operating Temp. Range	Deadband Min.	Deadband Max.	Well Dim. A	Well Dim. B
*	FM-437-153-3515	FM-437SS-153-3515	40-200°F	15	160	2⅞	2⅜
*	FM-437-153-3516	FM-437SS-153-3516	40-200°F	15	160	4½	4¼
*	FM-437-153-3510	FM-437SS-153-3510	80-240°F	15	160	2⅞	2⅜
*	FM-437-153-3511	FM-437SS-153-3511	80-240°F	15	160	4½	4¼
	FM-437-153-3528	FM-437SS-153-3528	160-300°F	18	140	2⅞	2⅜
	FM-437-153-3529	FM-437SS-153-3529	160-300°F	18	140	4½	4¼

PHYSICAL DATA

Maximum Pressure Copper well – 200 psig @ 300 F
304SS well – 900 psig @ 300 F
Maximum Bi Metal Temperature 375 F
Process Connection ¾ NPT
Electrical Rating 4A @ 120V 2A @ 240V both AC & DC ⅛ HP @ 120VAC or 240VAC **Switch Type** Tilting mercury type
Wiring Connections Three screw type common normally open and normally closed (SPDT) **Conduit opening** ½ inch conduit
Set Point Adjustment High and Low set points set via pointers on (F) calibrated dial
Housing Heavy gauge steel case with glass window
Well Material Copper or Type 304 stainless steel – see chart
Weight 3 lbs **Installation** Well must be horizontal window vertical

Compact and low cost model FM 437 employs a bimetal element inside an immersion well Instrument is detachable from the well allowing maintenance without draining system Visible calibrated dial reduces start up time and speeds set point changing Contacts are hermetically sealed and mercury wetted High current (up to 17A) capacity switches available on special order

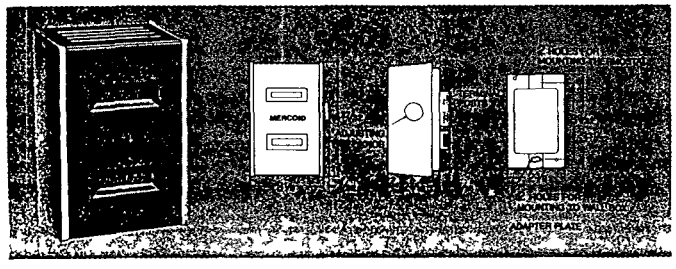
Suggested Specification

Temperature switches shall be immersion type with (copper) (type 304 stainless steel) well Switches shall be separable from well and shall be repairable without shutting down process Bi metal element shall operate hermetically sealed mercury switch Switches shall have F calibrated dial and two pointers indicating set and reset points Switches shall require no power supply Switches shall be Mercoid Corp Model No FM 437 (___)

SERIES 860

Line Voltage Thermostats

Built in thermometer, heavy duty construction, U L and C S A listed



SPDT ① Model No.	SPST ② Model No.	Operating Range	Housing
860-153-61	860-2-61	25-80°F	Indoor
860-153-62	860-2-62	38-70°F	Indoor
860-153-63	860-2-63	56-80°F	Indoor
860-153-64	860-2-64	65-90°F	Indoor
860-153-65	860-2-65	80-140°F	Indoor
860EH-153-61	860EH-2-61	25-80°F	Explosion proof
860EH-153-62	860EH-2-62	38-70°F	Explosion proof
860EH-153-63	860EH-2-63	56-80°F	Explosion proof
860EH-153-64	860EH-2-64	65-90°F	Explosion proof
860EH-153-65	860EH-2-65	80-140°F	Explosion proof

① Three terminals common normally open normally closed 4A @ 120V 2A @ 240V (AC or DC) ⅛ H P @ 120/240 VAC 1Ø (Not U L or C S A listed)

② Two terminals common normally closed (opens on temperature rise) 10A @ 120V 5A @ 240V AC or DC ¾ H P @ 120/240 VAC 1Ø V H P @ 120/240 VDC Normally open (instead of standard normally closed contact) is available on special order

PHYSICAL DATA

Temperature Limits –10 to 140 F
Electrical Rating See Chart **Deadband** approx 2 4 F
Wiring Connections Standard – screw type terminals explosion proof pigtail leads for connection inside junction box
Conduit Opening ½ on explosion proof model Standard unit mounts on standard wall switch box
Set Point Adjustment Removable knob at side of unit
Housing Standard units have plastic housing Explosion proof units have cast aluminum housing containing electrically live parts Thermostat mechanism is located in front of housing for better sensitivity mechanism is covered by plastic cover
Actuation Liquid filled brass bellows **Installation** Vertical
Weight Standard unit – 1 5 lbs Explosion proof unit – 4 5 lbs

Heavy duty and reliable Model 860 Line Voltage thermostat is designed for direct control of motors operating HVAC equipment in industrial environments Hermetically sealed mercury switch resists dust dirt grease and moisture Cadmium plated steel and brass mechanism resists corrosion Set point is easily adjustable via knurled knob located on the side of the unit Knob may be removed to prevent tampering Contacts rated up to 17A available on special order

Suggested Specification

Thermostats shall have heavy duty contacts suitable for 120/240V operation Contacts shall be hermetically sealed and mercury wetted Units shall include integral thermometer Enclosures shall be (indoor) (explosion proof) type Units shall be bellows actuated and shall have removable set point adjust knob Units shall be Mercoid Corp Model 860

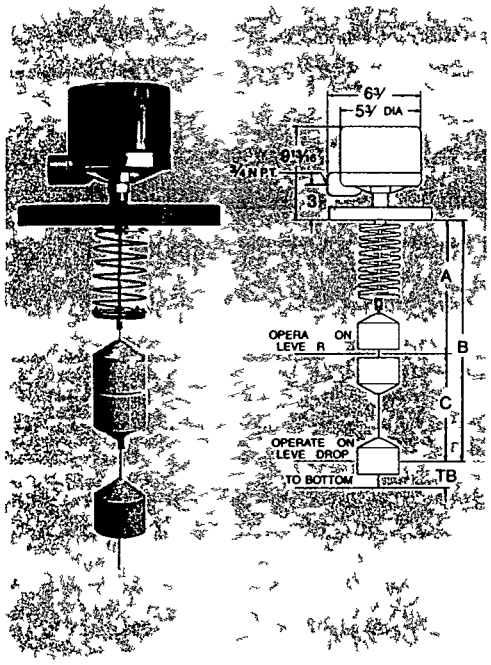
Mercoid®

A Division of
DWYER INSTRUMENTS INC

SERIES
B-190

Liquid Level Switches - Controls

Top Mounted Displacer Type, U L and C S A listed
Adjustable Setpoints, Magnetic Operation



One of our most versatile level controls the model B 190 can be used on all types of tank or sump level control applications Three porcelain displacers provide deadband adjustment Unit can start a sump pump (for example) when liquid reaches the high set point and turn the pump off when the level drops to the low set point Unit works equally well in pressurized tanks

Suggested Specification

Liquid level control shall be top mounted displacer type with adjustable deadband Cable and spring shall be stainless steel Motion of displacers shall actuate switch by magnetic linkage Electrical section of switch shall be separated from process by solid metal Switch shall be Mercoid Model No B 190WT 7810 1 0 4 125

Model No B 190WT 7810 1 0 4 125
Specify specific gravity if not equal to 1 0

PHYSICAL DATA

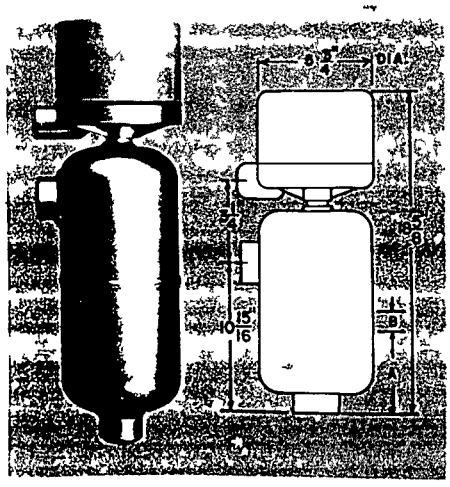
Temperature limits 32 F 200 F
Maximum pressure 125 psi standard higher ratings available
Connection 4 125 lb C I flange standard Other flanges available
Electrical rating 12A @ 120VAC 5A @ 240VAC (SPDT)
Standard calibration For water or other fluids with specific gravity between 0 6 and 1 2
Optional calibraton *Unit may be calibrated* for fluids with specific gravity as low as 0 5 Specify specific gravity on order
Wiring connections 3 screw type common normally open normally closed
Set point adjustment Cable clamps below displacers
Housing Heavy gauge steel ¾ conduit connection for outdoor use Neoprene gasketed cover
Displacers Porcelain standard 316 S S or graphite available
Cable 316 Stainless Steel
Weight 25 lbs

A		C		TB	B
Max	Min	Max	Min	Min	Max
115½	8½	11¼	6¾	2½	122¼

SERIES
201

Side Mounted - Chamber Type Level Control

Operating Pressures to 500 PSIG, U L and C S A listed



Model 201 liquid level control is designed for long life and reliable operation in chemical plants refineries and industrial facilities Stainless steel switching mechanism uses gravity return action instead of springs to prolong life Weather proof enclosure is standard Heavy duty welded steel float chamber is suitable for 500 psi at 750 F

Suggested Specification Level control shall be Mercoid Model 201 side mounted with welded steel chamber Stainless steel float shall actuate switching mechanism by direct magnetic linkage Switching mechanism shall be stainless steel with gravity return action

Model No 201 WT 7810 C1 60

PHYSICAL DATA

Temperature limits Float chamber 750 F Electrical housing 400 F
Maximum pressure 500 psig
Connection 1 NPT (may also be used as 1 socket weld)
Electrical rating 12A @ 120VAC 5A @ 240 VAC SPDT
Minimum specific gravity 0 6
Wiring connections 3 screw type
Set point adjustment by moving switch head up or down
Housing Heavy gauge steel ¾ conduit connection Neoprene gasketed for outdoor use
Floats Type 316 Stainless Steel
Weight 33 lbs

SP GR	A	B
1 0	6	[illegible]
0 6	6½	[illegible]

A is adjustable ± 1

ORIGINAL (Rev)

Mercoid®

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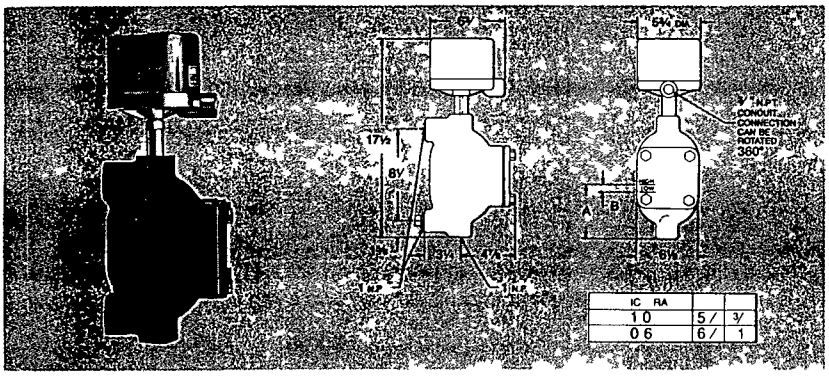
SERIES 102

Flanged Chamber Type Level Control

Operating pressures to 300 PSIG, U L and C S A listed



Model Number	Switch Type
102WT-4815-C-60	Mercury
102WT-7810-C-60	Snap Action

Suggested Specification

Level Control shall be magnetically operated and include (cast iron) (type 316 stainless steel) float chamber with bolted inspection plate Float shall be removable for cleaning without disconnecting piping Contacts shall be (snap action type) (hermetically sealed mercury switch type) Unit shall be Mercoid Corp Model 102WT (____)

PHYSICAL DATA

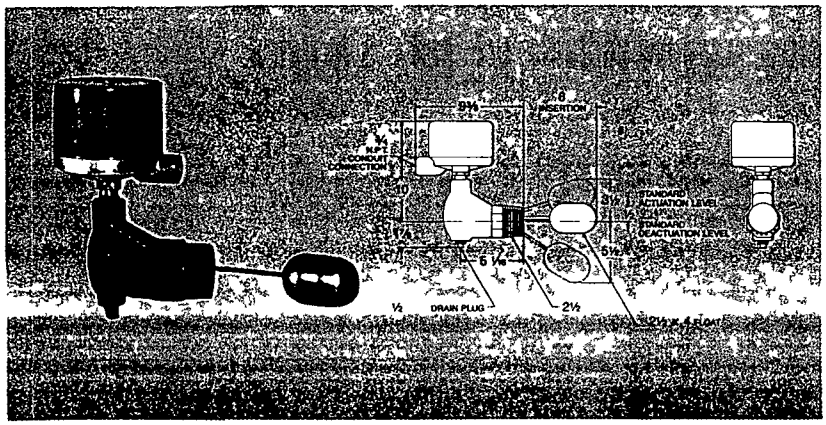
Maximum Temperature 400°F
Maximum Pressure 300 PSIG
Process Connection 1 NPT
Electrical Rating **Mercury Switch** – 10A @ 120V 5A @ 240V AC or DC **Snap Switch** – 12A @ 120VAC 5A @ 240VAC
Conduit Connection ¾ conduit
Minimum Specific Gravity 0 6
Wiring Connections Mercury switch uses two independent SPST switches four screw type terminals two for normally open contact and two for normally closed contact Snap switch has three screw type terminals common normally open and normally closed
Set Point Adjustment by moving switch head up or down Adjustable ±1 0
Deadband Drop in level to restore switch to original position is approximately ¾ at SG = 1 0 1 at SG = 0 6
Housing Heavy gauge steel neoprene gasketed for outdoor use
Float Type 304 stainless steel
Weight 35 lbs

Flanged inspection plate allows periodic inspection and clean out of Model 102 float chamber making unit ideal for use in refineries chemical plants and other areas with potentially dirty liquids Low cost cast iron chamber is standard Carbon steel and stainless steel chambers are available on special order Stainless steel float is standard

SERIES 500

Insertion Type Level Control

Adjustable deadband, weather proof enclosure, U L listed



Model Number	Switch Type	Body Material
500TWT-7810-C55	Snap	Cast Iron
500TWT-7810-C1-55	Snap	Cast Steel
500TWT-7810-C216-55	Snap	316SS
500TWT-4815-C55	Mercury	Cast Iron
500TWT-4815-C1-55	Mercury	Cast Steel
500TWT-4815-C216-55	Mercury	316SS

Suggested Specification Level switches shall be direct mount type with 2½ NPT connection Units shall have weather proof enclosures Contacts shall be (hermetically sealed and mercury wetted) (snap action type) Switching mechanism shall be stainless steel with gravity return action Stainless steel float shall actuate mechanism by magnetic linkage Units shall be Mercoid Corporation Model No 500TWT(___)

PHYSICAL DATA

Maximum Temperature 400 F
Maximum Pressure 300 PSIG
Process Connection 2½ NPT
Electrical Rating **Mercury Switch** – 10A @ 120V 5A @ 240V AC or DC **Snap Switch** – 12A @ 120VAC 5A @ 240VAC
Minimum Specific Gravity 0 55
Float 2½ x 4 type 316 stainless steel
Wiring Connections Mercury switch uses two independent SPST switches four screw type terminals two for normally open contact and two for normally closed contact Snap switch has three screw type terminals common normally open and normally closed
Conduit Connection ¾
Set Point Adjustment By moving switch head up or down
Float Rod Length 6
Deadband Adjustment By adjustment of stop nuts on shaft inside armature tube Standard adjustment is ½ Adjustment to 3 possible (These limits change if nonstandard float rod length is ordered)
Housing Heavy gauge steel Neoprene gasketed for outdoor use
Weight 10 lbs

Adjustable deadband makes Model 500 ideal for control of level in large or small tanks Mounts directly to threaded fitting on tank (Flanged mounting available on special order) Stainless steel float operates hermetically sealed mercury switch or SP DT snap action switch Available in a variety of materials to match most petrochemical and industrial applications

SERIES 123

Cast Iron Chamber – Water Level Control

Heavy duty, snap action type, U L and C S A listed

Mercoid®

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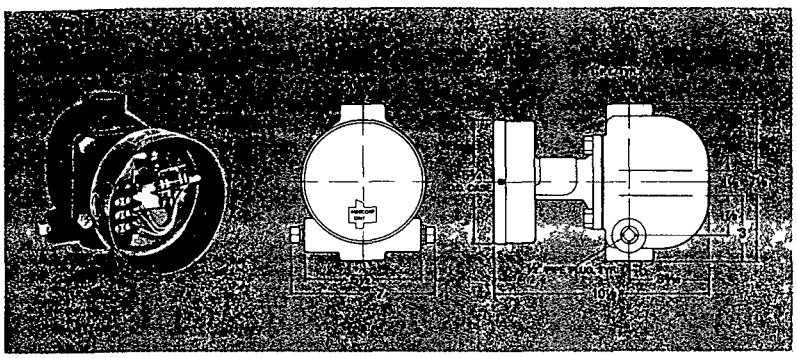


PHYSICAL DATA

Max Temp 365 F **Max Press** 150 psig
Connections 1 NPT
Electrical rating SPDT mercury switch rated 4A @ 120V 2A @ 240V A C or D C
Wiring connections 3 screw type
Housing General purpose NEMA 1
Float chamber Cast iron not for use with lethal or flammable substances either liquid or gaseous
Packing gland Brass
Float material 304 s s
Weight 20 lbs
Packing Special non asbestos graphite/lead packing

Designed for boiler applications the model 123 is used primarily for low water cut off or feed water control Other uses include condensate tanks de aerators etc A special snap action mechanism eliminates frequent operation due to surging water level Visible operation adds convenience in servicing Stainless steel trim and hand reset are available if required

Suggested Specification

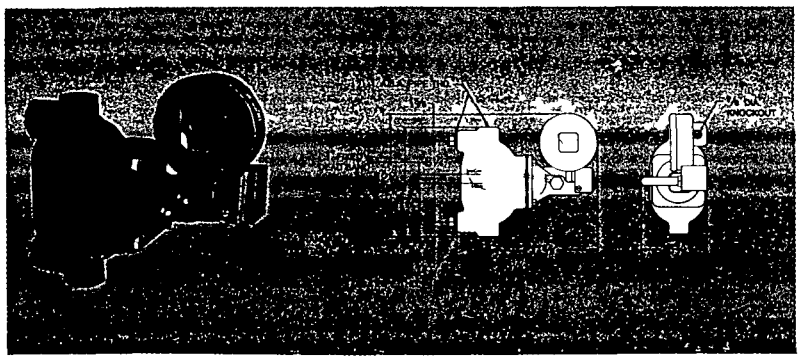
Level control shall be side mounted type with cast iron chamber Float shall operate switching mechanism by direct mechanical linkage Mech anism shall be snap action type Deadband shall be approximately 1⅛ inch Control shall be Mercoid Corporation No 123 153

Model Number 123 153

SERIES 75

Torque Tube Type Level Control

Direct action, mercury contacts, U L and C S A listed



Model No.	Max Pressure	Maximum Temp	Chamber Material	Torque Tube	Switch Contacts
75K[illegible]	300 psig	[illegible]	Cast Iron	Brass	N O
75K[illegible]	300 psig	125 F	Cast Iron	Brass	N O
75K[illegible]	300 psig	500 F	Cast Steel	Brass	N O
75K[illegible]	300 psig	500 F	Cast Steel	Brass	N O
75K[illegible]	300 psig	500 F	Cast and Stn Steel	Brass	N O
75K[illegible]	300 psig	500 F	Cast and Stn Steel	Brass	N O

PHYSICAL DATA

Maximum Pressure See chart
Maximum Temperature See chart
Minimum Specific Gravity 0 66
Process Connections 1 NPT Female
Electrical Rating 10A @ 115V 5A @ 230V AC or DC
Conduit Connection ½
Wiring Connections Two screw type common and normally open (NO) or normally closed (NC) N O closes on level rise N C opens on level rise See chart Other circuits are avail able on special order
Level Variation to Actuate Switch 1
Housing NEMA 1 painted steel transparent cover
Float 304 Stainless Steel
Weight 35 lbs

Torque Tube design eliminates O rings and pack ing in Model 75 level controls Float assembly removes easily from chamber for periodic inspec tion Flow Through connections reduce piping requirements and installation time

Suggested Specification

Level control shall be float operated through torque tube seal Float shall be easily removable from chamber for clean-out and inspection Unit shall be Mercoid Corp Model 75K(____)

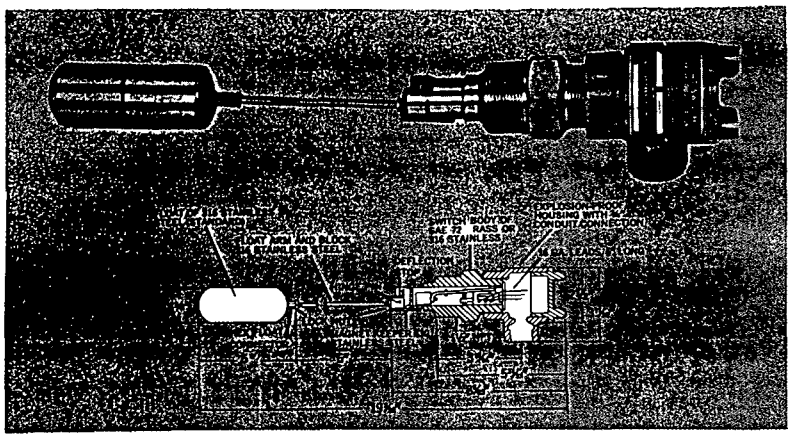
ORIGINAL (Red)

MODEL L4

FLOTECT™ Float Switch

• EXPLOSION PROOF
• U L CSA LISTED

For reliable liquid level control or alarm signal operation



The Model L4 Float Switch uses the time tested Model V-4 Flotect® Switch body to provide de pendable liquid level control to start/stop pumps open/close valves – or actuate alarm signals In stalled through a 1½ threadolet welded to tank the unit is easily field installed or replaced The electrical assembly may be quickly removed with out removing switch from tank Float arm hinge design limits the arm angle to prevent vertical hangup Float is 316 stainless steel for service with compatible corrosive materials For use in fluids with specific gravity down to 0 7

APPLICATIONS

The L4 Float Switch maintains predetermined liquid levels in tanks through direct pump control Also used to control sump levels scrubber system liquid levels and automatic tank dump operations Controls levels or provides alarms for hydro pneu matic tanks low pressure boilers and various waste water and sewage treatment processes With a special L shaped float arm it can be mounted vertically for tank overflow or alarm

Suggested Specification – Liquid level switches shall be operated by a type 316 stainless steel float via magnetic linkage Wetted parts shall all be metal No elastomeric or plastic O rings di aphragms or packing shall be required to contain process fluid Switches shall be weather proof ex plosion proof and U L listed Switches shall be W E Anderson No L4 (_ _)

PHYSICAL DATA

Temperature Limits Standard 275 F

Operating or Maximum Pressure 100 psig rating on std float Switch body rated 2 000 psig

Piping Connection 1/ NPT

Electrical Rating SPDT snap action micro switch contact rating 10 amps U L 125/250VAC 60 Hz 5 amps resistive 3 amps inductive 30 volts DC Contact life 1 000 000 cycles

Wire 16 ga copper 6 long mechanically and solder bonded to switch

Switch Body SAE 72 brass **Optional** At extra cost 316 stainless steel For Teflon or PVC coatings of parts consult factory

Standard Dead Band / (Approx)

Float 316 stainless steel 1/ dia on 6 arm std fits through 1/ NPT process connection

Minimum Specific Gravity 0 7

Installation Horizontal standard through 1/ NPT opening Vertical mounting optional

Weight 4 lbs 8 oz

Optional Vertical mounting floats for light fluids high pressure or corrosive service Other sizes materials available

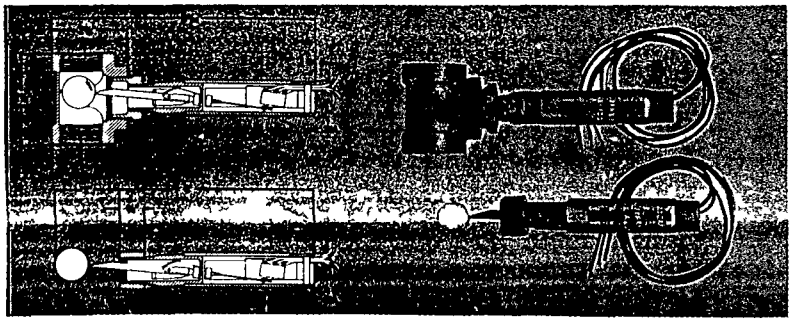
UL/CSA Listed Class I Groups C & D Class II Groups E F & G
Teflon s a t adema k eg ste ed by D Po t

MODEL L6

FLOTECT™ Liquid Level Switch

• Explosion-proof and UL-CSA listed • Easy in-wall or external installation

• Small size, up to 2000 psig operating pressure



The compact Flotect® Model L6 Level Switch is designed and built for years of trouble free service in a wide variety of process liquid level applications Machined from brass or stainless steel bar stock the lower body is leak proof eliminating the possibility of the process media entering the switch housing The float lever pivoted within the lower body moves when the process liquid displaces the solid polypro pylene float A magnet on the opposite end of the float lever controls a second magnet on the switch actuating lever located in the upper housing Maintenance is easy since the electrical assembly can be removed for inspection or replacement without removing the entire switch The stainless steel float lever arm and the polypropylene float are compatible with most process fluids

The Flotect Model L6 is sensitive to level changes of less than ½ and is UL/CSA listed for explosion proof service – Class I Groups A B C & D and Class II Groups E F & G CSA model furnished with optional junction box

PHYSICAL DATA

Temperature Limits 220 F max
Operating Pressure Up to 2000 psig
Piping Connections 1 NPT standard
Electrical Rating One (or two) SPDT snap action microswitch 5 amps 125/250 VAC 60 Hz
Wire 18 gauge 18 long
Switch Body Lower housing choice of brass or stainless steel upper housing brass ¾ NPT conduit connection
Float Solid polypropylene with stainless steel arm
Minimum Media Specific Gravity 0 9
Installation Install with index arrow pointing down
Weight (Approximate) 1 pound 1¾ pounds with external float chamber

Suggested Specifications

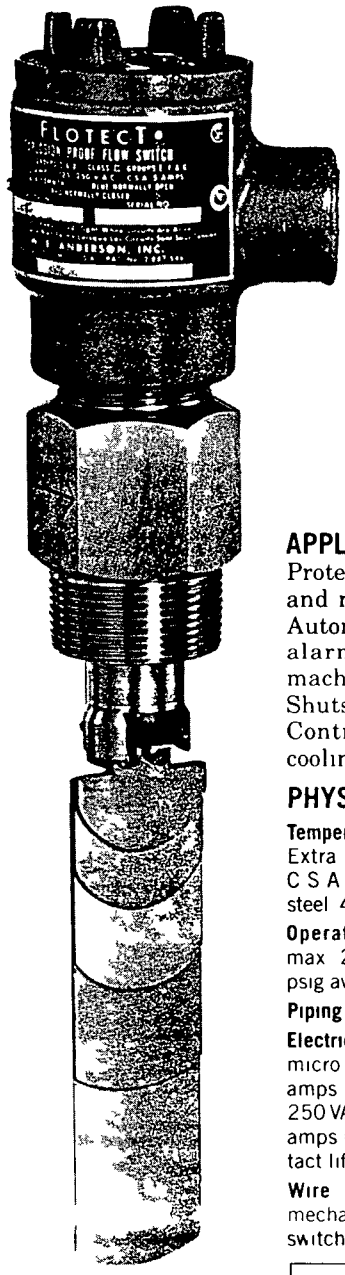
Automatic explosion proof level switches shall be operated by a solid polypropylene float actuating one (two) single pole double throw switch(es) rated at 5 amps 125/250 VAC 60 Hz Motion of the float shall actuate switch by action of a magnet which controls the switch inside the one piece switch body Switches shall be W E Anderson catalog number L6 _ _ _ _ with specified materials and pipe size

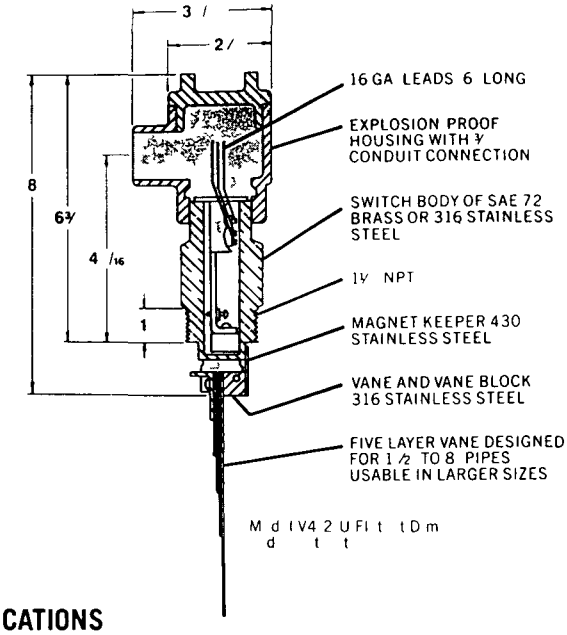
MODEL V4-2-U FLOTECT® Vane Operated Flow Switch

Explosion Proof U L and C S A listed – Class I Groups C D Class II Groups E F, G

Dependable protection against flow variation or stopping in pipelines for fluids gases and flowing solids

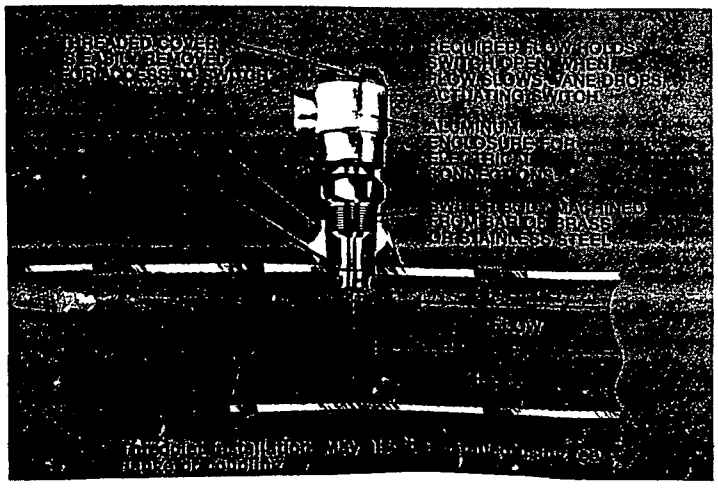
Supplied with Multi Layer Vane for field installation in pipes from 1½ to 8 diameter





Compact and reliable the Flotect® V4 Flow Switch operates automatically to protect equipment and pipeline systems against damage from reduction or loss of flow In stalled in thousands of pipelines and pro cessing plants around the world this unique magnetically actuated switching design gives superior performance Removing ap propriate layers of the five layer vane allows installation in pipes from 1½ to 8 in diame ter There are no bellows springs or seals to fail Instead the free swinging vane attracts a magnet within the sealed switch body above actuating a micro switch by means of a simple lever arm

Features include Simplicity of design and a leak proof switch body Machined from bar stock (for pressures to 2000 psig) it elimi nates the possibility of pipeline product entering the switch compartment The threaded conduit enclosure cover permits easy inspection or replacement of electri cal assembly without shutting down the pipeline or removing electrical conduit The unit fits directly into pipeline with tee thredolet flange or coupling for easy in stallation Pendulum like vane action re sponds accurately to product flow rate The multi layer vane is sensitive to low velocity flows yet it is rugged enough to withstand high flow surges If desired a delay timer can be wired into the installation The explo sion proof unit is U L and C S A listed for Class I Groups C and D Class II Groups E F and G



APPLICATIONS

Protects motors pumps and other equipment against low flow and no flow Controls sequential operation of pumps etc Automatically starts auxiliary pumps and engines or actuates alarm and signal systems Stops water cooled engines machines and processes when coolant flow is interrupted Shuts down burner when air flow through heating coil fails Controls dampers according to flow Stops machine tools if cooling oil flow ceases

PHYSICAL DATA

Temperature limits Standard 275 F Extra cost option (not U L or C S A) V 4 SS MT 316 stainless steel 400 F max

Operating pressure 2000 psig max 2500 psig Rating to 5000 psig available

Piping Connection 1½ NPT

Electrical rating SPDT snap action micro switch contact rating 10 amps U L 5 amps C S A 125/ 250 VAC 60 Hz 5 amps resistive 3 amps inductive 30 volts DC Con tact life 1 000 000 cycles

Wire 16 gauge copper 6 long mechanically and solder bonded to switch

Switch body One piece milled bored brass 316 stainless steel extra cost option

Vane Stainless steel 1⁹/₆ wide

Installation Within 5 vertical for proper operation Index arrow must point in direction of flow

Weight 4 lbs 4 oz

Options Time delay relay adjusta ble from 1 to 180 seconds Car tridge heater to melt paraffin etc DPDT snap switches

ACTUATION/DEACTUATION FLOW RATES
Upper figures are SCFM air lower shaded figures are GPM cold water

Vane Layers	1 / Pipe	2 Pipe	3 Pipe	4 Pipe	6 Pipe	8 Pipe
1	50 17	95 31	185 53	354 130	936 353	1225 534
1 2		32 14	88 44	176 102	556 291	786 533
1 2 3			44 21	126 71	327 211	550 392
1 2 3 4				63 40	229 172	471 330
1 2 3 4 5					141 106	315 236
C t m s l b l f t p t g g l m 6 t 7 ft/ l q d					000 t 6000 ft/m	

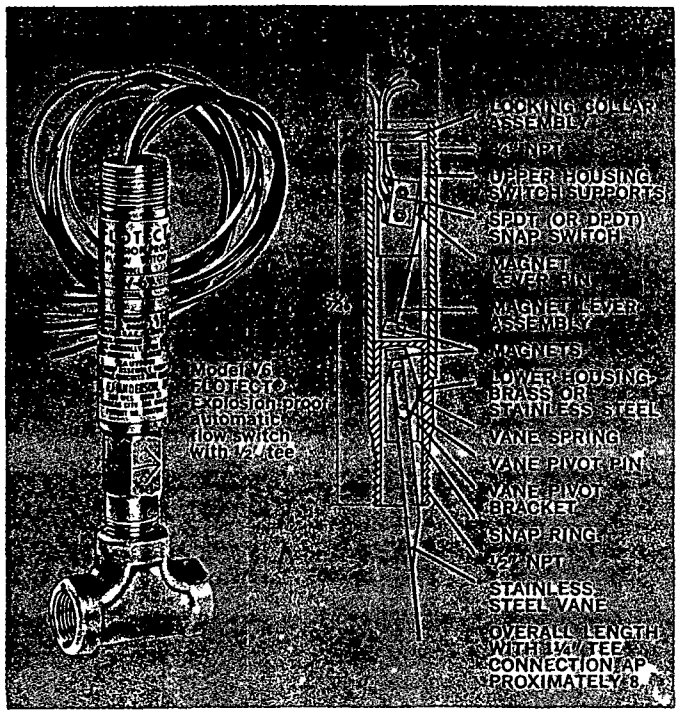
Suggested Specification

Automatic explosion proof flow switches shall be vane operated to actuate a single pole double throw snap switch Motion of the vane shall actuate switch by action of a magnet linked to the switch inside the single piece sealed switch body Switches shall be W E Anderson Catalog No V4 _____ with specified materials and vane area

ORIGIN (Red)

MODEL V6 FLOTECT® Mini-Size Flow Switches

Explosion Proof U L and C S A listed Built to protect against low flow and flow stoppage in pipelines from ½ to 2 dia*
For pressures to 2000 psig, to 220 F maximum



Surprisingly compact the Flotect® V6 Flow Switch is engineered specifically to monitor liquid gas or air flows in pipelines from ½ to 2 diameter With bushings added it is easily adapted to ¼ and ⅜ piping It is solidly built and designed for years of trouble free service on critical operations The brass or stainless steel bar stock lower body is leak proof preventing the pipeline product from entering switch housing above There is no mechanical linkage – the flow switch is magnetically actuated and explosion proof The lower body holds the flow vane and one magnet which controls the switch actuating magnet in separate housing above Maintenance is easy The entire electrical assembly can be removed for inspection or replacement without shutting down the pipeline A low flow version of the V6 is available which provides field adjustment of the actuation flow point

Installation is also easy Simply insert the tee in the pipeline and complete the electrical and conduit connections The Flotect V6 is U L and C S A listed for explosion proof service – Class I Groups A B C and D Class II Groups E F and G The C S A model must be furnished with explosion proof junction box for wiring connections

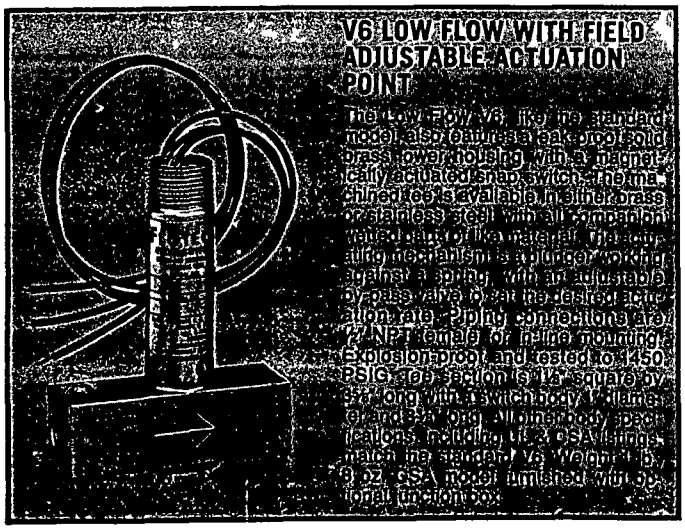
W th bush ngs adapts to / a d ⅜'

HOW FLOTECT PROTECTS EQUIPMENT

Operation is simple and dependable In most applications switch is normally off while flow of liquid gas or air continues When flow slows or stops vane spring moves vane actuating switch to start or stop motor pump engine etc operate a damper or valve shut down a burner or actuate an alarm or signal It will control sequential operations of pumps and protect unattended equipment from damage

USED IN A WIDE RANGE OF APPLICATIONS

- Chemical Processing
- Air Conditioning
- Refrigeration
- Boilers
- Heating Processes
- Cooling Lines
- Compressors
- Machinery
- Liquid Transfer
- Water Treatment
- Sprinkler Systems
- Fuel Oil Pumps
- Lube Oil Lines
- Food Processing
- Blending Operations
- Machine Tools


V6 LOW FLOW WITH FIELD ADJUSTABLE ACTUATION POINT
The Low Flow V6, like the standard model, also features a leak proof solid brass lower housing with a magnetically actuated snap switch. The machined tee is available in either brass or stainless steel with all companion wetted parts of like material. The actuating mechanism is a plunger working against a spring, with an adjustable by-pass valve to set the desired actuation rate. Piping connections are ½" NPT female for in-line mounting. Explosion proof and tested to 1450 PSIG. Tee section is 1⅛" square by 3⅞" long with a switch body 1" diameter and 3⅜" long. All other body specifications, including U L & CSA listings, match the standard V6. Weight 1 lb. 8 oz. CSA model furnished with optional junction box.

PHYSICAL DATA

Temperature limits 220 F max

Operating pressure To 2000 psig

Piping connection / to 2 For / and /8 use /2 switch tee and bushings

Electrical rating One (or two) SPDT snap action micro switch(es) 5 amps 125/250 VAC 60 Hz

Wire 18 gauge 18 long

Switch body Lower housing choice of brass or stainless steel Upper housing brass

Vane Stainless steel standard /6 wide x 020

Installation Install with Index Arrow pointing in direction of flow

Position Mount in any position

Weight Approx 1 lb 12 oz with 1/ switch tee construction

ACTUATION/DEACTUATION FLOW RATES
Upper figures are SCFM air lower shaded figures are GPM cold water

MODEL	PIPE SIZE	ACTUATE	DEACTUATE	MAX FLOW
STD	/2	6 5	5 0	42
STD	/	9 0	8 0	96
STD	1	14	12	102
STD	1¼	19	17	114
STD	1½	33	30	126
STD	2	43	36	135
LOW FLOW	½	04 1 10 GPM	03 1 00 GPM	1 25 GPM (10 psig drop)
LOW FLOW	½	18 3 90 SCFM (Air)	15 3 40 SCFM (Air)	

NOTE Actuation rates in ¼ and ⅜ pipe approx same as ½ pipe

Suggested Specification

Automatic explosion proof flow switches shall be vane operated to actuate a single pole double throw snap switch Motion of the vane shall actuate switch by action of a magnet which controls the switch inside the one piece sealed switch body Switches shall be W E Anderson Catalog No V6 ____ with specified materials and pipe size

Special Models For O.E.M. Requirements

Mercoid®
A Division of
DWYER INSTRUMENTS, INC.

Engineered for special applications
Many U.L. or C.S.A. listed, already tooled and tested
Typical examples shown – many more available

Model DS
Fixed Deadband
Fully Automatic
Single Adjustment

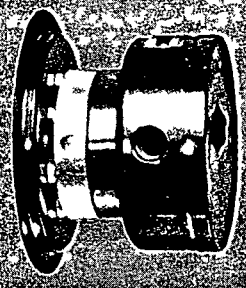
Model DR
Manual Reset
Single Adjustment
Semi Automatic

Type E Enclosure
for Hazardous Areas

Special type E explosion proof enclosure allows control to be removed if required

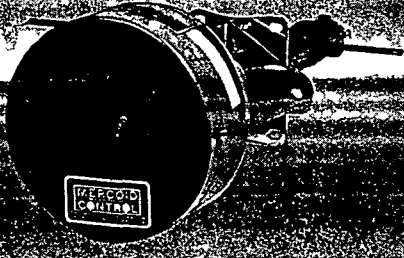
Type MSAG
Pipe Mounted
Diaphragm Seals
Available with DA
Series Switches

Type 316 stainless steel or tantalum diaphragm seals reduce risk of corrosion damage to Bourdon tubes



Series CPV
Low Pressure
Diaphragm Controls
with High Over-pressure Protection

Set point range 1-60 inches of water with 1 maximum deadband
Maximum over pressure 600 PSIG



Series ML-51
Damper Position
Switch

Switch is actuated by damper vane, to prevent fan operation until damper is in proper position. Also can operate lights, alarms when damper is open/closed.

Model V4-PVC
Flotect®
Flow Switch

Special Flotect has PVC body for corrosive fluids. Vane available in Monel, Hastalloy, Titanium, etc.

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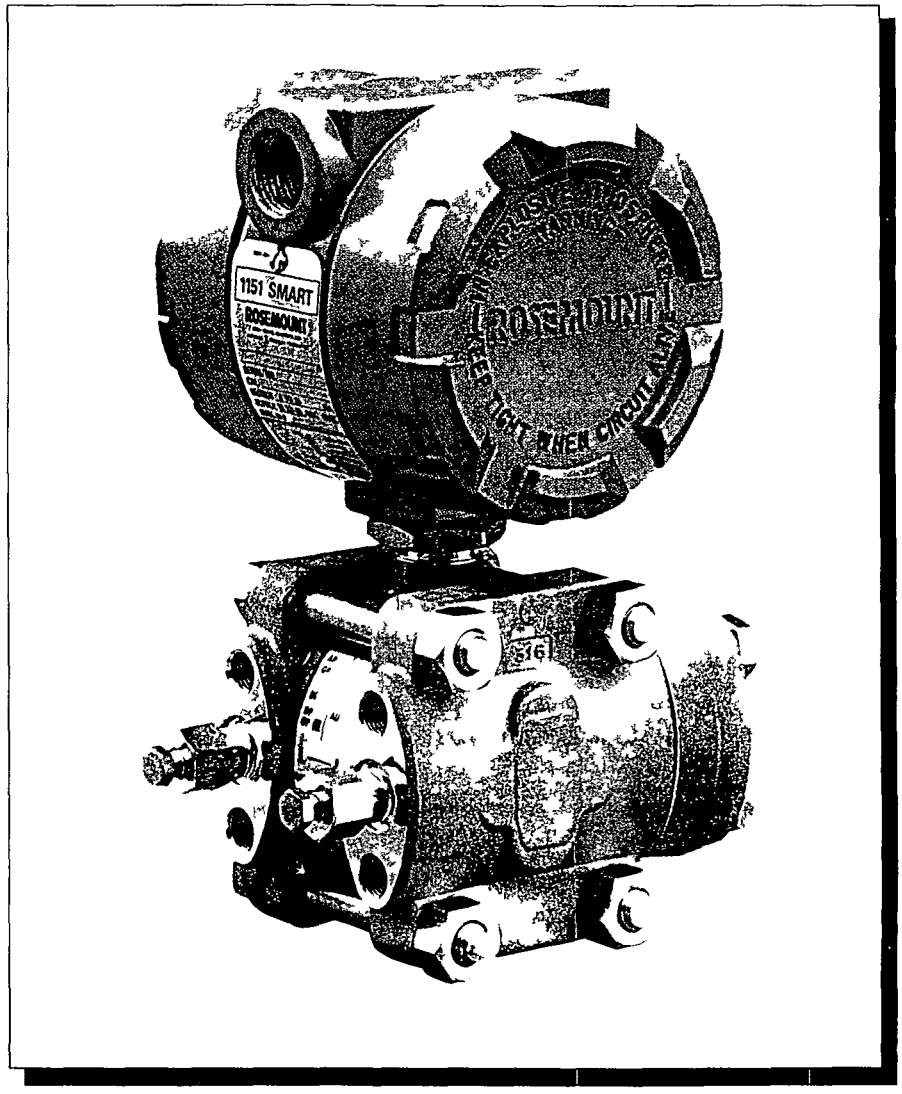
Model 1151 Alphaline® Pressure Transmitters



ROSEMOUNT® MEASUREMENT

FISHER ROSEMOUNT Managing The Process Better™

FEATURES

- *A complete family of transmitters*
- *Ranges from 0–0 5 inH$_2$0 to 6 000 psig (1 24 kPa to 41 369 kPa)*
- *Solid state plug in circuit boards*
- *Compact rugged construction impervious to vibration*
- *Local span and zero adjustments*
- *Modular construction*
- *Adjustable damping*
- *Numerous options to permit greater application flexibility*
- *Smart analog or low power electronics*

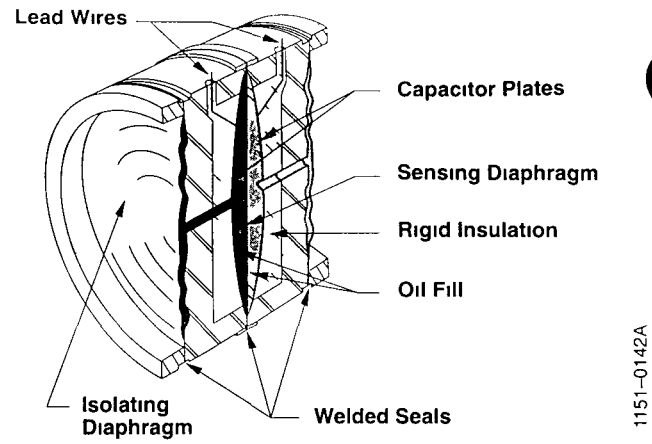


FIGURE 1 Cross Section of the Rosemount δ Cell Sensor

INTRODUCTION

This product data sheet highlights Rosemount© Model 1151 differential absolute gage and high line pressure differential transmitter features and options For information about the draft range liquid level transmitters transmitters with remote seals and additional information on smart transmitters refer to their respective data sheets referenced on the back page of this data sheet

INDUSTRY LEADING PERFORMANCE AND FEATURES

The Model 1151 Alphaline© series of pressure transmitters brings true precision to the measurement of flow level gage and absolute pressures vacuum and specific gravity Direct electronic sensing with the completely sealed δ-cells capacitance sensing element allows significant improvement and stability in pressure measurements Welded stress isolation clamping in the sensor housing prevents introduction of errors caused by stresses and torques on the process flanges and minimizes effects of line pressure and overpressure

Installation calibration and commissioning are simplified by compact design integral junction box and local span and zero adjustments

The housing features an explosion proof weather proof construction with separate compartments for the electronics and wiring connections For most models 316L SST Hastelloy® C Monel© gold plated Monel or tantalum materials are available for corrosive serv ce Modular construction and plug in printed circuit boards aid in trouble shooting and reduce parts stocking

APPLICATIONS

Model 1151 Pressure Transmitters are available in a variety of configurations for differential flow gage absolute vacuum liquid level and specific gravity measurement applications The transmitter model number determined from the ordering information tables specifies available features such as pressure ranges outputs and materials of construction that are basic to each transmitter Additional options such as accessories certifications and special manufacturing procedures are also available

OPERATION

During operation the isolating diaphragms and fill fluid on the high and low sides transmit the process pressure to the oil fill fluid The fluid in turn transmits the process pressure to a sensing diaphragm in the center of the δ cell (delta cell) sensor The sensing diaphragm functions as a stretched spring element that deflects in response to differential pressure across it (in GP transmitters atmospheric pressure is transmitted in a like manner to the low side of the sensing diaphragm) In AP transmitters a reference pressure is maintained on the low side The displacement of the sensing diaphragm a maximum movement of 0 004 in (0 10 mm) is proportional to the pressure Capacitor plates on both sides detect the position of the sensing diaphragm The differential capacitance between the sensing diaphragm and the capacitor plates is converted electronically to an appropriate current voltage or digital HART© (Highway Addressable Remote Transducer) output signal

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May be protected by one or more of the following U S Patent Nos 3 854 039 3 975 719 4 339 750 5 237 285 Re 30 603 May Depend on Model Other U S and Foreign Patents Issued and Pending

SPECIFICATIONS

Functional Specifications

Service

Liquid gas and vapor applications

Ranges

See Table 2 for ranges Minimum span equals the upper range limit (URL) divided by rangedown Rangedown varies with the output code See Table 1

Outputs

Code S Smart
4–20 mA dc user selectable for linear or square root output Digital process variable superimposed on 4–20 mA signal available to any host that conforms to the HART protocol

Code E Analog
4–20 mA dc linear with process pressure

Code G Analog
10–50 mA dc linear with process pressure

Code J Analog
4–20 mA dc square root of differential input pressure between 4 and 100% of input Linear with differential input pressure between 0 and 4% of input

Code L Low Power
0 8 to 3 2 V dc linear with process pressure

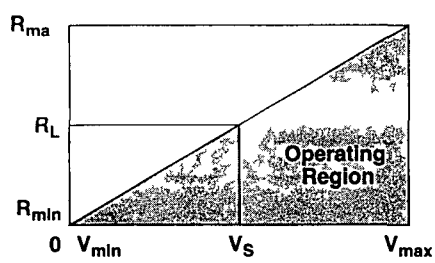
Code M Low Power
1 to 5 V dc linear with process pressure

Power Supply

External power supply required Transmitter operates on

Output Codes S E J	12 to 45 V dc with no load
Output Code G	30 to 85 V dc with no load
Output Code L	5 to 12 V dc
Output Code M	8 to 14 V dc

Where



Code	V_{min}	V_{max}	R_{min}	R_{max}	R_L at Supply Voltage (V_S)
S(1)	12	45	0	1650	$R_L = 43\ 5\ (V_S - 12)$
E J	12	45	0	1650	$R_L = 50\ (V_S - 12)$
G(2)	30	85	0	1100	$R_L = 20\ (V_S - 30)$

(1) A minimum of 250 ohms is required for communication
(2) Low power minimum load impedance 100 kΩ

Current Consumption Under Normal Operating Conditions (Low Power Only)

Output Code L
1 5 mA dc

Output Code M
2 0 mA dc

Span and Zero

Output Code S
Span and zero may be accessed with local adjustments or remotely through a HART compatible Interface

Output Codes E G J L and M
Span and zero are continuously adjustable

Zero Elevation and Suppression

Output Codes S E and G
Zero elevation and suppression must be such that the lower range value is greater than or equal to the (–URL) and the upper range value is less than or equal to the (+URL) The calibrated span must be greater than or equal to the minimum span

Output Code J
Zero is adjustable up to 10% of the calibrated flow span

Output Code L
Zero is adjustable ±10% of URL and span is adjustable from 90 to 100% of URL

Output Code M
Zero is adjustable ±50% of URL and span is adjustable from 50 to 100% of URL

Temperature Limits

Electronics Operating

Code S	–40 to 185 F (–40 to 85 C)
Code E	–40 to 200 F (–40 to 93 C)
Code G L M	–20 to 200 F (–29 to 93 C)
Code J	–20 to 150 F (–29 to 66 C)

Sensing Element Operating

Silicone fill	–40 to 220 F (–40 to 104 C)
Inert fill	0 to 160 F (–18 to 71 C)

Storage

Code S	–60 to 185 F (–51 to 85 C)
Codes E G L M	–60 to 250 F (–51 to 121 C)
Code J	–60 to 180 F (–51 to 82 C)

Static Pressure Limits

Transmitters operate within specifications between the following limits

Model 1151DP
0 5 psia (3 45 kPa) to 2 000 psig (13 790 kPa)

Model 1151HP
0 5 psia (3 45 kPa) to 4 500 psig (31 027 kPa)

Model 1151AP
0 psia to the URL

Model 1151GP
0 5 psia (3 45 kPa) to the URL

TABLE 1 Rangeability

Output Code	Minimum Span (URL=Upper Range Limit)	Maximum Span
S (DP and GP SST Range 3–8 HP SST Range 4–7)	URL/15	2 × URL(1)
S (All Others)	URL/6	2 × URL(1)
E G J	URL/6	URL
L	URL/1.1	URL
M	URL/2	URL

(1) Transmitter is capable of measuring from –URL to URL

TABLE 2 Model 1151 Transmitter Range Availability by Mode (URL = Upper Range Limit)

Range Code	Model 1151 Ranges (URL)	DP	HP	GP	DP/GP/Seals	AP
3	30 inH_2O (7 46 kPa)		NA		NA	NA
4	150 inH_2O (37 3 kPa)	•	•	•	•	•
5	750 inH_2O (186 4 kPa)					
6	100 psi (689 5 kPa)					
7	300 psi (2068 kPa)					
8	1000 psi (6895 kPa)		NA		NA	
9	3000 psi (20684 kPa)	NA	NA		NA	NA
0	6000 psi (41369 kPa)	NA	NA		NA	NA

TABLE 3 Model 1151 Upper Range Limits (URL)

Range Code	bar	mbar	kg/cm^2	psi	kPa	inH_2O @20 °C	mmH_2O @20 °C	inHg @0 °C
3	0 075	75	0 076	1 082	7 461	30	762	2 203
4	0 373	373	0 380	5 409	37 305	150	3810	11 013
5	1 865	1865	1 901	27 045	186 505	750	19050	55 065
6	6 90	6895	7 031	100	690	27 73	70434	204
7	21	20685	21	300	2069	8319	211302	611
8	69	68950	70	1000	6895	27730	704340	2036
9	207	206850	211	3000	20685	83190	2113020	6108
0	413 686	413686	421 842	6000	41369	166378	4225992	12216 12

TABLE 4 Model 1151 Output Code Availability

Code	Model 1151 Output Options/Damping	DP	HP	GP	DP/GP/Seals	AP
S	4–20 mA Digital Smart/Variable					
E	4–20 mA Linear Analog/Variable					
G	10–50 mA Linear Analog/Variable					
J(1)	4–20 mA Square Root Analog/Variable			NA	NA	NA
L	0 8 to 3 2 V Linear Low Power/Fixed					
M	1 to 5 V Linear Low Power/Fixed	•	•	•	•	•

(1) Available with Ranges 3–5

Overpressure Limits

Model 1151 transmitters withstand the following limits without damage

Model	Range	
DP	0 psia to 2 000 psig (0 to 13790 kPa)	
HP	0 psia to 4 500 psig (0 to 31027 kPa)	
AP	0 psia to 2 000 psia (0 to 13790 kPa)	
GP	Ranges 3–8	0 psia to 2 000 psig (0 to 13790 kPa)
	Range 9	0 psia to 4 500 psig (0 to 31027 kPa)
	Range 0	0 psia to 7 500 psig (0 to 51710 kPa)

Burst Pressure Limit

All models 10 000 psig (68 95 MPa) burst pressure on the flanges

Humidity Limits

0 to 100% relative humidity

Volumetric Displacement

Less than 0 01 in³ (0 16 cm³)

Failure Mode Alarm

If self diagnosis detects a gross transmitter failure the analog signal will be driven below 3 9 mA or above 21 mA to alert the user High or low alarm signal is user selectable

Level	4–20 mA Saturation Value	4–20 mA Alarm Value
Low	3 9 mA	3 8 mA
High	20 8 mA	21 75 mA

Transmitter Security

Activating the transmitter security function prevents changes to the transmitter configuration including local zero and span adjustments Security is activated by an internal switch

Overpressure Alarm

If the sensor detects a negative overpressure value the analog signal will be driven to 3 9 mA If the sensor detects a positive overpressure value the analog signal is driven to 20 8 mA

Damping

Numbers given are for silicone fill fluid at room temperature The minimum time constant is 0 2 seconds (0 4 seconds for Range 3) Inert filled sensor values would be slightly higher

Output Code S
Time constant is adjustable in 0 1 second increments from minimum to 16 0 seconds

Output Codes E and G
Time constant continuously adjustable between minimum and 1 67 seconds

Output Code J
Time constant continuously adjustable between minimum and 1 0 second

Output Codes L M
Damping is fixed at minimum time constant

Turn on Time

Maximum of 2 0 seconds with minimum damping Low power output is within 0 2% of steady state value within 200 ms after application of power

Performance Specifications

(Zero based calibrated ranges reference conditions silicone oil fill 316 SST isolating diaphragms)

Accuracy

Output Code S

Ranges 3 through 8 DP and GP transmitters
Ranges 4 through 7 HP transmitters

±0 1 of calibrated span for spans from 1 1 to 10 1 of URL Between 10 1 and 15 1 of URL

$$\text{accuracy} = \pm\left[0\ 02\left(\frac{\text{URL}}{\text{span}}\right) - 0\ 1\right]\% \text{ of calibrated span}$$

All other ranges and transmitters
±0 25% of calibrated span

Output Code S square root mode

$$\pm\left[0\ 2 + 0\ 05 \times \left(\frac{\text{URL}}{\text{span}}\right)\right]\% \text{ of calibrated flow span}$$

Output Codes E G L and M
±0 2% of calibrated span for Model 1151DP Ranges 3 through 5 All other ranges and transmitters ±0 25% of calibrated span

Output Code J
±0 25% of calibrated span

Stability

Output Code S
±0 1% of URL for six months for DP and GP Ranges 3 through 8 (±0 25% for all other ranges and transmitters)

Output Codes E and G
±0 2% of URL for six months for Ranges 3 through 5 (±0 25 for all other ranges)

Output Codes J L and M
±0 25% of URL for six months

Temperature Effect

Output Code S [–20 to 185 F (–29 to 85 C)]

For DP and GP transmitter Range 4 through 8
HP transmitter Range 4 through 7

Zero Error = ±0 2% URL per 100 F (56 C)
Total Error = ±(0 2% URL + 0 18% of calibrated span) per 100 F For other ranges and transmitters follow analog temperature specifications (Output Code E)

Output Code E G L and M
[–20 to 200 F (–29 to 93 C)]

For Ranges 4 through 0
Zero Error = ±0 5% URL per 100 F
Total Error = ±(0 5% URL + 0 5% of calibrated span) per 100 F double the effect for Range 3

Output Code J
The total output effect whether at zero or full scale including zero and span errors is ±1 5% of URL per 100 F (56 C) ±2 5% of URL per 100 F (56 C) for Range 3

Static Pressure Effect

DP Transmitters

Zero Error
±0 25% of URL for 2 000 psi (13790 kPa) or ±0 5% for Range 3 correctable through rezeroing at line pressure

Span Error
Correctable to ±0 25% of input reading per 1 000 psi (6895 kPa) or to ±0 5% for Range 3 For Output Code J the span error is correctable to ±0 125% of output reading per 1 000 psi or to ±0 25% for Range 3

HP Transmitters

Zero Error
±2 0% of URL for 4 500 psi (31027 kPa) correctable through rezeroing at line pressure

Span Error
Correctable to ±0 25% of input reading per 1 000 psi (6895 kPa)
For Output Code J the span error is correctable to ±0 125% of output reading per 1 000 psi

Vibration Effect

0 05% of URL per g to 200 Hz in any axis

Power Supply Effect

Output Codes S E G and J
Less than 0 005% of output span per volt

Output Codes L M
Output shift of less than 0 05% of URL for a 1 V power supply shift

Load Effect

Output Codes S E G and J
No load effect other than the change in power supplied to the transmitter

Output Codes L M
Less than 0 05% of URL effect for a change in load from 100 kΩ to infinite ohms

Short Circuit Condition (Low Power Only)

No damage to the transmitter will result when the output is shorted to common or to power supply positive (limit 12 V)

EMI/RFI Effect

Output shift of less than 0 1% of span when tested to SAMA PMC 33 1 from 20 to 1000 MHz and for field strengths up to 30 V/m (Code J is 0 1% of flow span)

Mounting Position Effect

Zero shift of up to 1 inH_2O (0 24 kPa) that can be calibrated out Range 3 transmitters with Output Code J should be installed with the diaphragm in the vertical plane

Physical Specifications
Standard Configuration

Wetted Materials

Isolating Diaphragms
316L SST Hastelloy® C 276 Monel gold plated Monel or Tantalum See ordering table for availability per model type

Drain/Vent Valves
316 SST Hastelloy C or Monel See ordering table for availability per model type

Process Flanges and Adapters
Plated carbon steel 316 SST Hastelloy C or Monel See ordering table for availability per model type

Wetted O rings
Viton® (other materials also available) With gold plated Monel diaphragms (diaphragm Code _6) special fluorocarbon O rings are supplied

Non wetted Materials

Fill Fluid
Silicone oil or inert fill

Bolts and Bolting Flange (GP and AP only)
Plated carbon steel

Electronics Housing
Low copper aluminium NEMA 4X

Cover O rings
Buna N

Paint
Epoxy polyester

Process Connections

¼–18 NPT on 2 125 in (54 mm) centers on flanges for Ranges 3 4 and 5

¼–18 NPT on 2 188 in (56 mm) centers on flanges for Ranges 6 and 7

¼–18 NPT on 2 250 in (57 mm) centers on flanges for Range 8

½–14 NPT on adapters

For Ranges 3 4 and 5 flange adapters can be rotated to give centers of 2 0 in (51 mm) 2 125 in (54 mm) or 2 250 in (57 mm)

Electrical Connections

½–14 NPT conduit with screw terminals and integral test jacks compatible with miniature banana plugs (Pomona 2944 3690 or equivalent) The Model 268 SMART FAMILY Interface connections are fixed to the terminal block on smart transmitters

Weight

12 lb (5 4 kg) for AP DP GP and HP transmitters excluding options

Optional Selections

The following sections describe a variety of available options for the Model 1151 Transmitter These options will permit greater application flexibility

MOUNTING BRACKETS

B1 Bracket for 2 in Pipe Mounting

Bracket for mounting transmitter on 2 in pipe

Constructed of carbon steel with carbon steel U bolt

Coated with epoxy polyester paint

B4 Bracket for 2 in Pipe with 316 SST Bolts

Same bracket as Option B1 with 316 SST bolts

B7 304 SST Bracket and 316 SST Bolts for 2 in Pipe Mounting

Same bracket as Option Code B1 with all SST materials

B2 Bracket for Panel Mounting

Bracket for mounting transmitter on panel or wall

Constructed of carbon steel with carbon steel bolts

Coated with epoxy polyester paint

B5 Bracket for Panel with 316 SST Bolts

Same bracket as Option B2 with 316 SST bolts

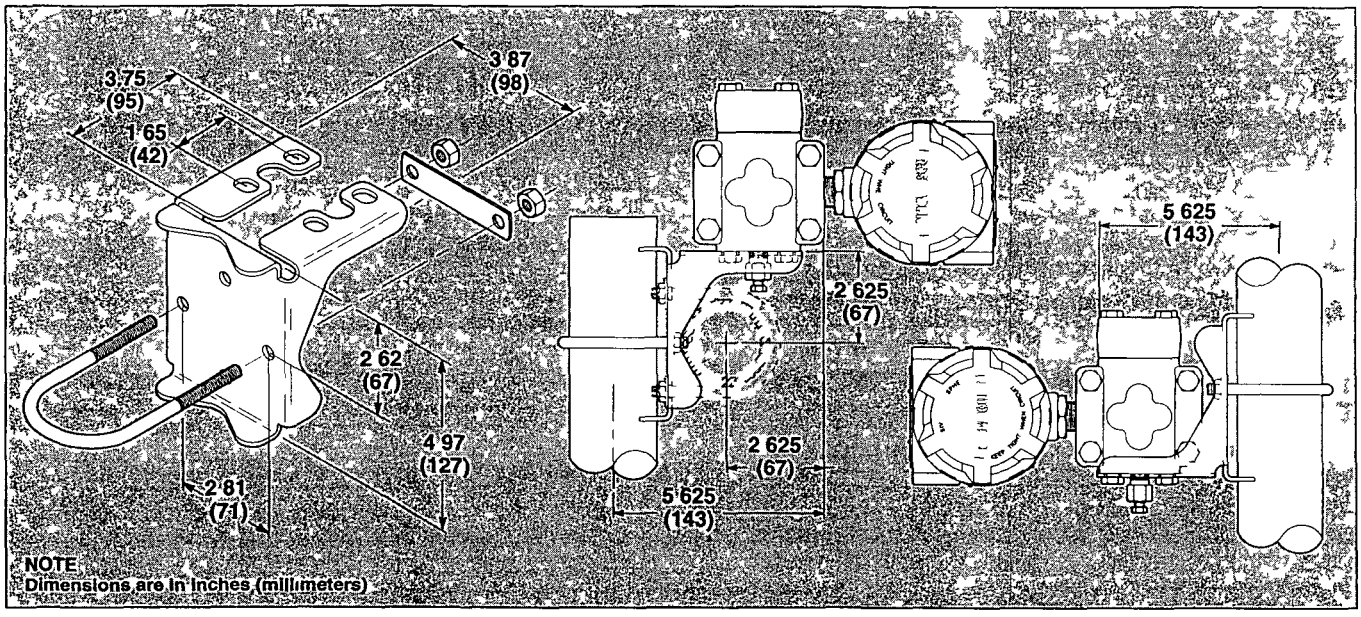


FIGURE 2 Mounting Bracket Option Codes B1 B4 and B7

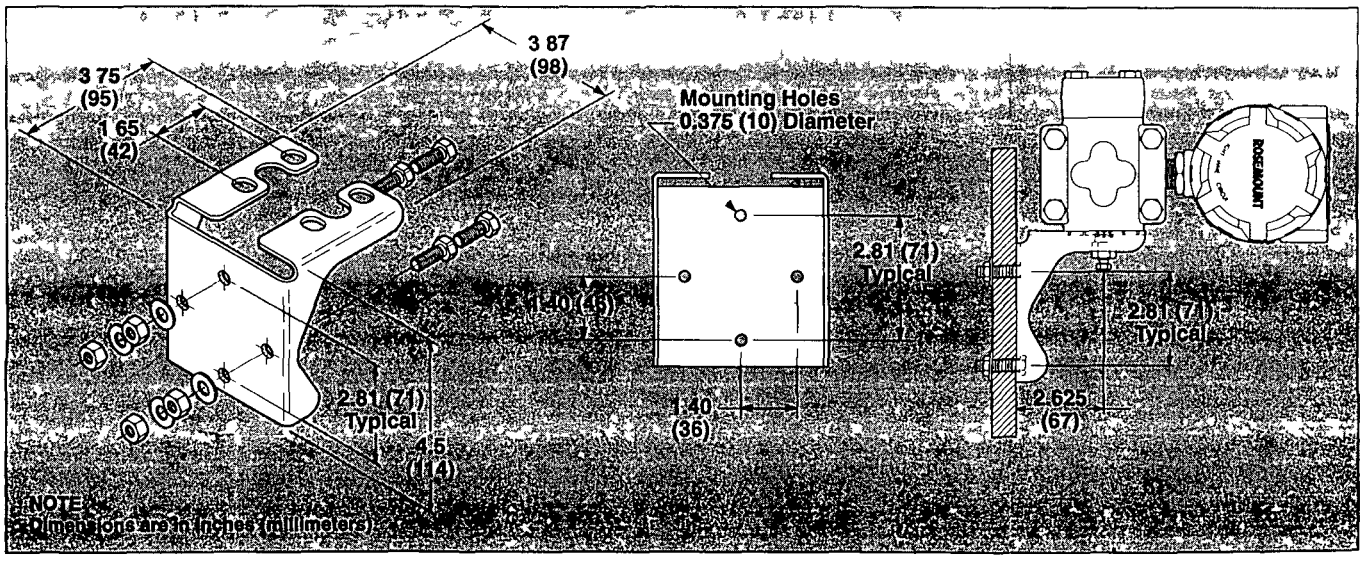


FIGURE 3 Panel Mounting Bracket Option Codes B2 And B5

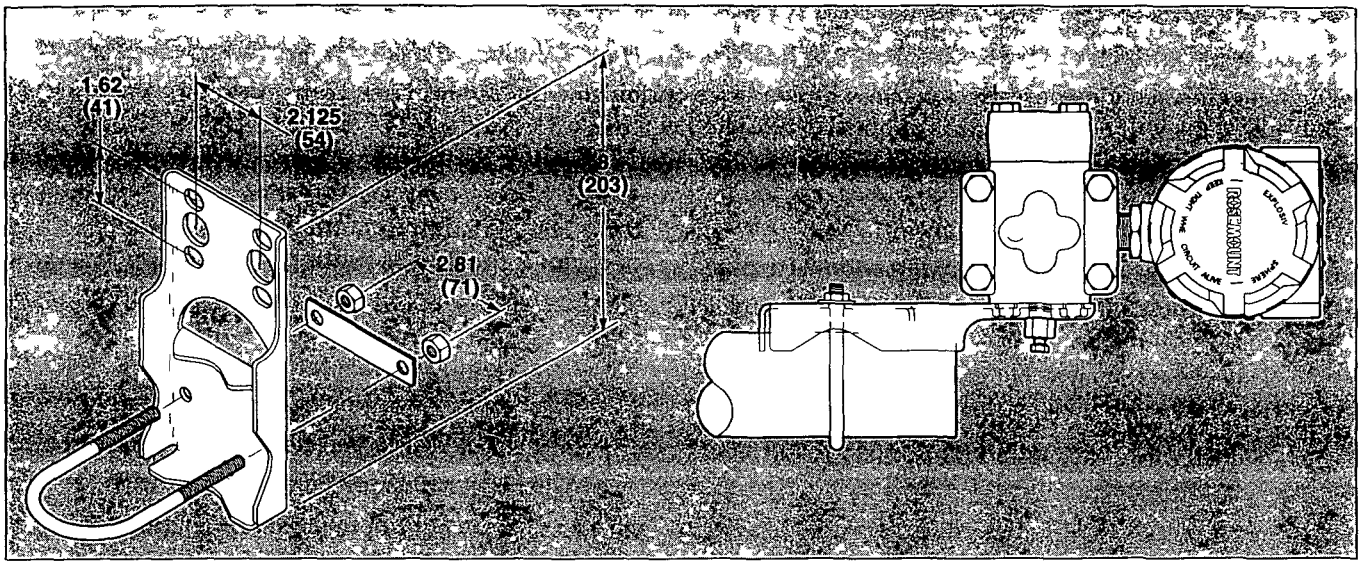


FIGURE 4 Flat Mounting Bracket Option Codes B3 B6 and B9

B3 Flat Bracket for 2 in Pipe Mounting

Bracket for vertical mounting of transmitter on 2 in pipe

Constructed of carbon steel with carbon steel U bolt

Coated with epoxy polyester paint

B6 Flat Bracket for 2 in Pipe with 316 SST Bolts

Same bracket as Option B3 with 316 SST bolts

B9 304 SST Flat Bracket and 316 SST Bolts for 2 in Pipe Mounting

Same bracket as Option B3 with all SST materials

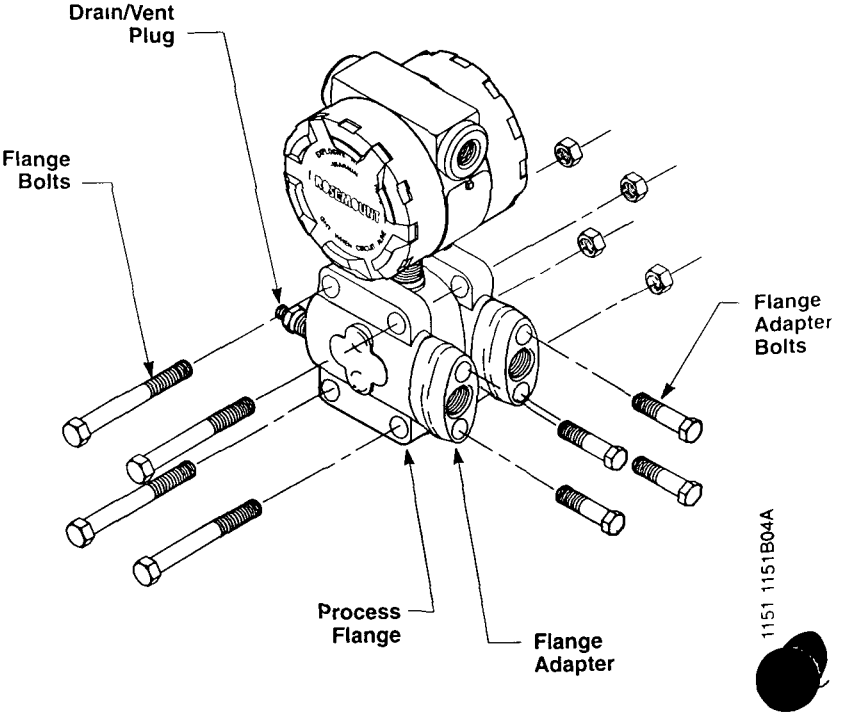
BOLTS AND NUTS FOR FLANGES AND ADAPTERS

Options permit bolts and nuts for flanges and adapters in the specified material

L3 ANSI/ASTM A 193 B7

L4 Austenitic 316 SST

L5 ANSI/ASTM A193 B7M



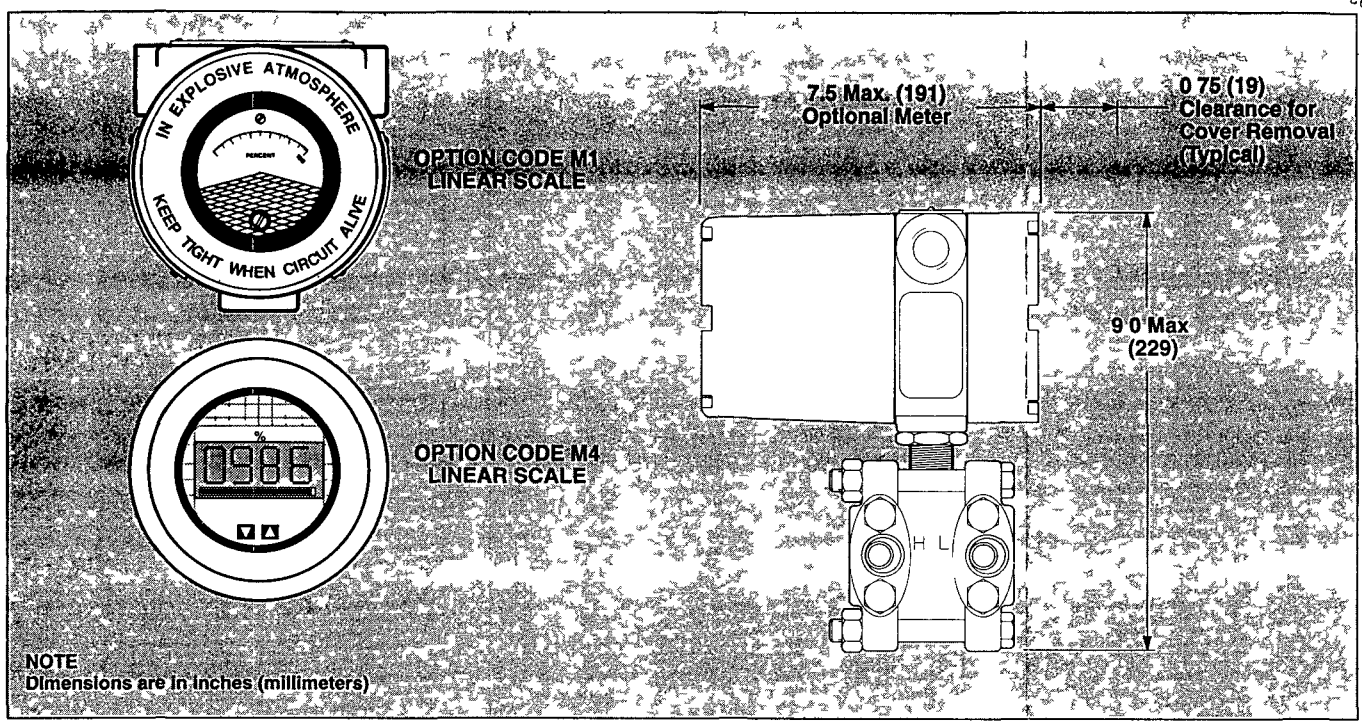


FIGURE 5 Meter Options

METERS

Analog

Meters have 2 in (50 8 mm) scale

Plug in mounting configuration

Indication accuracy ±2%

Operating temperature limit –40 to 150 F (–40 to 65 C)

Meters are enclosed in a housing certified by Factory Mutual as explosion proof for Class I Division 1 Groups B C and D Class II Division 1 Groups E F and G and Class III Division 1

For Optional CSA explosion proof approval see certification Option Code E6

M1 Linear Analog Meter 0–100% Scale

M2 Square Root Analog Meter 0–100% Flow Scale

M3 Special Scaling Analog Meter (Specify Range)

M6 Square Root Analog Meter 0–10$\sqrt{\ }$ Scale

LCD

4 digit display

Indication accuracy ±0 25% of calibrated span ±1 digit

Display resolution at ±0 5% of calibrated span ±1 digit

Operating temperature limit –4 to 158 F (–20 to 70 C)

Plug in mounting configuration

Meters are enclosed in a housing certified by Factory Mutual as explosion proof for Class I Division 1 Groups B C and D Class II Division 1 Groups E F and G and Class III Division 1

For Optional CSA explosion proof approval see certification Option Code E6

M4 Linear LCD Meter 0 to 100%

M7 Special Scale LCD Meter (Specify Range Mode and Engineering Units)

M8 Square Root LCD Meter 0 to 100%

M9 Square Root LCD Meter 0 to 10

NOTES

Meter Options are not available with Output Codes L or M or Option Codes V2 or V3

Meter Options M2 M6 M8 and M9 are not available with Output Code J

Meter Options M4 M7 and M9 are not available with Output Code G

ORIGINAL Rev

CERTIFICATIONS

TABLE 5 FM Entity Approvals

1151 Parameters	Equipment Associated Parameters	FM Approved for Class I, II, III, Division 1 and 2 Groups		
		A	B	C–G
V_{Ma} = 40 V I_M = 165 mA C_I = 0 (Standard) C_I = 0 024 µF (Smart) C = 0 010 µF (Standard w/R Option) C = 0 034 µF (Smart w/R Option) L_I = 0 (Standard) L = 20 µH (w/R Option)	$V_{OC} \leq 40$ V $I_{SC} \leq 165$ mA $C_A > 0$ $C_A > 0$ 024 µF $C_A > 0$ 010 $C_A > 0$ 034 $L_A > 0$ $L_A > 20$ µH			
V_M = 40 V I_M = 225 mA C = 0 (Standard) C = 0 024 µF (Smart) L = 0	$V_{OC} \leq 40$ V $I_{SC} \leq 225$ mA $C_A > 0$ $C_A > 0$ 024 µF $L_A > 0$	NA	NA	

TABLE 6 CSA Barrier Selection

Barrier Manufacturer/Model	CSA Approved for Class I, Division 1 and 2 Groups			
	A	B	C	D
Any CSA Approved Barrier ≤30 V ≥ 330 Ω or ≤ 28 V ≥300 Ω or ≤22 V ≥ 180 Ω				
Foxboro Converters 2AS I3I CGB 2AI I3V CGB 2AI 12V CGB 2AS I2I CGB 3A2 I2D CS E/CGB A 3F4 I2DAI CS E/CGB A 3AD I3IA CS E/CGB A 3A2 I3D CS E/CGB A and 3A4 I2DA CS E/CGB A	NA			
Any CSA Approved Barrier ≤ 30 V ≥ 150 Ω	NA	NA		

Hazardous Locations Certifications

Stainless steel certification tag is provided

Factory Mutual (FM) Approvals

FM Explosion Proof tag is standard Appropriate tag will be substituted if optional certification is selected

Explosion Proof Class I Division 1 Groups B C and D Dust Ignition Proof Class II Division 1 Groups E F and G Suitable for use in Class III Division 1 Indoor and outdoor use NEMA 4X Factory Sealed

I5 Intrinsic Safety and Non incendive Approvals FM certifications optional for specific Classes Divisions and Groups when connected in accordance with the FM entity approvals table Table 4 Factory Sealed

Canadian Standards Association (CSA) Approvals

E6 Explosion proof for Class I Division 1 Groups C and D Class II Division 1 Groups E F and G Class III Division 1 Hazardous Locations Certified for Class I Division 2 Groups A B C and D CSA enclosure 4 Factory Sealed

I6 Intrinsic Safety Approvals CSA certifications optional for specific Classes Divisions and Groups when connected in accordance with the CSA barrier selection table Table 5 Not available with Output Code G

C6 Combination of I6 and E6 CSA Explosion Proof and Intrinsic Safety Approval Factory Sealed

Standards Association of Australia (SAA) Flameproof Certification

E7 Ex d IIB T6 DIP T6 IP 65
Class I Zone 1

Standards Association of Australia (SAA) Intrinsic Safety Certification

I7 Analog

Ex ia IIC T6 Class I Zone 0

Smart
Ex ia IIC T6 Class I Zone 0

Low Power
Ex ia IIC T4 Class I Zone 0

ORIGINAL Red

CESI/CENELEC Flameproof Certification

E8 90 C 016 EEx d IIC T6 (without meter)
90 C 017 EEx d IIB + H2 T6 (with meter)
IP 65

CESI/CENELEC Intrinsic Safety Certification

I8 EEx ia IIC T6 (P_{max} = 0 35 W)
EEx ia IIC T5 (P_{max} = 1 00 W)
IP 65

BASEEFA/CENELEC Intrinsic Safety Certification

I1 Smart
EEx ia IIC T5 (T_{amb} = 40 C)
EEx ia IIC T4 (T_{amb} = 80 C)

Analog
EEx ia IIC T5

BASEEFA Type N (Non incendive) Certification

N1 Output Code S
Ex N II T5 (T_{amb} = 50 C) Un = 45 V
Ex N II T4 (T_{amb} = 80 C) Un = 45 V

Output Code E
Ex N II T6 Un = 28 V

Output Code F
Ex N II T5 Un = 45 V

Output Code J
Ex N II T5 Un = 30 V In = 30 mA

Schweizerischer Elektrotechnischer Verein (SEV) Intrinsic Safety Certification

IC Smart
EEx ia IIC T5 (T_{amb} = 40 C)
EEx ia IIC T4 (T_{amb} = 80 C)

Analog
EEx ia IIC T6 (P_{max} = 0 35 W)
EEx ia IIC T5 (P_{max} = 0 65 W)
EEx ia IIC T4 (P_{max} = 0 95 W)

PROCESS CONNECTIONS

D1 Side Drain/Vent Top

Drain/vent valve mounted in side of flange

Top position used to vent gas buildup in liquid process applications with transmitter mounted vertically

Plug of same material as requested flange inserted in end of flange opposite adapter

D2 Side Drain/Vent Bottom

Drain/vent valve mounted in side of flange

Bottom position used to drain liquid buildup in gas process applications with transmitter mounted vertically

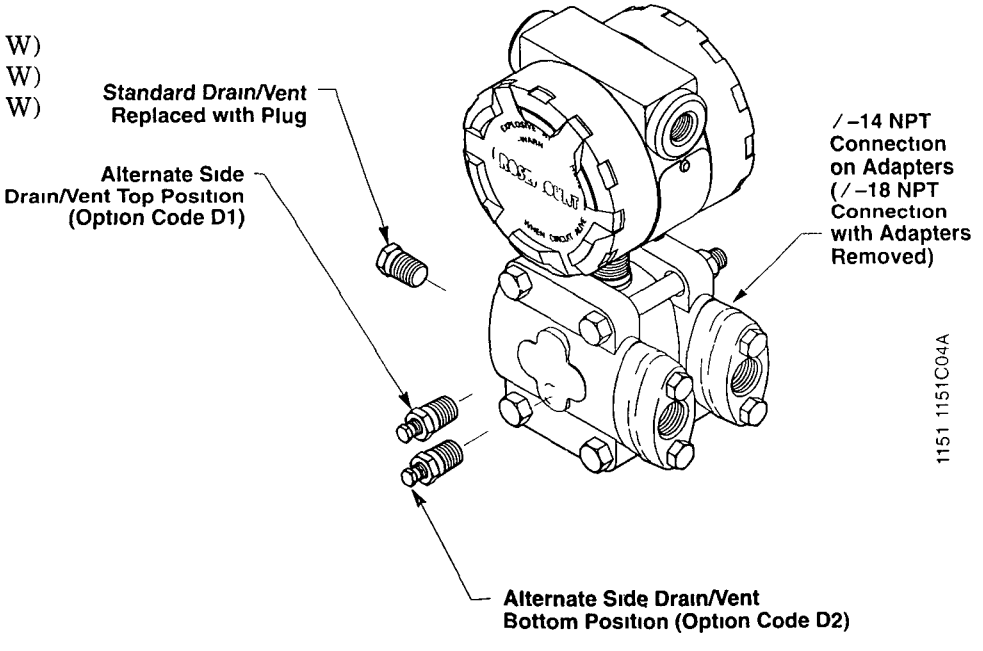
Plug of same material as requested flange inserted in end of flange opposite adapter

D3 ¼–18 NPT Process Connection

Option provides ¼–18 NPT process connection on flanges rather than standard ½–14 NPT

Flange adapters are deleted to provide desired connection

D6 316 SST Low Side Flange (Models 1151GP and 1151AP Only)



K1 ¼–18 NPT Kynar ™ Process Flange Insert

K2 ½–14 NPT Kynar Process Flange Insert

Options provide Kynar plastic process flange insert that prevents process from coming in contact with the metal of the flange One process insert for Models 1151AP GP and LT· two inserts for Model 1151DP

Process connections are from the side

Available with carbon steel and stainless steel process flanges only

Pressure Maximum 200 psi at 200 F with Kynar impulse piping 300 psi at 200 F with metal impulse piping

S1 Assembled with One Remote Diaphragm Seal

S2 Assembled with Two Remote Diaphragm Seals

Options provide for the assembly of one or two remote diaphragm seals

For Models 1151AP and 1151LT applications consult factory

For seal choices consult Product Data Sheet PDS 4016

S4 Assembled with Model 1195 Integral Orifice

Designed for highly accurate small bore flow measurement of any clean gas liquid or vapor See Product Data Sheet PDS 4686

Reduce the costs associated with traditional orifice plate installations

Several configurations are available factory assembled to Rosemount differential pressure transmitters [1]

Wide orifice bore/flow range capability

Wide choice of process connections including threaded socket weld and ANSI flanges

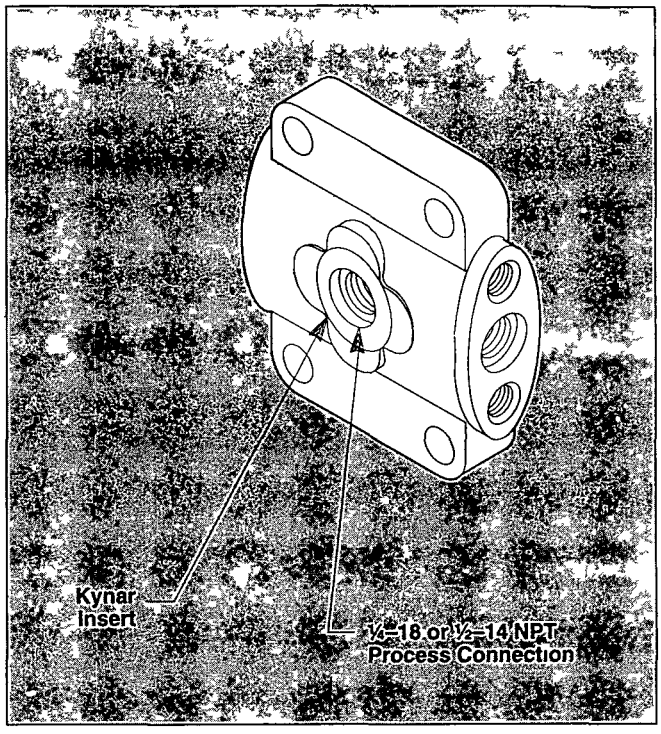
Static pressure maximum limit is 3 000 psig

Wetted materials are available that comply with NACE MR 01 75(90)

Available only with Ranges 2 3 4 and 5

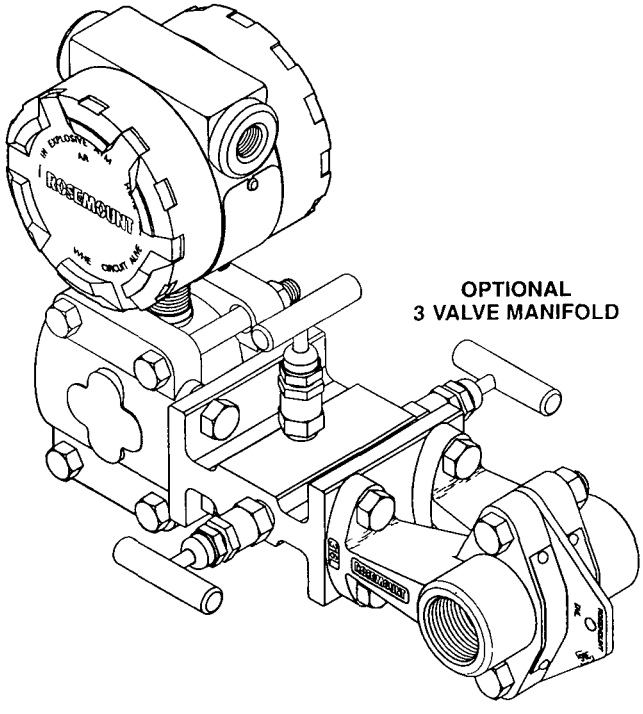
For integral orifice selection see Product Data Sheet PDS 4686

(1) Applicable only to orifice assemblies without piping



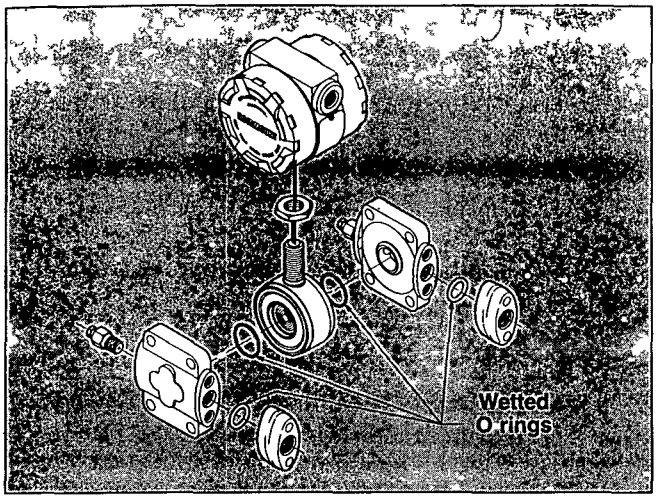
1151 1151D17A

MODEL 1151 TRANSMITTER



1151 1151A21A

MODEL 1195 INTEGRAL ORIFICE ASSEMBLY



1151 1151B17B

TABLE 7 Hydrostatic Test Pressure

Model	Test Pressure
1151DP	3 000 psi
1151HP	6 750 psi
1151AP	2 000 psi
1151GP	
Ranges 3–8	2 000 psi
Range 9	4 500 psi
Range 0	7 500 psi
1151LT	
Class 150 Flange	450 psi
Class 300 Flange	1 100 psi
1151DR	1 500 psi

WETTED O RINGS

W2 Buna N

W3 Ethylene Propylene

W4 Aflas®

W6 Spring Loaded Teflon®

Contains a Hastelloy spring that is in contact with the process fluid Consult factory if Hastelloy is unacceptable

PROCEDURES

Standard Configuration

Unless otherwise specified transmitter will be shipped as follows

Engineering Units	inH_2O
4 mA	0
20 mA	Upper Range Limit
Output	Linear
Software Tag	Blank

Customer may specify the above items at no charge Software tag (8 characters) is left blank unless specified

C9 Custom Configuration (Option Code C9)

If Option Code C9 is ordered the customer may specify the following data in addition to the standard configuration parameters Refer to Configuration Data Sheet CDS 4593

Descriptor	16 characters
Message	32 characters
Date	Day Month Year
Damping	Seconds
Burst Mode	Select Output Choice
Flange Material	Model Code Information
O Ring Material	Model Code Information
Isolator Material	Model Code Information
Sensor Fluid	Model Code Information
Drain/Vent	Model Code Information
Integral Meter	Installed or None
Remote Seal	Specified Information
Failure Mode	High or Low
Transmitter Security	Off or On

P1 Hydrostatic Testing

Each transmitter is hydrostatic tested according to Table 7

Test medium is water

This option provided for transmitters with remote diaphragm seal on application only

Rosemount Procedure 1746 outlines the testing procedure

P2 Cleaning for Special Service

This option minimizes contaminants to the process system by cleaning wetted surfaces with a suitable detergent

Rosemount Procedure 97412 outlines the cleaning procedure

P3 Cleaning for <1 PPM Chlorine/Fluorine

P4 Calibration at Line Pressure

This option allows transmitters to be calibrated at an elevated line pressure rather than atmospheric pressure

Customer must specify line pressure at which transmitter is to be calibrated

Customer is provided with calibration data at line pressure and equivalent data at atmospheric pressure

Available with Models 1151DP and 1151HP only (Not available with Remote Seals)

Elevated line pressure and differential span desired for calibration must not exceed the rated pressure for that model of transmitter

Minimum differential span that can be calibrated at elevated line pressure is 30 inH_2O maximum is 300 psi

Rosemount Procedure 3787 outlines the calibration procedure

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P5 Calibration at Temperature

This option allows transmitters to be calibrated at temperatures other than room temperature in the range of 0 to 200 F (–18 to 93 C)

Customer must specify temperature at which transmitter is to be calibrated and calibration range

Calibration temperature will be printed on instrument tag specified by customer or on a tag wired to the transmitter if no tag is specified

Rosemount Procedure 27823B outlines the calibration procedure

P7 Enhanced Temperature Performance for Analog Electronics

Transmitter is specifically compensated as a complete assembly and will exhibit ½ of the standard temperature coefficient over the ambient temperature range of 20 to 140 F (–7 to 60 C) Outside this range the unit will meet the standard temperature effect specification published for that model

Not available on Range 10 limited to 1 500 psi on Range 9

The transmitter is compensated as an assembly therefore units in which the sensor module or electronics are changed after the P7 procedure has been performed will meet the standard published temperature specification for that particular model

Available on DP GP and HP models Ranges 3–8 with SST diaphragms and Output Codes E G L and M

P8 0 1% Accuracy for Analog Electronics

Available on Model 1151DP (Ranges 3–8) GP (Ranges 3–8) HP and LT transmitters with 316 SST diaphragms and Output Codes E G L and M

OUTPUTS

V1 Reverse Output

This option permits reversing of pressure input so that electrical output will increase as **pressure input decreases**

This option applies only to Models 1151GP and 1151LT When this option is selected the process flange adapter drain/vent valve appropriate O rings and bolting are installed on low side of transmitter Not available for Ranges 9 and 0

Not available with Model 1151AP Reverse output on Models 1151DP 1151HP and 1151DR can be obtained by connecting high pressure input to low side of transmitter and vice versa

This option should not be ordered with smart transmitters (Output Code S) The Model 1151 Smart transmitter can be configured for reverse output through the Model 268 SMART FAMILY© Interface

V2 1 Ω Test Resistor

A 1 Ω precision resistor is mounted across the test terminals to provide 4–20 mV output or a 10–50 mV output if 10–50 mA output is used

This option cannot be used with any meter options or Option Codes I5 or I6

V3 5 Ω Test Resistor

A 5 Ω precision resistor is mounted across test terminals to provide 20–100 mV output or a 50–250 mV output if 10–50 mA output is used

This option cannot be used with any meter options or Option Codes I5 or I6

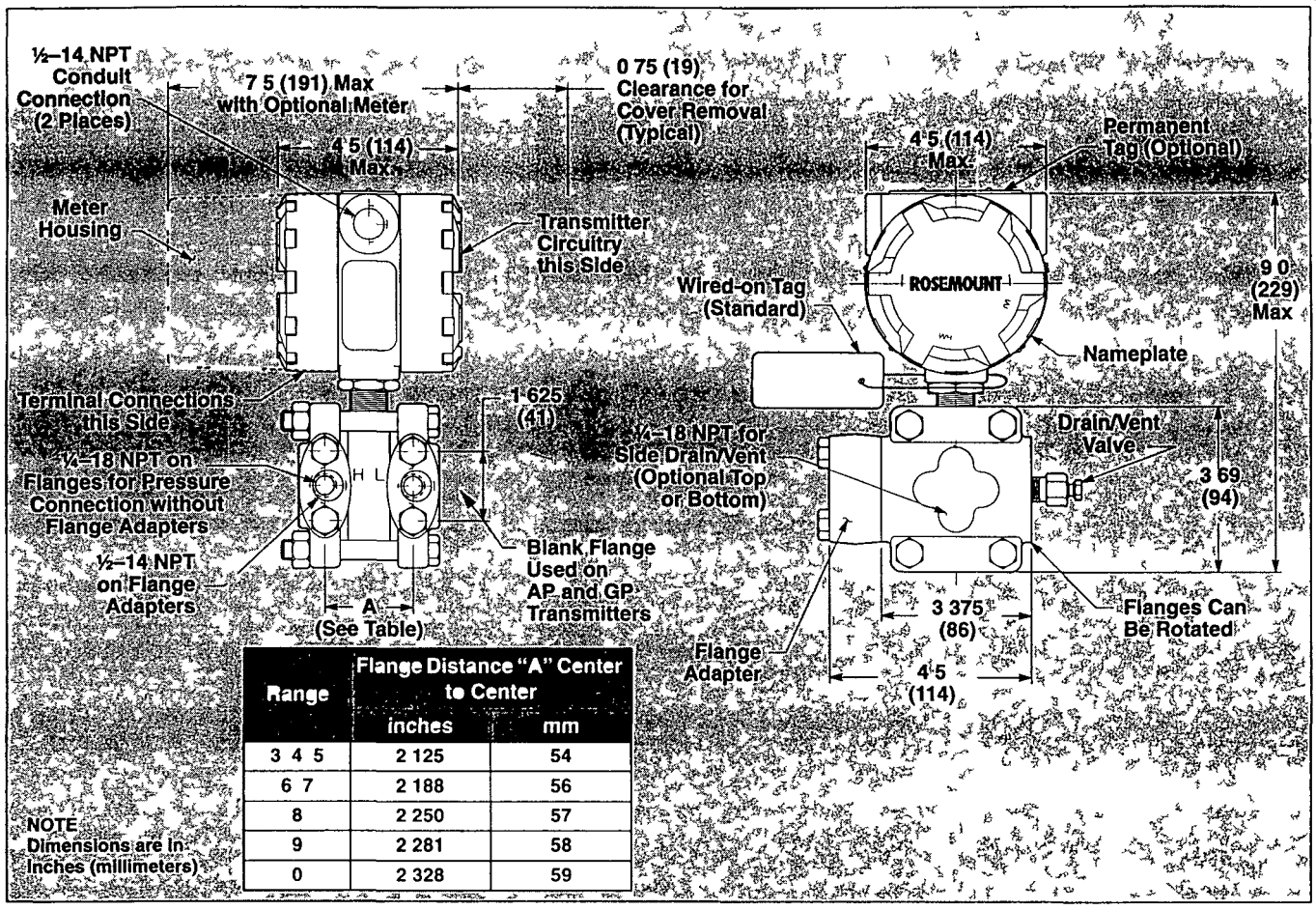
Z1 4 Wire 0–20 mA Output

Z2 4 Wire 0–16 mA Output

Z3 4 Wire 0–10 mA Output

These options provide a zero based current output

These options cannot be used with any meter or certification options Vx options or Output Codes G L M or S



Range	Flange Distance "A" Center to Center	
	inches	mm
3 4 5	2 125	54
6 7	2 188	56
8	2 250	57
9	2 281	58
0	2 328	59

FIGURE 6 Model 1151 Transmitter Dimensional Drawing

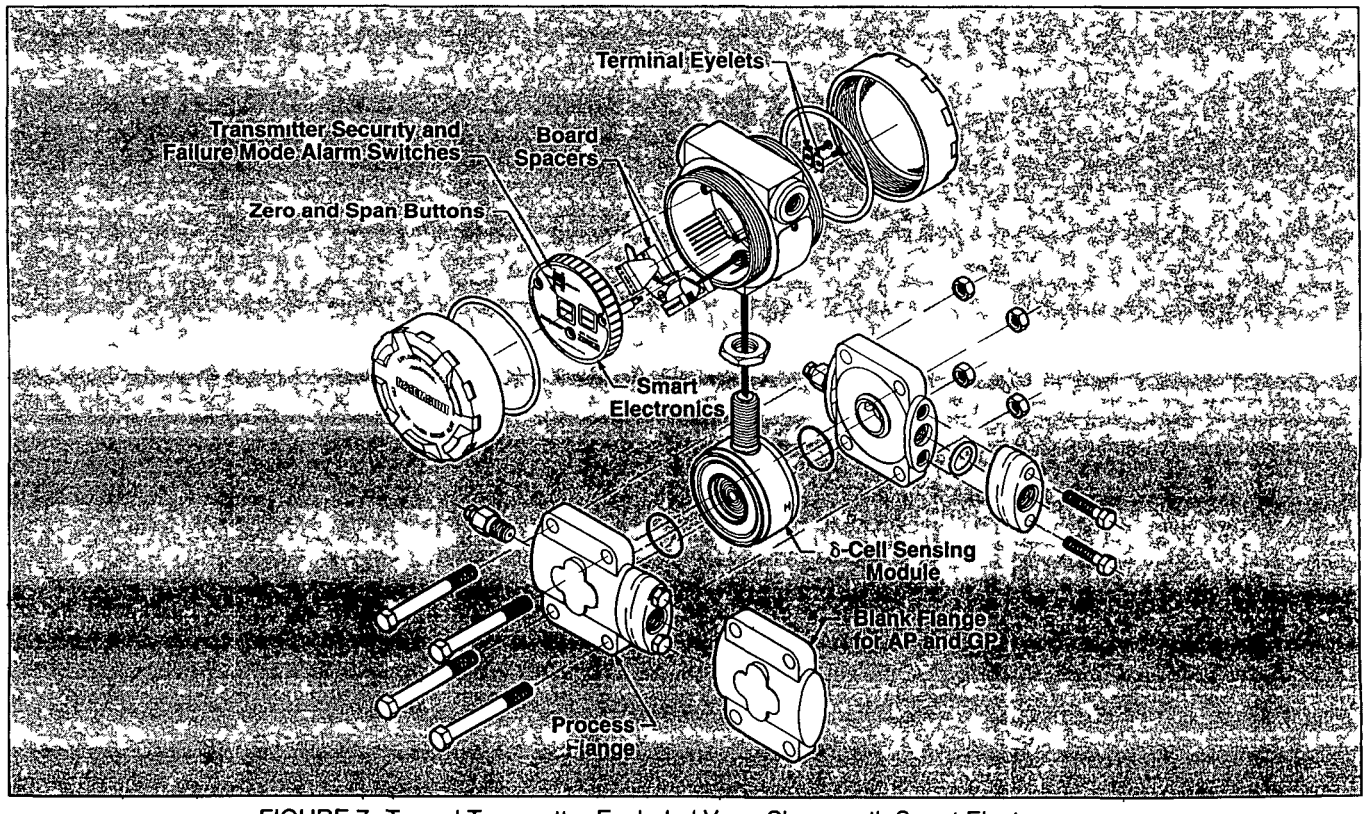


FIGURE 7 Typical Transmitter Exploded View Shown with Smart Electronics

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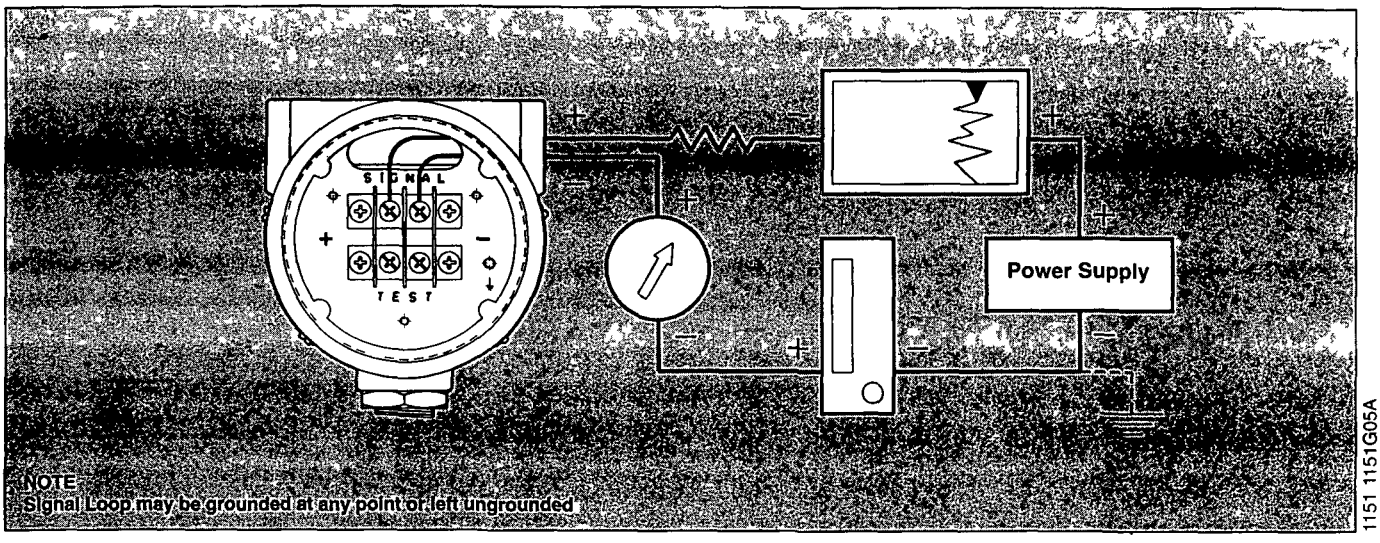

FIGURE 8 Wiring Diagram for Output Codes E and G

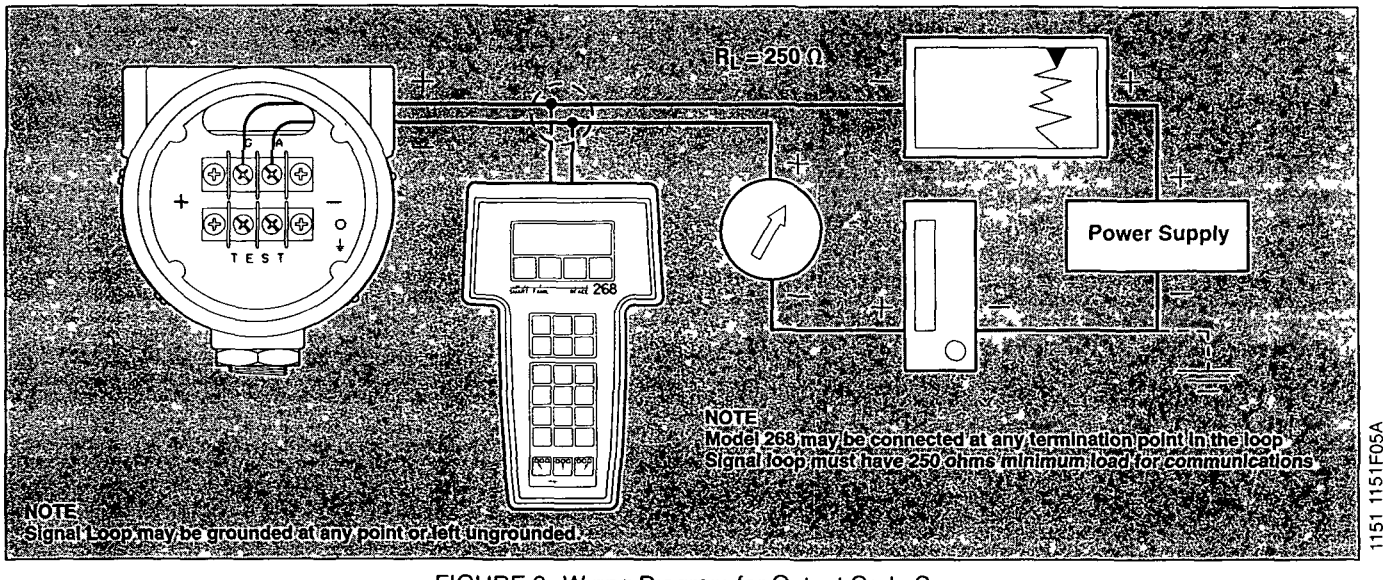

FIGURE 9 Wiring Diagram for Output Code S

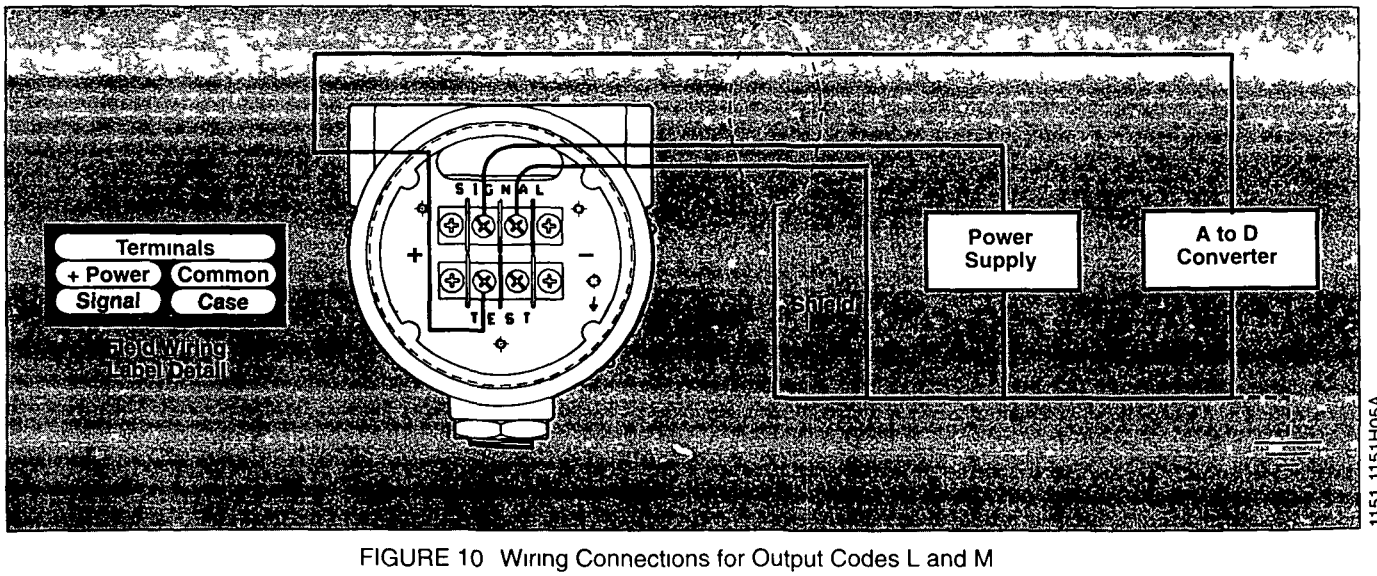

FIGURE 10 Wiring Connections for Output Codes L and M

Transmitter Ordering Information

— = Not Applicable • = Applicable

Model	Transmitter Type (select one)	Base Price DP	HP	GP	AP
1151DP	Differential Pressure Transmitter	•	—	—	—
1151HP	Differential Pressure Transmitter for High Line Pressures	—		—	—
1151GP	Gage Pressure Transmitter	—	—		—
1151AP	Absolute Pressure Transmitter	—	—	—	•

Code	Pressure Ranges (URL) (select one)	Add DP	HP	GP	AP
3	30 inH_2O (7 46 kPa)	•	—	•	—
4	150 inH_2O (37 3 kPa)				
5	750 inH_2O (186 4 kPa)				•
6	100 psi (689 5 kPa)			•	
7	300 psi (2068 kPa)				
8	1 000 psi (6895 kPa)		—		
9	3 000 psi (20684 kPa)	—	—		—
0	6 000 psi (41369 kPa)	—	—		—

Rangeability

Output Code	Min Span
S (DP and GP SST Range 3–8 HP SST Range 4–7)	URL/15
S (all others)	URL/6
E G J	URL/6
L	URL/1 1
M	URL/2

Code	Transmitter Output (select one)	DP	HP	GP	AP
S	4–20 mA/Digital Smart/Variable Damping				
E	4–20 mA Linear Analog/Variable Damping	•			
G	10–50 mA Linear Analog/Variable Damping				
J	4–20 mA Square Root Analog/Variable Damping			—	—
L	0 8 to 3 2 V Linear Low Power/Fixed Damping				
M	1 to 5 V Linear Low Power/Fixed Damping				

Code	MATERIALS OF CONSTRUCTION (1) Flanges/Adapters	Drain/Vents	Diaphragms	Fill Fluid	DP	HP	GP(2)	AP(2)
52	Nickel plated Carbon Steel	316 SST	316L SST	Silicone				
53	Nickel plated Carbon Steel	316 SST	*Hastelloy C*	Silicone				
54	Nickel plated Carbon Steel	316 SST	*Monel*	Silicone				
55	Nickel plated Carbon Steel	316 SST	Tantalum	Silicone		—		—
56	Nickel plated Carbon Steel	316 SST	Gold plated *Monel*	Silicone		—		—
12	Cadmium plated Carbon Steel	316 SST	316L SST	Silicone				
22	316 SST	316 SST	316L SST	Silicone				
23	316 SST	316 SST	*Hastelloy C*	Silicone				
24	316 SST	316 SST	*Monel*	Silicone				
25	316 SST	316 SST	Tantalum	Silicone		—		—
26	316 SST	316 SST	Gold plated *Monel*	Silicone		—		—
33	*Hastelloy C*	*Hastelloy C*	*Hastelloy C*	Silicone				
34	*Hastelloy C*	*Hastelloy C*	*Monel*	Silicone		—		—
35	*Hastelloy C*	*Hastelloy C*	Tantalum	Silicone		—		—

(1) Bolts and conduit plugs are plated carbon steel
(2) On GP and AP transmitters the low side flange is plated carbon steel For a stainless steel low side flange order process connections Option Code D6

(continued on next page)

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Code	MATERIALS OF CONSTRUCTION [1] – continued from previous page Flanges/Adapters	Drain/Vents	Diaphragms	Fill Fluid	DP	HP	GP[2]	AP[2]
36	*Hastelloy C*	*Hastelloy C*	Gold plated *Monel*	Silicone	•	—	•	—
43	*Monel*	*Monel*	*Hastelloy C*	Silicone	•		•	•
44	*Monel*	*Monel*	*Monel*	Silicone	•	•	•	•
45	*Monel*	*Monel*	Tantalum	Silicone		—		—
46	*Monel*	*Monel*	Gold plated *Monel*	Silicone		—		—
73[3]	316 SST	*Hastelloy C*	*Hastelloy C*	Silicone				
83[3]	Nickel plated Carbon Steel	*Hastelloy C*	*Hastelloy C*	Silicone	•	•	•	•
5A	Nickel plated Carbon Steel	316 SST	316L SST	Inert		—		—
5B	Nickel plated Carbon Steel	316 SST	*Hastelloy C*	Inert		—		—
5C	Nickel plated Carbon Steel	316 SST	*Monel*	Inert		—	•	—
5D	Nickel plated Carbon Steel	316 SST	Tantalum	Inert		—		—
1A	Cadmium plated Carbon Steel	316 SST	316L SST	Inert	•	—	•	—
2A	316 SST	316 SST	316L SST	Inert		—		—
2B	316 SST	316 SST	*Hastelloy C*	Inert		—		—
2D	316 SST	316 SST	Tantalum	Inert	•	—	•	—
3B	*Hastelloy C*	*Hastelloy C*	*Hastelloy C*	Inert		—		—
3D	*Hastelloy C*	*Hastelloy C*	Tantalum	Inert		—		—
4B	*Monel*	*Monel*	*Hastelloy C*	Inert		—		—
4C	*Monel*	*Monel*	*Monel*	Inert		—		—
4D	*Monel*	*Monel*	Tantalum	Inert		—		—
7B[3]	316 SST	*Hastelloy C*	*Hastelloy C*	Inert		—	•	—
8B[3]	Nickel plated Carbon Steel	*Hastelloy C*	*Hastelloy C*	Inert		—		—

Optional Selections

Code	Mounting Brackets (optional – select one)	DP	HP	GP	AP
B1	Bracket 2 in Pipe Mount				
B2	Bracket Panel Mount				
B3	Bracket Flat 2 in Pipe Mount				
B4	B1 Bracket w/Series 316 SST Bolts				
B5	B2 Bracket w/Series 316 SST Bolts				
B6	B3 Bracket w/Series 316 SST Bolts				
B7	316 SST B1 Bracket with 316 SST Bolts				
B9	316 SST B3 Bracket with 316 SST Bolts				
Code	**Meters (optional - select one)**	**DP**	**HP**	**GP**	**AP**
M1[4]	Analog Scale Linear Meter 0–100 /				
M2[5]	Analog Scale Square Root Meter 0–100 / Flow			—	—
M3[4]	Analog Scale Linear Meter Special Scale				
M4[ ]	LCD Display Linear Meter 0–100 / User Selectable				
M6[5]	Analog Scale Square Root Meter 1–10√			—	—
M7[6]	LCD Display Linear Meter Special Configuration				
M8[5 6]	LCD Display Square Root Meter 0–100 / Flow	•		—	—
M9[5 6]	LCD Display Square Root Meter 0–10√			—	—

(1) Bolts and conduit plugs are plated carbon steel

(continued on next page)

(2) On GP and AP transmitters the low side flange is plated carbon steel For a stainless steel low side flange order process connections Option Code D6

(3) These selections meet NACE material recommendations per MR01 75

(4) Not available with Output Codes L or M or Option Codes Zx V2 or V3

(5) Not available with Output Codes J L M or Option Codes Zx V2 or V3

(6) Not available with Output Codes G L M or Option Codes Zx V2 or V3

Code	Certifications (optional - select one)	DP	HP	GP	AP
E6	Canadian Standards Association (CSA) Explosion Proof Approval (NOTE: FM explosion proof approval is standard)			•	
I5(7)	Factory Mutual (FM) Non incendive and Intrinsic Safety Approval		•	•	
I6(7)	Canadian Standards Association (CSA)Intrinsic Safety Approval				
C6(7)	Combination of I6 and E6 CSA Explosion Proof and Intrinsic Safety Approval (Requires 42 4 V dc max power supply)	•		•	•
E7	Standards Association of Australia (SAA) Flameproof Certification				
E8	CESI/CENELEC Flameproof Certification		•		
I1(8)	BASEEFA Intrinsic Safety Certification		•		
I7(17)	Standards Association of Australia (SAA) Intrinsic Safety Certification		•		
I8(15)	CESI/CENELEC Intrinsic Safety Certification	•	•	•	•
N1(16)	BASEEFA Type N Certification				
IC(8)	Schweizerischer Elektrochnischer Verein (SEV) Intrinsic Safety Certification				

Code	Housing	DP	HP	GP	AP
H1(9)	SST Non wetted Parts on Transmitter without Meter	•	•	•	•
H2(9)	SST Non wetted Parts on Transmitter with Meter	•			
H3	SST Housing Covers Conduit Plug Lock nut Without Meter	•	•	•	•
H4	SST Housing Covers Conduit Plug Lock nut With Meter				

Code	Terminal Blocks	DP	HP	GP	AP
R1	Integral Transient Protection	•		•	

Code	Bolts for Flanges and Adapters (optional - select one)	DP	HP	GP	AP
L3	ASTM A193 B7 Flange and Adapter Bolts				
L4	316 SST Flange and Adapter Bolts				
L5	ASTM A193 B7M Flange and Adapter Bolts			•	•

Code	Process Connections (optional(10))	DP	HP	GP	AP
D1	Side Drain/Vent Top { 316 SST, *Hastelloy*, *Monel* }				
D2	Side Drain/Vent Bottom { 316 SST, *Hastelloy*, *Monel* }				
D3	Process Adapters Deleted { 316 SST, *Hastelloy*, *Monel* }				
D6	316 SST Low Side Blank Flange	—	—		
K1(11)	*Kynar* insert / –18 NPT		—		
K2(11)	*Kynar* insert / –14 NPT		—		
S1(12)	Attachment of One Remote Seal See PDS 4016 for Ordering Information	•	—		—
S2(12)	Attachment of Two Remote Seals See PDS 4016 for Ordering Information		—	—	—
S4(3)	Attachment of Integral Orifice Assembly See PDS 4686 for Ordering Information			—	—

Code	Wetted O-ring Material	DP	HP	GP	AP
W2	Buna N				
W3	Ethylene Propylene				•
W4	*Aflas*				
W6( )	Spring loaded *Teflon*		—		

(continued on next page)

(7) *Not available with Output Code G or option Zx*
(8) *Not available with Output Codes G J L M or option Zx*
(9) *Option includes SST housing covers conduit plug locknut L4 bolting and D6 low side blank flange for GP and AP transmitters Option Codes L4 and D6 should not be ordered separately*
(10) *Allowable combinations are D1 D3 D6 D2 D3 D6 and D6 S1*
(11) *The Maximum working pressure on this option is 300 psig Available only with Materials of Construction code 1x or 2x*
(12) *This options may only be used on ranges 4 through 8*
(13) *This option has a maximum static pressure rating of 3 000 psi and is available for factory assembly only without associated piping and is available only for ranges 2 3 4 and 5*
(14) *Contains a Hastelloy spring that is wetted by the process consult factory for* Teflon *O ring without a spring*
(15) *Not available with Output Codes G J L M S or option Zx*
(16) *Not available with Output Codes G L M or option Zx*
(17) *Not available with Output Code G or option Zx*

ORIGINAL (Red)

Code	Procedures	DP	HP	GP	AP
C9[18]	Software Configuration				
P1	Hydrostatic Testing 150 / Maximum Working Pressure				
P2	Cleaning for Special Service		•		
P3[19]	Cleaning for <1 PPM Chlorine/Fluorine			—	—
P4	Calibrate at Line Pressure				
P5	Calibrate at Specific Temperature	•	•	•	•
P7[20]	Improved Temperature Coefficient	•		•	—
P8[21]	Calibrate to 0 1 / Accuracy				
Code	**Outputs**	**DP**	**HP**	**GP**	**AP**
V1[22]	Reverse Output	—	—		—
V2[23]	4–20 mV Test Signal				
V3[23]	20–100 mV Test Signal				
Z1[24]	4 wire 0–20 mA Output				
Z2[24]	4 wire 0–16 mA Output	•	•	•	•
Z3[24]	4 wire 0–10 mA Output				
Typical Model Number:	**1151DP 4 S 52 B3 M1**				

(18) *Available with Output Code S only*
(19) *Flourolube grease on wetted O rings*
(20) *Not available on range 10 limited to 1 500 psi on range 9 not applicable with Output Code S*
(21) *Available only with stainless steel isolators and for span of 10 inH$_2$O and greater not applicable with Output Code S available only with Output Codes E G L or M not available on AP or DR transmitters*
(22) *Reverse output option is not needed with smart electronics configured via Model 268 SMART FAMILY® Interface*
(23) *Not available with Output Codes L or M*
(24) *Not available with Option Codes Mx Vx Ix or Ex or Output Codes G L M or S*

Standard Accessories

All models are shipped with flange adapters drain/vent valves and one instruction manual per shipment

Tagging

The Alphaline Pressure Transmitter will be tagged at no charge in accordance with customer requirements All tags are stainless steel The standard tag is wired to the transmitter Tag character height is 0 125 in (0 318 cm) A permanently attached tag is available upon request

Calibration

Transmitters are factory calibrated to customer s specified range If calibration is not specified then the transmitters are calibrated at maximum range Calibration is performed at ambient temperature and pressure

Optional Three Valve Manifolds

Part No 01151 0150 0001
3 valve manifold carbon steel
(Anderson Greenwood & Co M4AVIC)

Part No 01151 0150 0002
3 valve manifold 316 SST with carbon steel bolts
(Anderson Greenwood & Co M4AVIS)

Rosemount Inc
Measurement Division
8200 Market Boulevard
Chanhassen MN 55317 USA
Tel (612) 949 7000
Telex 4310012
Fax (612) 949 700

General Notes

The listed prices are effective with date of issue and are subject to change without notice All prices are F O B at our plant in Chanhassen Minnesota The listed prices are exclusive of all sales and use taxes

Other Model 1151 Literature

PDS 4526	Model 1151 Liquid Level Flange Mounted Liquid Level Transmitter Ranges from 25 to 2 770 inH$_2$O
PDS 4294	Model 1151DR Draft Range Differential Pressure Transmitter Ranges from ½ to 6 inH$_2$O
PDS 4593	Model 1151 Smart Microprocessor based Transmitter
PDS 4016	Model 1199 Filled Systems for Pressure Transmitters Ranges from 25 inH$_2$O to 1 000 psi

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Aflas is a registered trademark of Asahi Glass Co Ltd
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Cover Photo 1151 001AB

ROSEMOUNT® MEASUREMENT

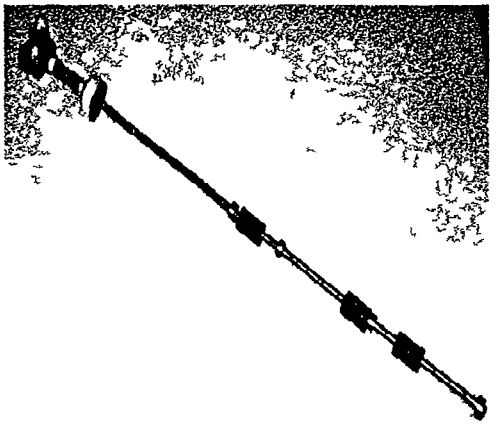
FISHER ROSEMOUNT Managing The Process Better™

ORIGINAL
Red

Sigma Controls, Inc.

PROCESS CONTROLS AND INSTRUMENTATION

SERIES 1500 MULTI FLOAT SWITCH



FEATURES

- 316SS Central Shaft
- 316SS or Buna Floats
- Positive Float Stops
- 1 5 or 2 NPT Process Connection
- Adjustable Connection Location
- Weather Proof Terminal Head
- 1 2 3 or 4 Float System
- 1 AMP @ 250 VDC Switching Element

DESCRIPTION

Sigma Series 1500 Float Level Switches are specifically designed to meet the harsh conditions found in industrial municipal environmental and machine level control applications

Available with up to four (4) level stages the Series 1500 utilizes hermetically sealed reed switches actuated by a magnetic embedded in the float Floats are restricted in their movement by positive float stops

A non-metallic weatherproof head contains a screw terminal barrier strip for field connections

Floats are provided as standard in 316SS or Buna N however many other non-metallic materials are available as special order

1 1/2 or 2 NPT process connections facilitate ease of installation in tanks drums or sight glass

Multiple stage independent switches permit both pump control and alarm functions to be carried out by a single switch assembly easily installed through a tank top mounted fitting

514 West Walnut Street Perkasie PA 18944 (215) 257 3412 FAX (215) 257 3416

ORIGINAL Red

SERIES 1500 MULTI FLOAT SWITCH

SPECIFICATIONS

Switching Element.
Hermetically Sealed Reed Switch
Rated @ 1A @ 250 VDC

Construction
316SS Shaft Brass Unions (SS Optional)
C S Process Connection Ryton Terminal
Weatherproof Head

Float Construction
316SS Buna N

Electrical Connections
Screw Terminal Barrier Strip in Ryton Head
1/2 Conduit Connection

Pressure Rating
150 PSI Max

Temp Rating
150 F

ORDERING INFORMATION

Model	No Floats	Float Mat l
1501S	1	316SS
1502S	2	316SS
1503S	3	316SS
1504S	4	316SS
1501B	1	Buna N
1502B	2	Buna N
1503B	3	Buna N
1504B	4	Buna N

APPLICATIONS

Tank Level Alarms

Pump Control

Cooling Tower Basins

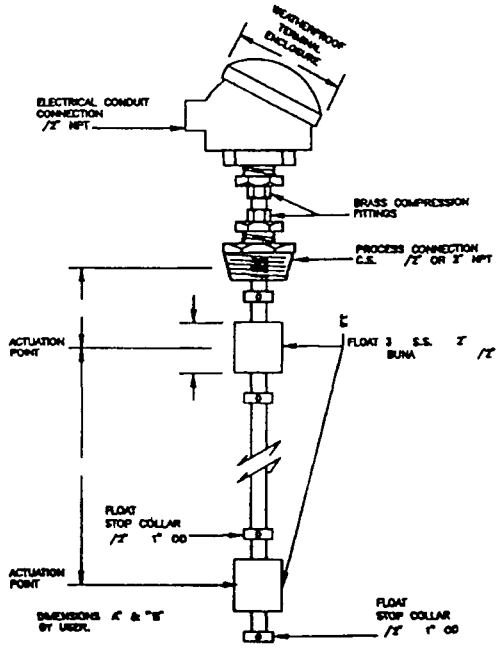
Effluent & Holding Tanks

Condensate Tanks

Sump Alarm and Control

Drum Level Alarm

DIMENSIONS



VISIT OUR WEBSITE WWW ITW COM/~SIGMACON

ORIGINAL
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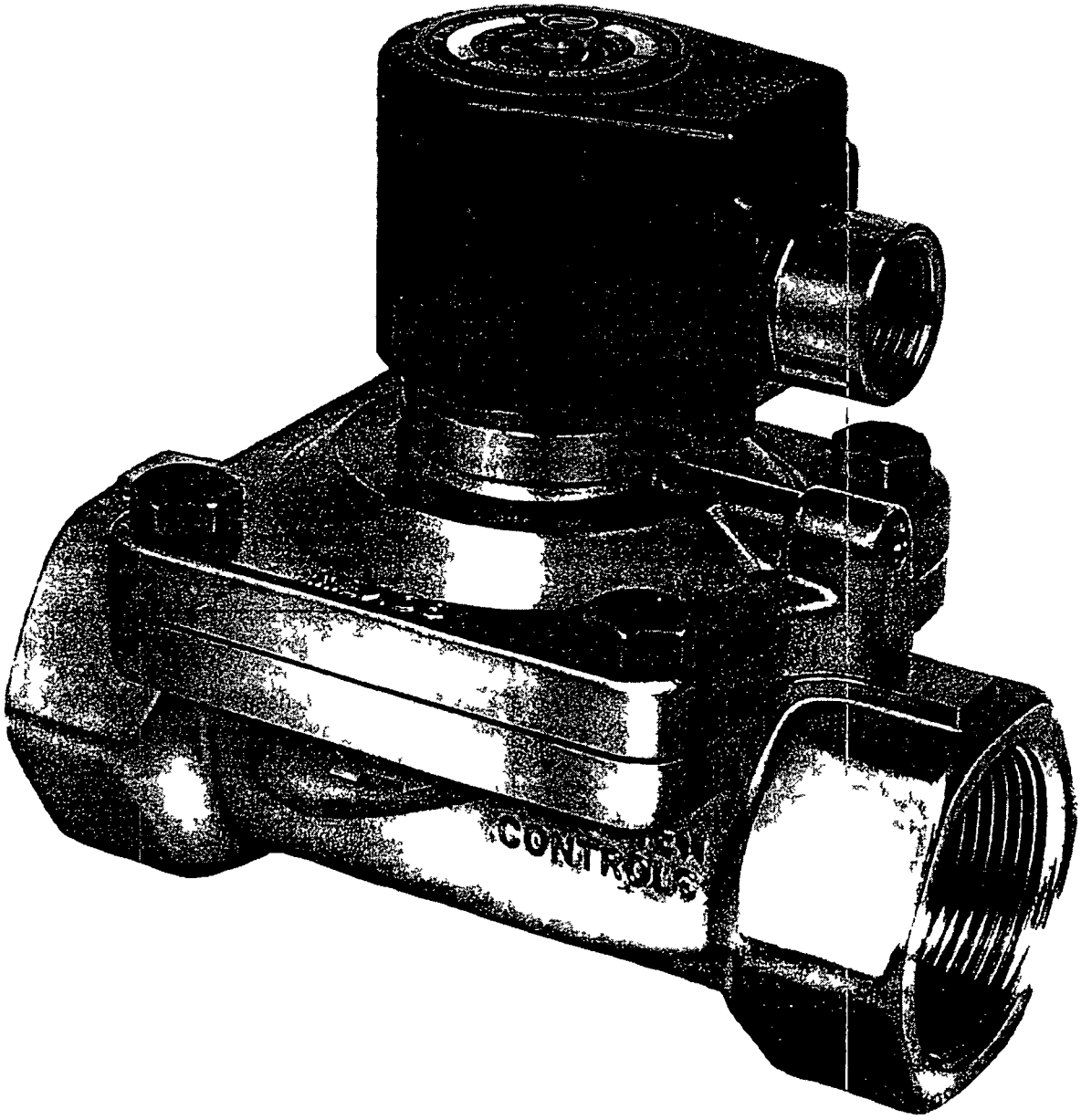
GOYEN CONTROLS
INDUSTRIAL SOLENOID VALVES



GOYEN AVAILABLE INTERNATIONALLY

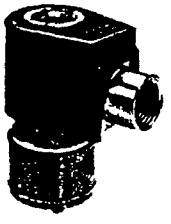
PERFORMING
UNDER PRESSURE

ORIGINAL

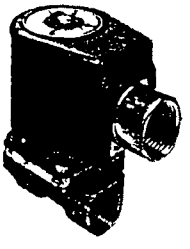
VALVES FOR AIR SERVICE

QM SERIES
- Small Size General Purpose
- 2 Way Normally Closed
- 1/8 NPT Direct Acting
- Brass Body Buna N Elastomers
- Pressure Range 0 to 200 PSI
- Solenoid Options D F R T

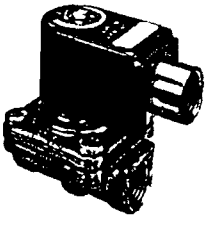
BM & BM NO SERIES
- General Purpose Design
- 2 Way Normally Closed/Normally Open
- 1/4 NPT Direct Acting
- Brass Body Buna N Elastomers
- Pressure Range 0 to 300 PSI
- Panel Mount Design with Locking Nut
- Solenoid Options C FD R H



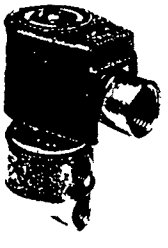
BL SERIES
- Low Pressure Design
- 2 Way Normally Closed
  3/8 to 1 NPT Direct Acting
- Brass Body Buna N Elastomers
- Pressure Range 0 to 10 PSI
  Solenoid Options C FD R H



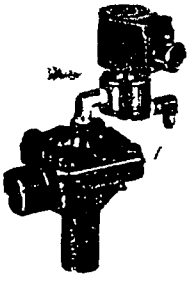
QA & QAJ SERIES
- Air & Gas Design
- 2 Way Normally Closed
- 1/2 NPT Internal Pilot Operated
- Aluminum Body Buna N Elastomers
- Pressure Range 0 to 150 PSI (QAJ)
  3 to 150 PSI (QA)
- Solenoid Options D F R T



BM3 NC/NO SERIES
- General Purpose Design
- 3 Way Normally Closed/Normally Open
- 1/4 NPT Direct Acting
- Brass Body Buna N Elastomers
- Pressure Range 0 to 125 PSI
- Panel Mount Design with Locking Nut
- Solenoid Options C FD R H

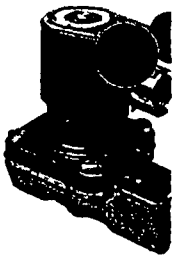


9000 SERIES
- High Flow Air Valves
- 2 Way Normally Closed & Open
- 3/4 to 2½ NPT Sizes
- Aluminum Body Buna N Elastomers
- Pressure Range 3 to 110 PSI
- Solenoid Options C FD R H

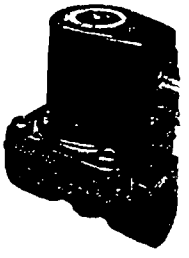


VALVES FOR WATER SERVICE

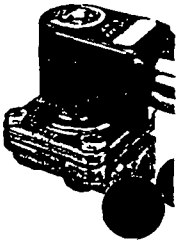
BW & BW NO SERIES
General Purpose Design
- 2 Way Normally Closed 1/4 to 1½ NPT
- 2 Way Normally Open 1/2" to 1½ NPT
- Internal Pilot Operated
- Brass Body Buna N Elastomers
- Pressure Range 3 to 150 PSI
- Solenoid Options C FD R H



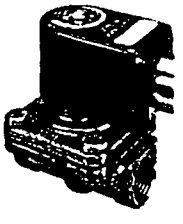
BWJ SERIES
- Zero Differential Design
- 2 Way Normally Closed
- 1/4 to 1 NPT Internal Pilot Operated
- Brass Body Buna N Elastomers
  Pressure Range 0 to 150 PSI
- Solenoid Options C FD R H



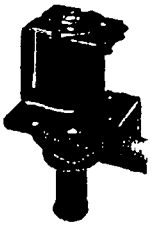
QW D SERIES
- General Purpose Design
- 2 Way Normally Closed
  1/4 to 1/2 NPT Internal Pilot Operated
- Brass Body Buna N Elastomers
- Pressure Range 3 to 150 PSI
- Solenoid Options F R T



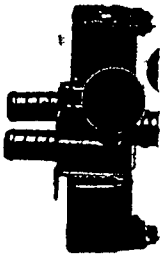
QWJ D SERIES
- Zero Differential Design
- 2 Way Normally Closed
- 1/4 to 1/2 NPT Internal Pilot Operated
- Brass Body Buna N Elastomers
- Pressure Range 0 to 150 PSI
- Solenoid Options F R T



ST2 H & HR SERIES
- Straight Through & Angle Body Versions
- Plastic Body Buna N Elastomers
- 2 Way Normally Closed Internal Pilot Operated
- 1/2" Hose Bib Inlet & Outlet Connections
- Pressure Range 1 to 150 PSI
- Solenoid Options F T

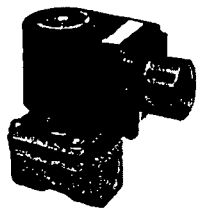


DMV 2 SERIES
- Dual Solenoid Mixing Valve
- 2 Way Normally Closed
- 5/8 Hose Bib Inlets 3/4 Hose Bib Outlet
- Plastic Body Buna N Elastomers
- Pressure Range 1 to 150 PSI
- Solenoid Options F T

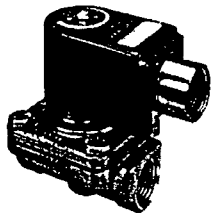


VALVES FOR GAS SERVICE

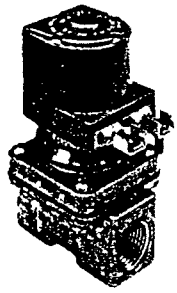
QG D SERIES
- Small Size General Purpose
- 2 Way Normally Closed
- 1/4 & 3/8" NPT Direct Acting
- Aluminum Body Buna N Elastomers
- Pressure Range 0 to 3 PSI
- Solenoid Options F R T



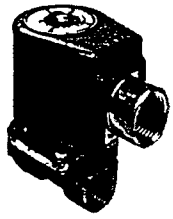
QAL D SERIES
- Low Pressure Design
- 2 Way Normally Closed
- 1/2" NPT Direct Acting
- Aluminum Body Buna N Elastomers
- Pressure Range 0 to 1 PSI
- Solenoid Options F T



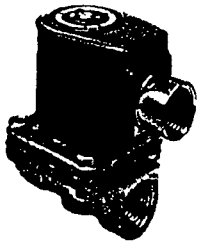
QLS SERIES
- Low Pressure LP Gas Design
- 2 Way Normally Closed
- 3/8 NPT Direct Acting
- Aluminum Body Buna N Elastomers
- Pressure Range 0 to 1 PSI



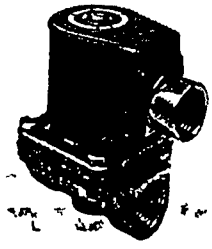
BLG SERIES
- Special Purpose Gas Valve
- 2 Way Normally Closed
- 1/2 NPT Direct Acting
- Brass Body Buna N Elastomers
  Pressure Range 0 to 1 PSI with 2 5 lb Closing Spring to hold against Back Pressure
- Solenoid Options C FD R



BAL SERIES
- Low Pressure Gas Valve
- 2 Way Normally Closed
- 3/4 NPT Internal Pilot Operated
- Aluminum Body Buna N Elastomers
- Pressure Range 0 to 1 PSI
- Solenoid Options C FD R



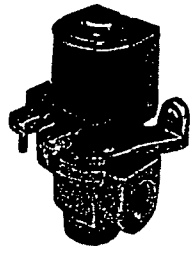
BG SERIES
- General Purpose Gas Valve
- 2 Way Normally Closed
- 3/4 NPT Internal Pilot Operated
- Aluminum Body Buna N Elastomers
- Pressure Range 1 to 36 PSI
- Solenoid Options C FD R



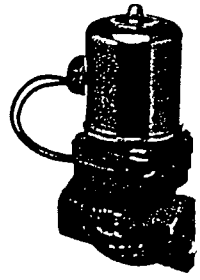
SPECIAL PURPOSE VALVES

AD4 H & HR SERIES
- Straight Through & Angle Body Versions
- Plastic Body Ethylene Propylene Elastomers
- 2 Way Normally Closed Direct Acting
- 1/2 Hose Bib Inlet & Outlet Connections
- Pressure Range 0 to 1 PSI
- Non Wetted Solenoid Design
- Solenoid Options F T

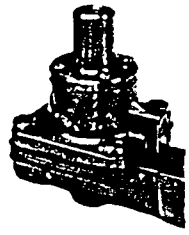
GSV SERIES
- Automotive Gasoline Design
- Straight Through & Angle Body Versions
- 2 Way Normally Closed
- 1/4 NPT Direct Acting
- Aluminum Body Viton® Elastomers
- Pressure Range 0 to 6 5 PSI



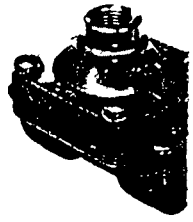
TS2 SERIES
- Steam & Hot Water Service
- 2 Way Normally Closed
- 3/8 1/2 3/4 & 1 NPT Sizes
- Electroless Nickel Plated Body
  Pressure Range 3 to 150 PSI
- Nema 4 Enclosure with Conduit Hub



AO NC SERIES
Air Operated Design
- 2 Way Normally Closed
- 1/2 to 1½ NPT External Pilot Operated
- Brass Body Buna N Elastomers
  Pressure Range 3 to 150 PSI



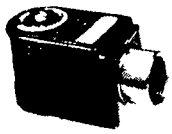
BXX SERIES
- Air Operated Design
- 2 Way Normally Open
- 1/4 to 1 NPT External Pilot Operated
- Brass Body Buna N Elastomers
- Pressure Range 1 to 150 PSI



8000 SERIES
- High Volume Vacuum Valves
  2 Way Normally Closed & Open
- 1 1½ & 2½ NPT Sizes
- Aluminum Body Buna N Elastomers
- Pressure Range to 29 5" HG
- Solenoid Options C FD R H

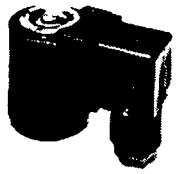
ORIGINAL Redl

SOLENOID OPTIONS • Q SERIES COILS



SUFFIX D
JUNCTION BOX

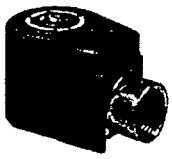
SUFFIX F
FLYING LEADS



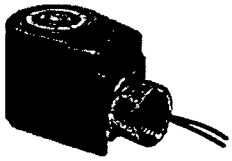
SUFFIX R
PLUG IN DIN
CONNECTOR

SUFFIX T
SCREW-CLAMP
CONNECTIONS

SOLENOID OPTIONS • B SERIES COILS

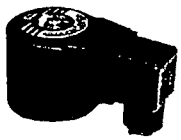


Standard B Co l and Enclosure
Model ff not required C l d j nc
uon box e lo re pro d 8 UNC oil
and earth term nals with an M20 1 5 or
/ N P S C cond t entry Protect on
class
IP31 NEMA 1



Model Suff x—FD
General Purpose Enclos re d Co l
with 20 w re leads M20 1 5 o /
N P S C conduit entry
Protection class
IP31 NEMA 1

Model Suffix—C
Open fram o l w th posed
8 UNC screw term al for
connect on within c b net
other enclos re



Model Suffix—R
Pl g o l and DIN sock t w th
PG9 cabl gland for internal
external installation Weather
d t and h se proof
Protection Class
IP65 DIN40050 NEMA 4

Model Suffix—H
HAZARDOUS LOCATIONS
ENCLOSURE A-C ONLY
NEMA Types 4 7C 7D 9E,
9F 9G These Enclosures also
tabl for Class 1 D is on 2
locations

OTHER GOYEN PRODUCTS

In addition to our line of Industrial Solenoid Valves Goyen offers the following products for Dust Collector Systems and other applications

Reverse Jet Pulse Dust Collector Diaphragm Valves 3/4 to 3 sizes
Remote or Integral Solenoid designs

Pilot Solenoid Valves & Multi Valve Enclosures Nema 4 7 or 9 Protection
UL & CSA Approved

Bulkhead Connectors in 3/4 1 & 1 1/2 sizes

Sequential Timers & Differential Pressure Controllers in AC or DC Voltages

Baghouse Cleaning Systems & Baghouse Electronic Control Systems

Particulate Emission Monitors for Stack or Dust monitoring

Dry Solids Flow Monitors for Dust Collector or Material Handling Systems

Motorized & RF Point Level Monitors for Liquid Level Sensing Blocked Chute Detection, Dust Collector Bin Level Sensing & other applications

Spare Parts Kits & Replacement Coils for all Goyen Valve products

For additional information or assistance regarding any of these products, please contact us at 1-800-538-8121 (OUTSIDE OF CALIFORNIA)

Goyen Valve Corp.

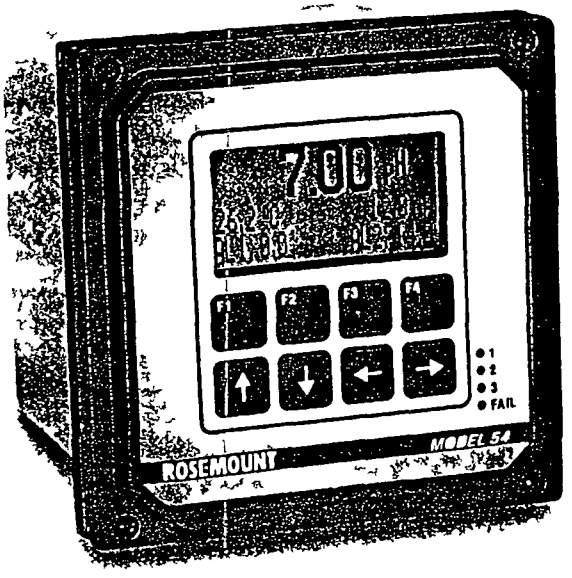
WEST COAST 25327 Ave Stanford Valencia California 91355

EAST COAST 1195 Airport Road Lakewood New Jersey 08701

pH/ORP Microprocessor Analyzer

- COMPREHENSIVE pH GLASS AND REFERENCE DIAGNOSTICS[1] warn user of the need for calibration maintenance or sensor replacement
- HEAVY DUTY NEMA 4X (IP65) enclosure of epoxy painted aluminum
- FULLY DESCRIPTIVE DIAGNOSTIC MESSAGES and easy to use interface spells out each operation in choice of English French German Italian or Spanish
- AUTOMATIC CALIBRATION with buffer recognition and stabilization check
- TWO INDEPENDENT OUTPUTS for primary variable and temperature
- THREE ALARMS WITH PROGRAMMABLE LOGIC plus one dedicated fault alarm

Patent Pend ng



FEATURES AND APPLICATIONS

The Model 54 Microprocessor Analyzer with the appro priate sensor is designed to monitor and control pH or ORP in industrial and municipal processes using the most advanced technology available

The analyzer is housed in a rugged NEMA 4X (IP65) weatherproof corrosion resistant enclosure of epoxy painted aluminum It is suitable for panel pipe or wall mounting All functions are accessible through the front panel membrane keyboard which features tactile feedback The large dot matrix liquid crystal display continuously indicates the measured variable in large numerals along with the temperature output value and two programmable process parameters such as alarms or diagnostics variables Three levels of securi ty are available 1) calibration 2) output range and alarm setpoint adjustment and 3) advanced configura tion A hinged front panel provides convenient wiring access

The two independent galvanically isolated outputs provide 4 20 or 0 20 mA signals for the measured vari able and temperature Both output ranges are pro grammable within the measurement ranges of pH or ORP and temperature A hold output mode allows manual control during routine sensor maintenance During hold mode the outputs will be at a preset or last process value

The state of the art continuous diagnostic capability of the analyzer eliminates troubleshooting guesswork by alerting the user to the following problems

- Cracked or broken pH electrode
- Plugged or coated ref erence junction or depletion of reference cell electrolyte
- Aged glass calibration recommended
- Worn out or non immersed electrode
- Poisoned reference (off line only)
- Faulty temperature ele ment
- Open wiring
- pH electrode slope error (off line)
- Analyzer electronics failure

Continued on page 2

ORIGINAL Red)

FEATURES AND APPLICATIONS continued from page 1

In the event of one of these conditions the analyzer will display a descriptive message of the problem illuminate a red LED on the front panel and drive the outputs to preselectable fault mode values A dedicated fault relay may be used to provide a visible or audible alarm to an operator All operations and descriptive messages can be field selected for English French German Italian or Spanish

The glass and reference impedances are continuously monitored and can be programmed to read out on the main display Fault setpoints for the glass and reference impedances are all programmable The glass impedance is temperature compensated for the greatest accuracy

The automatic buffer recognition uses stored buffer values and their temperature curves for the most common buffer standards available worldwide The analyzer will recognize any two of the three selected buffer values for the two point calibration and perform a self stabilization check on the sensor in each buffer

Three process alarms are a standard feature All alarms have programmable high or low activation independent setpoints adjustable hysteresis (dead band) and time delay One relay may be configured as a timer relay for chemical cleaning which may be activated by a high reference impedance (indicating coating) or a specific time interval Green LED s on the front panel indicate the status of each of the three alarm relays

The Model 54 is compatible with either an external PT 1000 or a PT 100 RTD located in the sensor to compensate the pH reading for process temperature fluctuations Manual temperature compensation is keyboard selectable Processes with pH changes due to temperature can be compensated using a programmable temperature coefficient or isopotential point

Patent Pending

PHYSICAL SPECIFICATIONS - GENERAL

Enclosure Epoxy painted aluminum
NEMA 4X (IP65)
144 X 144 X 192mm DIN size (5 7 X 5 7 X 7 6 inches)

Front Panel Membrane keyboard with tactile feedback and user selectable security Light gray blue and white overlay
Light gray enclosure dark gray bezel

Display Dot matrix LCD (7 0 x 3 5 cm) blue on gray green
The display contrast is compensated for ambient temperature

Process Variable Character Height 16mm (0 6 inch)

Electrical Classification
FM Class I Div 2 Group A thru D
28 Vdc relays 6 0 amps resistive only 150 mA Groups A & B 400 mA Group C 540 mA Group D Ci = 0 Li = 0
CSA Class I Div 2 Group A thru D
28 Vdc 110 Vac & 230 Vac relays 6 0 Amps resistive only

Power 115 Vac ± 10% 50/60 Hz ± 6% 6 0 W
230 Vac ± 10% 50/60 Hz ± 6% 6 0 W

Current Outputs Output 1 pH or ORP
Output 2 pH ORP temperature glass impedance or reference impedance
Each output is galvanically isolated 0 20 mA or 4 20 mA into 600 ohms maximum load

RFI/EMI
EN 50081 2
EN 50082 2
CE

Ambient Temperature 0 to 50 C (32 to 122 F)
NOTE The analyzer is operable from 20 to 60 C performance

Relative Humidity 95 % non condensing

Alarms Relay 1 Process alarm
Relay 2 Process alarm
Relay 3 Process alarm or timer for cleaning
Relay 4 Sensor/analyzer and process fault alarm
Each relay has a dedicated LED on the front panel

Relay Contacts Relays 1 3 Epoxy sealed form A contacts SPST normally open
Relay 4 Epoxy sealed form C SPDT

	Resistive	Inductive
28 Vdc	6 0 Amps	3 0 Amps
115 Vac	6 0 Amps	3 0 Amps
230 Vac	3 0 Amps	1 5 Amps

Weight/Shipping Weight 1 1 kg/1 6 kg (2 5 lbs./3 5 lbs)

ORIGINAL Rev01

The Model 54 when configured as a pH Analyzer requires a dual (glass and reference) impedance preamplifier (patent pending) This preamp converts the high impedance pH glass electrode signal to a low impedance signal The preamplifier may be located in one of three areas in the pH sensor for best perfor mance in a remote junction box when process temper atures exceed 80 C (176 F) in submersion applications or in the analyzer when the distance between the pH sensor and the analyzer is 4 5 meters (15 feet) or less

The Model 54pH measures over the full range of 0 14 pH The current output may be calibrated to represent any 1 to 14 pH span

A two point calibration is made by immersing the sen sor in two different buffer solutions and entering the pH values When two buffers are used the micropro cessor automatically calculates the electrode slope which is used for self diagnostics The electrode slope can be read on the display and manually adjusted A one point process standardization is easily accom plished by entering the pH value of a grab sample

INSTRUMENT SPECIFICATIONS @ 25 C

Measurement Range 0 to 14 pH

Output Scale Expansion Zero suppression up to 13 pH units
Span Any pH from 1 to 14

Accuracy ± 0 01 pH

Repeatability ± 0 01 pH

Stability ± 0 01 pH/month non cumulative

Temperature Coefficient Input ± 0 003 pH/ C
Output ± 0 006 pH/ C

Temperature Compensation Pt100 or Pt1000 RTD
Automatic or Manual
–15 to 120 C (5 to 248 F)

RECOMMENDED SENSORS

Model 381+ Insertion/Submersion/Flow Through pH Sensor[1]
Model 385+ Retractable/Submersion/Insertion Disposable pH Sensor[1]
Model 389 Disposable pH Sensor
Model 396P[1] **Disposable pH Sensor**
Model 396R[1] **Retractable pH Sensor**
Model 399 Disposable pH Sensor

The Model 54 when configured as an ORP Analyzer measures over a range of 1400 mV to +1400 mV in either the American convention (oxidation reduction potential) or the European convention (Reduction Oxidation Redox) Although temperature compensation is not used for ORP measurements the process temperature is measured and displayed Temperature measurement is made by an RTD located in the sensor assembly

INSTRUMENT SPECIFICATIONS @ 25 C

Measurement Range –1400 to +1400 mV

Output Scale Expansion Zero suppression up to ± 2550 mV
Span Any ORP range from 100 to 2800 mV

Accuracy ± 1 0 mV

Repeatability ± 1 0 mV

Stability ± 1 0 mV/month non cumulative

Temperature Coefficient Input ± 0 2 mV/ C Output ± 0 4 mV/ C

Temperature Measurement –15 to 120 C (5 to 248 F)
Pt100 or Pt1000 RTD

RECOMMENDED SENSORS

Model 381+ Insertion/Submersion/Flow Through ORP Sensor[2]
Model 385+ Retractable/Submersion/Insertion Disposable ORP Sensor
Model 389 Disposable ORP Sensor
Model 396P Disposable pH Sensor
Model 396R Retractable pH Sensor

NOTES

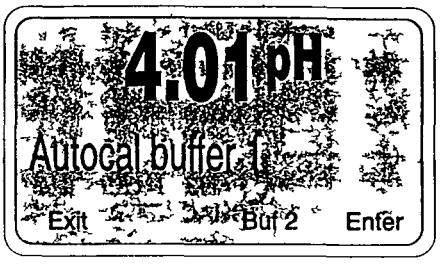
pH sensors available with both glass and reference diag nostics Other pH sensors available with only glass diag nostics

ORP sensors available with reference diagnostics

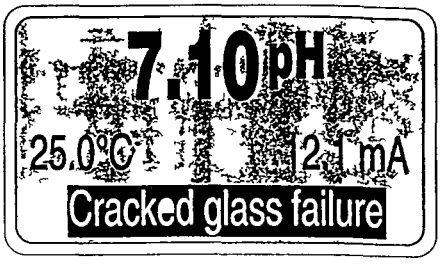
ORIGINAL Redi

EASY TO USE MENU DRIVEN INTERFACE

AUTO CALIBRATION with buffer recognition and stabilization check removes calibration guesswork

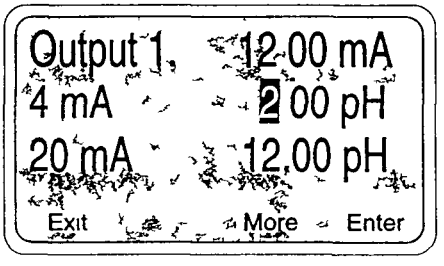


DIAGNOSTIC MESSAGES are clearly spelled out on the main display and on all other screens

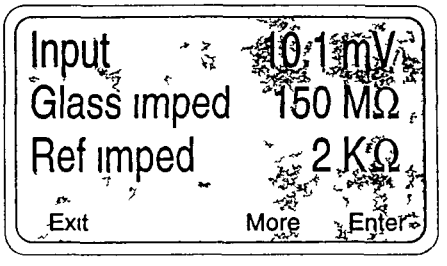


In the screen above pressing Enter (Function key #4) initiates the automatic calibration procedure for buffer 1

PROGRAMMING THE ANALYZER involves simply entering or changing the selected item (shown in reverse video) using the arrow keys



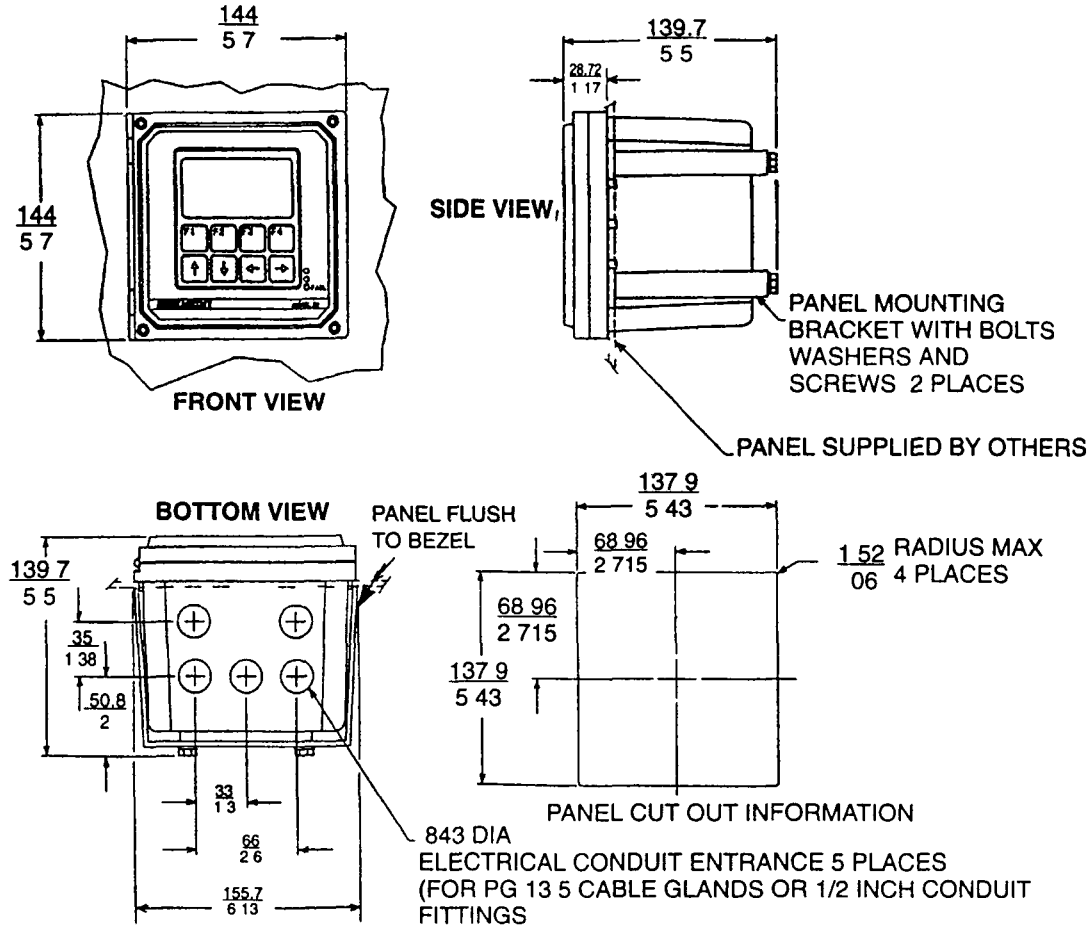
TROUBLESHOOTING is made easy because all diagnostic variables can be displayed at the press of a few keys



The following fault setpoints are programmable

1 High reference impedance and zero offset
2 High and low glass impedances
3 Calibration warning percent increase in glass impedance due to aging

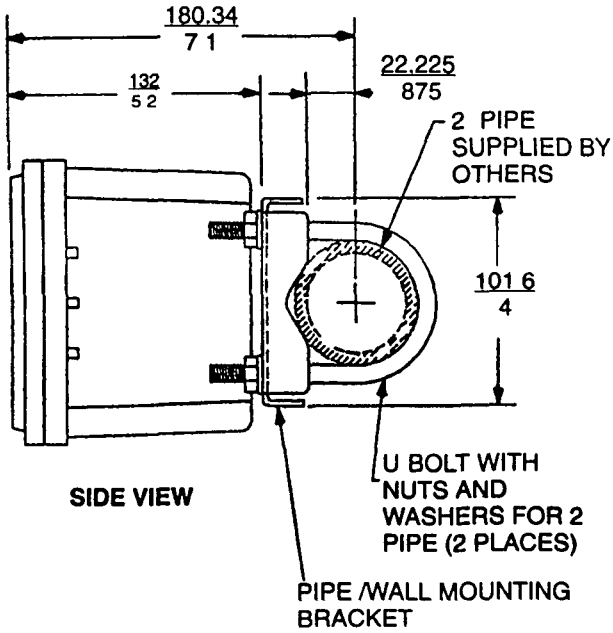
ORIGINAL Red)

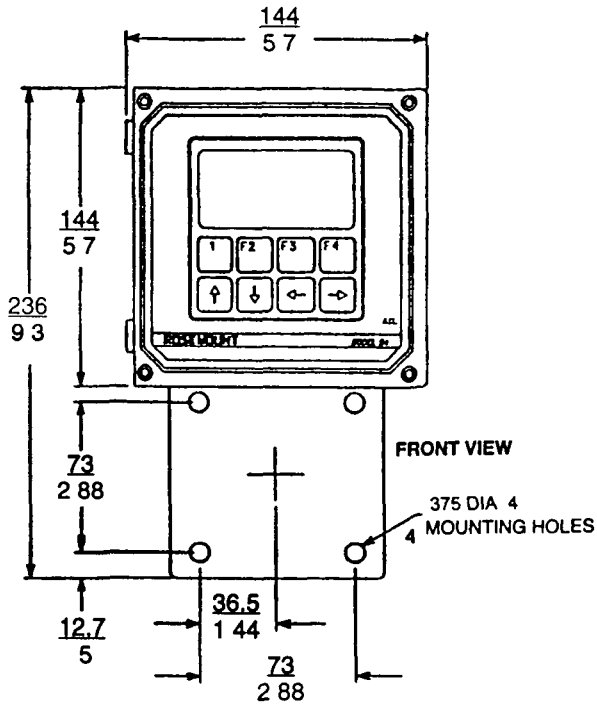


WHEN INCH AND METRIC DIMS ARE GIVEN

MILLIMETER
INCH

P/N 23545 00 PANEL MOUNTING



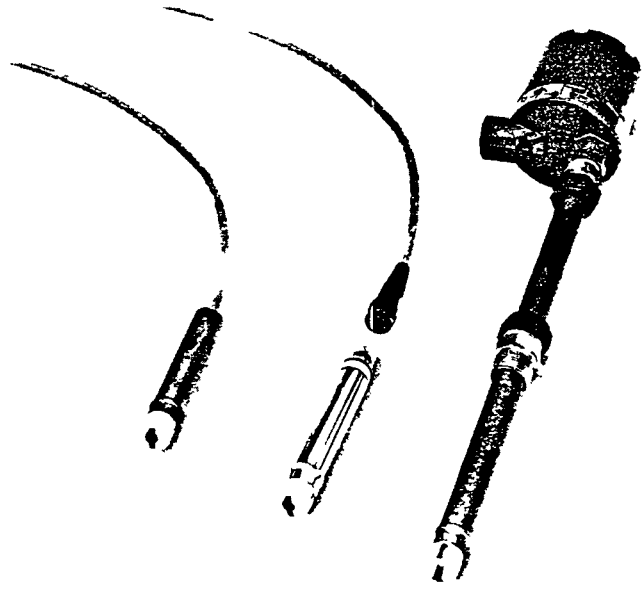


PIPE MOUNTING P/N 23541-00 WALL MOUNTING

ORIGINAL

Model 385+

Retractable/Submersion/Insertion pH/ORP Sensor



- QUICK DISCONNECT insertion/submersion version for easy installation
- ADVANCED ON LINE SENSOR DIAGNOSTICS for use with the Model 54 pH/ORP Analyzer 3081 pH/ORP Transmitter or 81 pH/ORP Transmitter
- RETRACTABLE VERSION allows safe removal and replacement under pressure without process shutdown
- LONG LIFE TRIPLE JUNCTION REFERENCE ELECTRODE provides longer service life in applications where poisoning ions are present
- DISPOSABLE TEFZEL[1] AND TITANIUM DESIGN provides maximum chemical resistance and economic advantage where minimal troubleshooting and maintenance downtime are of prime importance

FEATURES AND APPLICATIONS

The Rosemount Model 385+ Sensor is designed to provide advanced sensor diagnostics available with Model 54 pH/ORP Analyzer 3081 pH/ORP Transmitter and the 81 pH/ORPTransmitter (Please refer to the Model 54 pH/ORP or the 3081/81 pH/ORP Product Data Sheet for complete information) These advanced sensor diagnostics provide preventative maintenance by notifying the operator for replacement of an aged sensor or cleaning of a fouled sensor for continuous optimum performance

The Model 385+ Sensor measures the pH or ORP (Oxidation Reduction Potential) of aqueous solutions in pipelines open tanks or ponds It is suitable for applications where a low cost industrial disposable sensor is required The combination elec trode features a peripheral ceramic junction The triple junction reference cell provides longer life in processes containing sugar ammonia chlorides, sulfides or other poisoning ions The Model 385+ body is constructed of molded chemically resistant Tefzel in two standard body versions

The retraction version is housed in a titanium tube with a plug in style surface mount preamplifier in a weatherproof junction box It is designed for use with a standard 1 1/2 inch ball valve assembly for process mounting where a separate sample stream is difficult or impossible to provide The entire in stallation process is accomplished without line depressurization and minimal process fluid loss Upon sensor removal from the ball valve maintenance and replacement is easy

The insertion/submersion version has three body configurations 25 ft integral cable and preamplifier 15 ft integral cable for use with remote preamplifier integral preamplifier with cable connector for quick disconnect at the sensor Interconnecting cable comes in 25 ft and 50 ft lengths and must be ordered as an accessory for initial installation

[1] Tefzel is a registered trademark of E I duPont de Nemours & Company
Patent pending

PERFORMANCE SPECIFICATIONS

Measuring Range General Purpose Low Resistivity
Glass 0 13 pH
High pH Glass 0 14 pH
ORP −1400 to 1400 mV

Temperature Compensation (pH only) 0 to 100 C (32 to 212 F)

ACCESSORIES

ACCESSORIES	DESCRIPTION
11275 01	Handrail mounting assembly (Code 03 04 only)
23550 00	Remote J Box with extension board 54/3081 compatible
23555-00	Remote J Box with preamplifier 54/3081 compatible
23166 00	Process connector 316SS insertion/submersion (Code 02 03 04 05)
9510066	Process connector Nylon submersion only 1 MNPT (Code 03 04 05)
23557 00	Preamplifier for remote J Box 54/3081 compatible
33320 00	25 ft cable with connector (Code 05 only)
33320 01	50 ft cable with connector (Code 05 only)

PHYSICAL SPECIFICATIONS

ORIGINAL Red)

Wetted Materials Tefzel titanium EPDM 316 SS and Teflon[1] (Code 02) Viton glass ceramic and (ORP only) platinum

Maximum Process Pressure and Temperature
790 KPa (100 psig) at 100 C (212 F)

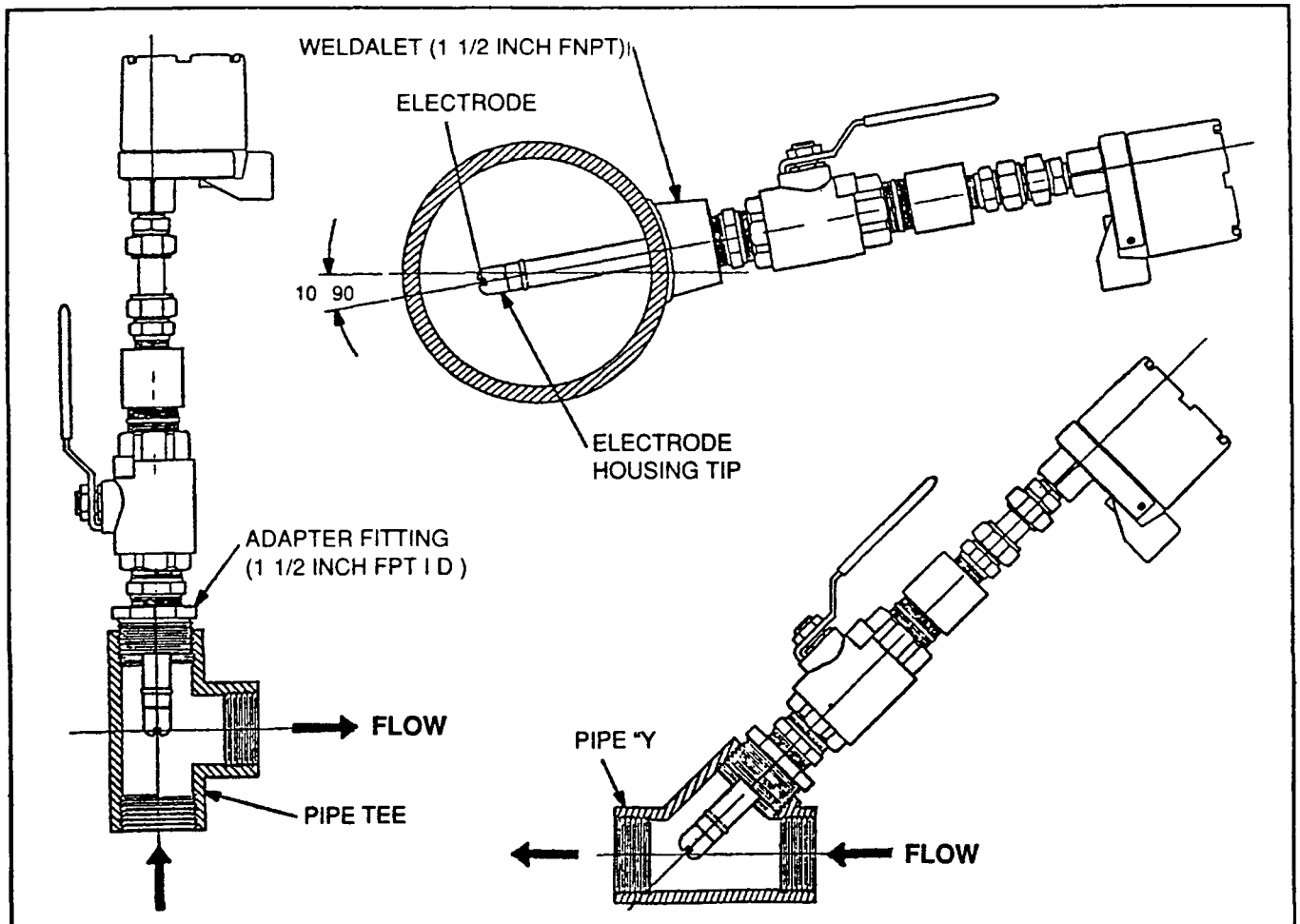
Maximum Pressure at Retraction or Insertion (ball valve version) 542 KPa (64 psig)

Process Connections 1 1/2 inch with ball valve
1 inch without ball valve

Cable P/N 9200273 (Unprepped) or P/N 23646 01 (Prepped) 33320 00 or 33320 01

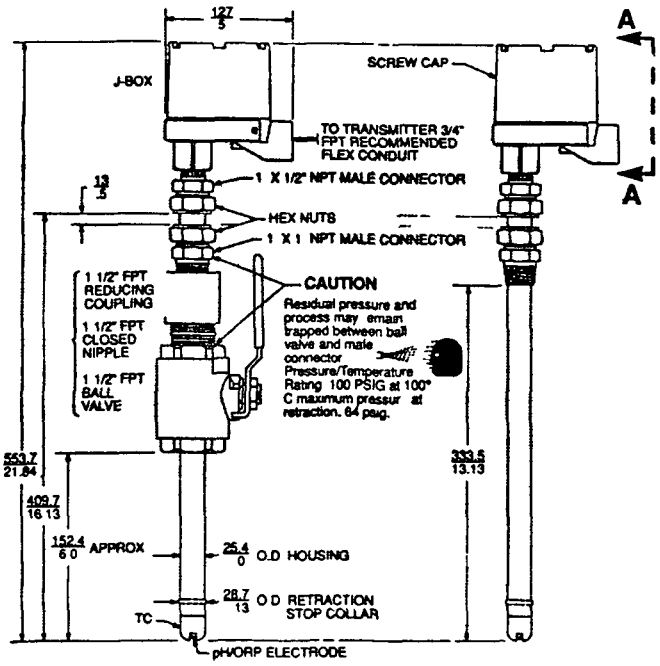
Weight/Shipping Weight
Submersion/insertion 1 6 lbs/2 8 lbs 0 7Kg /1 25 Kg
Retraction 6 lbs/11 lbs (2 7 Kg/5 0 Kg)
Ball Valve 5 lbs/10 lbs (2 25 Kg/4 5 Kg)

[1] Registered trademark of E I du Pont de Nemours & Company

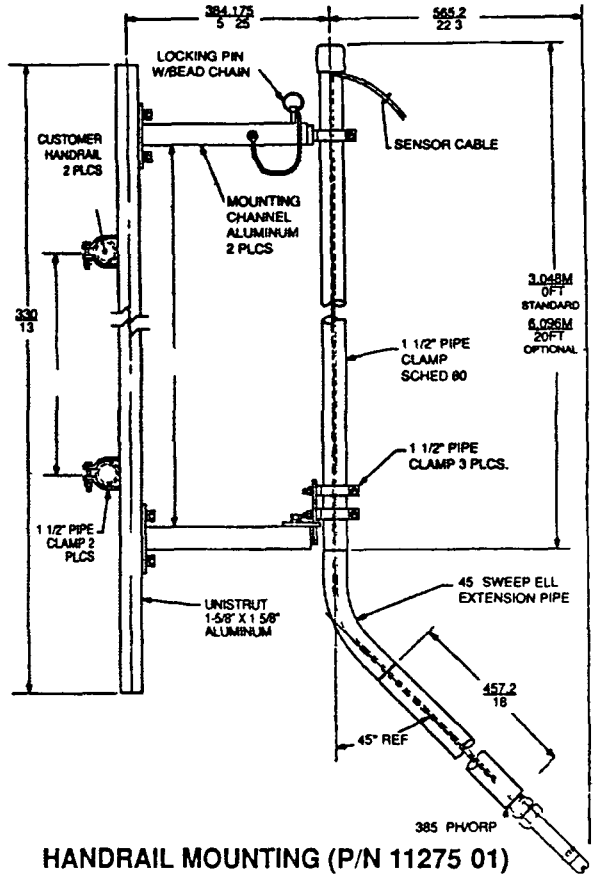


TYPICAL MOUNTING DETAILS-RETRACTION VERSION

ORIGINAL R 01

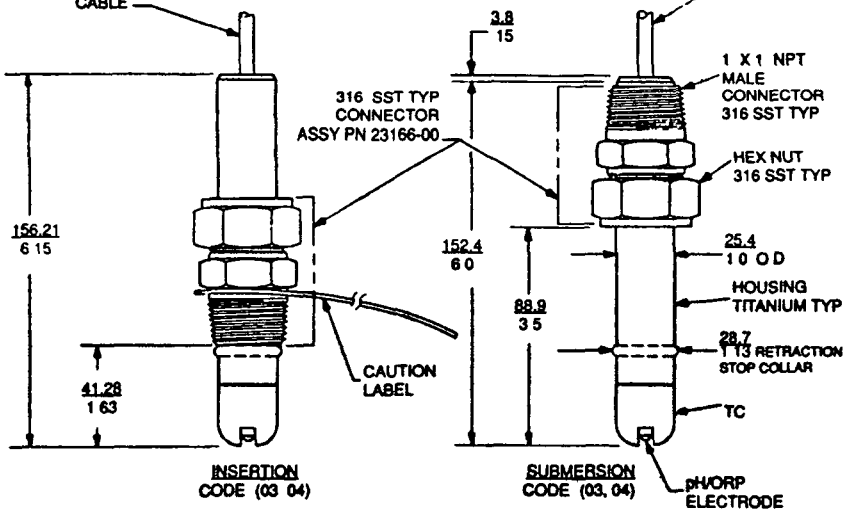


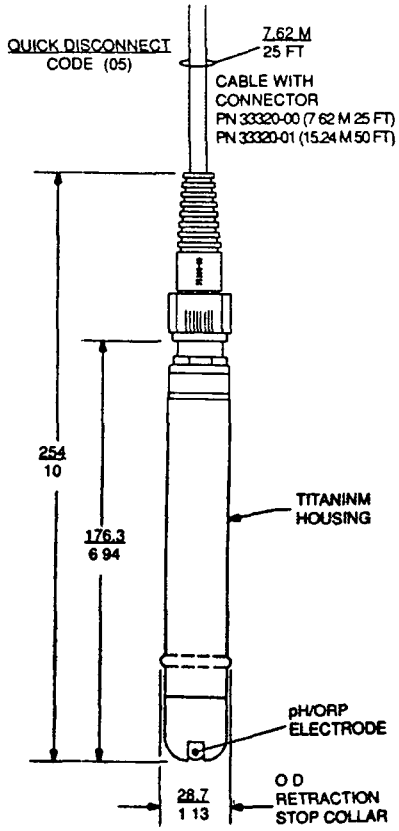
RETRACTION VERSION (CODE 02)



HANDRAIL MOUNTING (P/N 11275 01)

MOUNTING AND DIMENSIONAL DRAWING





SUBMERSION/INSERTION VERSIONS

ORIGINAL Redi

ORDERING INFORMATION

The Model 385+ pH/ORP Sensor Standard features include a Tefzel sensor body with a triple junction gel filled reference electrode and automatic temperature compensator housed in a titanium tube The retractable version comes with a weather proof junction box and preamplifier The insertion/submersion version has three optional body configurations integral pream plifier and 25 foot (7 6 m) integral cable integral preamplifier with a cable connector (cable not included) or 15 foot (4 5 m) integral cable for use with remote preamplifier The 385+ is designed to be used with the Model 54 pH/ORP Analyzer 3081 pH/ORP Transmitter and 81 pH/ORP Transmitter

MODEL 385+	pH/ORP SENSOR
Code	Body Configuration (Required Selection)
02	Retractable with Preamplifier in J Box
03	Insertion/Submersion with Integral Preamplifier and 25 ft (7 6 m) cable
04	Insertion/Submersion for use with Remote Preamplifier and 15 ft (4 5 m) cable
05	Insertion/Submersion with Integral Preamplifier and cable connector

Code	Combination Electrode (Required Selection)
10	GPLR General Purpose Low Resistivity (0 13 pH)
11	High pH (0 14 pH)
12	ORP (Platinum)

Code	Options
21	316 Stainless Steel Ball Valve Kit
385+ 02 10 21	EXAMPLE

NOTES

OPTION-05 does not include cable Initial installation requires cable P/N 33320-00 (25ft) or 33320-01 (50ft) refer to accessories

OPTION 02 recommended interconnecting cable from sensor to transmitter is Rosemount Analytical P/N 23646 01 (prepped) or P/N 9200273 (unprepped) Specify length

The right people the right answers right now

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RESPONSES TO 90% PRE-FINAL DESIGN

Southern Maryland Wood Treatment Site
Water Treatment Site
Hollywood, Maryland
OHM Project 19991

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments from Ronald F Adams letter dated August 25 1997 ***ICF Kaiser Specifications***		
Division 1 and 2 General Comment	All OHM specifications to agree with EA specifications of the site Specific Work Plan by EA	Comment noted Division 1 and 2 OHM specifications will make direct reference to the Site Specific Work Plan (prepared by the EA dated July 1997) Health and Safety Plan Contractor Quality Plan and Sedimentation Erosion and Control Plan (prepared by ICF Kaiser)
Division 11 – General Comments	Section 11204 2 1 A	Compressed air requirement changed to read 1 4 scfm @ 15 25 psig per comment
	Section 11212 2 1 B	AOP feed pump TDH was corrected to 50 ft per the comment
	Section 11225 2 01 C	The following sentences were inserted into the opening paragraph prior to the last sentence 'The Flash Mix and Flocculation Tank covers shall be equipped with a hinged and gasketed inspection hatches located above each compartment The Inclined Plate Separator cover shall also be equipped with same type of hatch located above the effluent weir
	Section 11241 2 01 A	Polymer Feed System will be Hoffland Environmental Polymixer Model PM 100 42
	Section 11312 2 1 a	Floor Sump Pump TDH is 35 ft
	Section 11317 2 1 A	TDH for pump P 101 was revised to 20 ft per comment
	Section 11325 2 02 A	Specification revised to reflect the approved unit on order

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments from Ronald F Adams letter dated August 25 1997 ***ICF Kaiser Specifications*** (continued)		
	Section 11325 2 04 C	Automated cleaning mechanism is a standard feature of the UV/OX systems
	Section 11370 2 01 A	Section 11370 shows a demand of 250 scfm which will be sufficient to operate all of the pneumatic pumps except during carbon changeout of T 402 or T 403
	Section 13600 1 05 A	Timers are not required for proper operation
	Section 15836	Based on 10 ft x 10 ft control room A/C has been sized for 5 000 BTU/hr drawing 5 amps at 115 Volt/single phase Based on the size of the plant (80 ft x 40 ft) 100 ft^2 (control room) and the assumption that the building temperature is maintained at approx 55 F in the winter a minimum of four (4) electric unit heaters will be required each rated at 34 000 BTU/hr (10 kW) The units are available for 480 volt/three phase electrical service requiring 12 line amps/phase Calculations are provided in attachment
Comments from Ronald F Adams letter dated August 25 1997 ***ICF Kaiser Drawings***		
	Drawing C 1 a	Comment noted
	Drawing C 1 b	Comment noted
	Drawing C 1 c	Comment noted
	Drawing C 2	Drawing has been deleted

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments from Ronald F Adams letter dated August 25 1997 *ICF Kaiser Drawings* (continued)		
	Drawing C 3	Drawing has been deleted
	Drawing C 4	Drawing has been deleted
	Drawing C 5	Comment noted
	Drawing C 6 General	Comments noted
	Drawing C 6 a	Comment noted nothing corrected
	Drawing C 6 b	Comment noted
	Drawing C 6 c	Comment noted
	Drawing C 6 d	Comment noted the vehicle entrance has been changed to the west end
	Drawing C 6 e	Comment noted trench bedding detail added
	Drawing S 1 a	Comment noted
	Drawing S 1 b	Comment noted
	Drawing S 1 c	Comment noted
	Drawing P 1 General	3 000 gal sludge tank is sufficient calculations provided in attachment
	Drawing P 1 a	The P&I has been revised to more clearly show the influent streams
	Drawing P 1 b	Comment noted
	Drawing P 1 c	Comment noted
	Drawing P 1 d	An instrument list has been provided
	Drawing p 2 General	The piping for the selected UV/OX unit has been incorporated into the process and mechanical drawings Bypass provided
	Drawing P 2 a	Note 2 has been deleted for clarity
	Drawing P 2 b	Comment noted
	Drawing P 2 c	A manually operated globe valve is sufficient

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments from Ronald F Adams letter dated August 25 1997 *ICF Kaiser Drawings* (continued)		
	Drawing P 2 d	SF 401 has been deleted
	Drawing P 2 e	Same response as to comment P 1d
	Drawing M 1 a	Comment noted Northing corrected
	Drawing M 1 b	Temporary portable sanitary facilities will be used Fire protection via smoke detection and fire extinguishers A 10 x 10 control room has bee added Heating facilities are described in response to comment to Section 15836 on page 2 of this Table
	Drawing M 1 c	Comment noted
	Drawing M 1 d	Comment noted and corrections made
	Drawing M 1 e	The 12 pipe sleeve detail is shown in drawing C 3
	Drawing M 2	Comment noted
	Drawing M 3	Drawing well be retained for OHM construction crew use
	Drawing E 1	Comments noted
	Drawing E 2	Automatic telephone dialout has been added
	Drawing E 4	Heaters are shown in Drawing M 1

Southern Maryland Wood Treatment Site
Water Treatment Site
Hollywood, Maryland
OHM Project 19991

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments by Kiersarsky File DB7215GK DBF *(USACE by Civil Discipline)*		
Comment 1	Civil Drawing C 1	Comment noted
Comment 2	Civil Drawing C 1	Piping specifications are addressed in Section 15076
Comment 3	Civil Drawing C 3	Comment noted
Comment 4	Civil Drawing M 2	The clearance is adequate for all activities at elevated locations Total IPS height including clearance for plates removal is 14 11 which is sufficient room in a 21 ft high building
Comment 5	Civil General	The eye wash water will be self contained with the unit The treatment effluent will not be used

Southern Maryla Wood Treatment Site
Water Treatment Site
Hollywood, Maryland
OHM Project 19991

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Shear File DB7215BD DBF (USACE by Architectural Discipline)		
Comment 1	Drawing A 1	Comment noted Refer to Building Vendor Approval Drawings Therefore Section A has been deleted
Comment 2	Drawing A 1	Comment noted Refer to Building Vendor Approval Drawings
Comment 3	Drawing A 1	Figure presented was typical Refer to Pre engineered Building Approval Drawings
Comment 4	Drawing A 1	Submittals will include vapor retarder and insulation samples which will be correctly installed as per manufacturer s instructions
Comment 5	Drawing A 1	Refer to approval drawings
Comment 6	Drawing A 1	Refer to approval drawings
Comment 7	Section 08116 2 03 and 2 04	Current manufacturer of door frames incorporates door stops frames and beads as a monolithic item Frames provided are 16 gage therefore the components are also 16 gage
Comment 8	ARC specs	Specifications for Overhead Coiling Doors are included in Section 13120 Pre Engineered Building
Comment 9	ARC A 1	The information will be provided on approval drawings Section detail through louvers will be provided under louver submittal
Comment 10	ARC A 1	Refer to approval drawings
Comment 11	ARC A 1	Comment noted Refer to Drawing A 1 There are no handrails for this building

Southern Maryland Wood Treatment Site
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Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Lohorn File DB7215D9 DBF (USACE by Plumbing Discipline)		
Comment 1	Drawing M 1	Comment noted
Comment 2	Drawing M 1	Comment noted check valves have been added where appropriate
Comment 3	Drawing M 1	Comment noted
Comment 4	Drawing M 1	Dates to be supplied during submittal process
Comment 5	Drawing M 1	For short term duration only cold water will be supplied
Comment 6	Drawing M 1	Three units will be furnished with self contained water supplies rated for the service
Comment 7	Drawing M 1	Comment noted
Comment 8	Drawing M 1	Comment noted
Comment 9	Section 15401	Comment noted
Comment 10	Section 15401	The General Plumbing specification addresses plumbing fixtures and piping only Compressor dryer compressed air piping are addressed in Section 11370 Compressed Air System

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OHM Project 19991

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by D R (USACE by Mechanical Discipline)		
Comment 1	General	Comment noted
Comment 2	Drawing M 1	See Note 2 on M 1 Airlines will be fitted in the field during the mechanical installation
Comment 3	Drawing M 1	Pipe anchors will be shown during the construction phase All piping anchoring will be provided per manufacturer s recommendation Section 15070 Fiberglass Reinforced Pipe addresses this comment in 2 02H and paragraph 3 01B has been added to 15067 Thermoplastic Pipe as follows Pipe Anchors Pipe anchors shall be spaced for a particular piping according to the manufacturer s recommendations
Comment 4	Drawing M 1	Alignment guides will be shown during the construction phase
Comment 5	Drawing M 1	Mechanical equipment schedule of all major components is shown on M 1
Comment 6	Drawing M 1	Comment noted
Comment 7	Drawing M 1	All details will be provided to the contractor at the appropriate time for this design/ build project
Comment 8	Mechanical Specs	Comment noted If Section 13080 is the correct incorporation this could not be obtained in time for the submittal Please furnish to ICF Kaiser and it will be incorporated

Southern Maryland Wood Treatment Site
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Hollywood, Maryland
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Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Vanden File DB7215C4 DBF (USACE BY Electrical Discipline)		
Comment 1	Electrical Sub Reg General	Comment noted
Comment 2	Electrical Specs General	Comment noted
Comment 3	Electrical D A Narrative	Comment noted a narrative description has been added
Comment 4	Electrical D A Calcs	Comment noted
Comment 5	Electrical Plans E 1	Comment noted line size corrected
Comment 6	Electrical Plans E 2	Comment noted
Comment 7	Electrical Plans E 2	BOM listings from Table on drawing
Comment 8	Electrical Plans E 2	Proprietary or vendor references to be deleted
Comment 9	Electrical Plans E 3	Comment noted and drawing revised for clarity
Comment 10	Electrical Plans E 3	Comment noted
Comment 11	Electrical Plans E 4	Comment noted
Comment 12	Electrical Plans General	The fire protection system will be smoke detection and the lighting plan is incorporated in Drawing E 4

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Hollywood, Maryland
OHM Project 19991

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Svitil File DB72155J3 DBF		
Comment 1	ATM Section General Bid Schedule	Comment to be responded to by ICF Kaiser
Comment 2	ATM Section Division 1	Comment noted
Comment 3	ATM Section Division 1 General	Section 01000 Administrative Requirements Section 01050 Job Conditions Section 01060 Safety Section 01440 Contractor Quality Control Section 01561 Environmental Protection The documents referenced in the response to R F Adams comments regarding Division 1 address these specification sections Section 01720 As Built Drawings has been added to the OHM Technical Specifications for the Water Treatment Plant following USACE guidelines
Comment 4	ATM Section Division 1 Section 01300	Comment noted

Southern Maryland Wood Treatment Site
Water Treatment Site
Hollywood, Maryland
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Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Russell Marsh from the Remedial Investigation and Design Section POC CENAB EN HT USACE by Specifications		
	ACCEPTANCE TEST	
Comment 1	Section 01652	Comment noted Section 1 10 Acceptance Test Criteria inserted into Section 01652
Comment 2a	Section 11204 2 1 A	Bed depth of 40 is correct Specification 13228 was revised to read 40 also
	SAND FILTER	
Comment 2b	Section 11204 2 1 A	Compressed air requirement changed to read 1 4 scfm @ 15 25 **psig**
Comment 2 c	Section 11204 2 2 B 5	The language in Section 13228 was changed to read Filter Operating Conditions See Section 11204
	INCLINED PLATE SEPARATOR	
Comment 3a	Section 11225 1 02 B	Sentence revised to read The groundwater shall be pumped at a maximum flowrate of 75 GPM from the Mix ReactionTank (T 201) to the Inclined Plate Separator (ME 303)
Comment 3b	Section 11225 2 01 B	The Flocculator Tank volume was changed from 1 000 gallons to **200 gallons**
	SUMP PUMPS	
Comment 4 a	Section 11312 1 1 b	Pump Tag Nos added to the text per comment Also Floor Sump Tag No was revised from T 302 to 305
Comment 4 B	Section 11312 2 1 a	Text revised to read PUMP P 305 LOCATION and PUMP P 503 LOCATION to address the comment
	UV OX SYSTEM	
Comment 5 a	Section 11325 1 03 E 2 A	Comment noted Treatability Testing Plan rewritten

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Russell Marsh from the Remedial Investigation and Design Section POC CENAB EN HT (continued) USACE by Specifications		
Comment 5 c	Section 11325 2 02 A	Text corrected to read Operating Flowrate – 45 gpm (Groundwater only) Maximum Flowrate – 75 gpm
Comment 5 d	Section 11325 2 07 A	All wetted surfaces are either stainless steel or plastic which do not require passivation
	TANKS	
Comment 6 a	Section 11340 1 02 A	Tank Tag No changed form T 120 to T 201 per comment
Comment 6 b	Section 11340 2 01	Specifications for the 105 gallon Decant Tank (T 503) was added as Section 2 01 E
Comment 6 c	Section 11340 2 01 D	Text revised to read The CONTRACTOR shall provide and install a horizontal single walled **carbon steel** Product Storage Tank
	SAND FILTER MEDIA	
Comment 7 a	Section 13228 2 01 B	Text of this paragraph revised to read Filter Operating Conditions See Section 11204
Comment 7 b	Section 13228 2 02 A 2 a	Bed depth was corrected from 80 inches to 40 inches
	PROCESS CONTROL SYSTEM	
Comment 8 a	Section 13600 1 05 A	Closed loop operation has been deleted form the drawings
Comment 8 b	Section 13600	Filtration will occur at the new treatment plant and automatic backwash filtration unit has been incorporated into the final design

Southern Maryland Wood Treatment Site
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Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Russell Marsh from the Remedial Investigation and Design Section POC CENAB EN HT (continued) USACE by Drawings		
Comment 1 a	Drawing C 1	Comment noted ICF Kaiser will be responsible for the overall site plan coordination
Comment 1 b		Comment noted corrections made to 4 discharge line
Comment 2	Drawing C 2	Drawing has been deleted from the treatment plant set See resoinse to Comment 1 a above
Comment 3 a	Drawing C 6	The location of pipe bends etc are indicated in the profile
Comment 3 b	Drawing C 6	Comment noted
Comment 4	Drawing S 1	Comment noted
Comment 5 a	Drawing P 1 P&ID Diagram I Top Diagram	Comment noted
Comment 5 b	Drawing P 1 P&ID Diagram I Top Diagram	The pipeline has been redirected and the bag filter has been eliminated
Comment 5 c	Drawing P 1 P&ID Diagram I Top Diagram	Comment noted
Comment 5 d	Drawing P 1 P&ID Diagram I Top Diagram	Comment noted Hoffland IPS revised 11225 accordingly
Comment 5 e	Drawing P 1 P&ID Diagram I Top Diagram	Comment noted TDH for P 301 coordinated between M 1 and Section 11311
Comment 5 f	Drawing P 1 P&ID Diagram I Top Diagram	Comment noted TDH for P 305 coordinated between M 1 and Section 11312
Comment 5 g	Drawing P 1 P&ID Diagram I Bottom Diagram	Comment noted
Comment 6 a	Drawing P 2 P&ID Diagram II	Comment noted

Responses to ICF Kaiser and USACE Comments on 90% Design Submittal

Comment Number	Cross Reference Where Comment Has Been Addressed	Response
Comments made by Russell Marsh from the Remedial Investigation and Design Section POC CENAB EN HT (continued) USACE by Drawings		
Comment 6 b		Comment noted Line size corrected to ½
Comment 6 c		Comment noted
Comment 6 d		Comment noted Inconsistency corrected in Section 11212
Comment 6 e		Closed loop operation has been deleted
Comment 7a	Drawing M 1 Mechanical Plan Equipment Schedule	Comment noted
Comment 7b		Comment noted
Comment 7c		Comment noted
Comment 7d		T 604 added to Equipment Schedule and Section 11340
Comment 7e	Drawing M 1 Mechanical Plan Pump Schedule	Comment noted
Comment 7f		Comment noted inconsistencies corrected
Comment 7g	Drawing M 1 Mechanical Plan Plan Drawing	Comment noted
Comment 8	Drawing M 2 Mechanical Section 1	Comment noted

Southern Maryland Wood Treatment Site
Water Treatment Site
Hollywood, Maryland
OHM Project 19991

Responses to ICF Kaiser and SMWT Citizen's Task Force Comments on 90% Design Submittal

Comment Number	COMMENT	ICF KAISER RESPONSE	OHM RESPONSE
Comments from Ralph Gunther St Mary s County SMWT Task Force dated September 4 1997			
1	Plant appears set up for intermittent operation since tank T201 is on/off from level switches	Hand operated ball valve at discharge will be manually adjusted to maintain tank level between floats Admittedly this is difficult and using two tanks or adding some crude automation may lead to smoother ops with a fluctuating influent	Hand operated ~~ball~~ **globe** valve at discharge will be manually adjusted to maintain tank level between floats Admittedly this is not full automation but the tank is sized with sufficient residence time to minimize on/off cycling for a particular slow valve setting
2	Discharge pH probe will not provide good readings when no discharge flow from T201 (i e during high or low level conditions) which will lead to under/over additions of caustic and treatment problems	pH probe could be placed in the tank to allow continual monitoring of actual pH in T201	Comment noted – Probe will be located below the low level
3	What is the purpose of stream labeled from T403 going to T201 – makes plant a closed loop for use during treatment of poorly treated effluent?	Will be addressed during the 100% design	Stream labeled from T403 has been deleted
4	Why does storm water form pond bypass the oil/water sep since currently the existing WTP is in place to remove floating product and then treat prior to stream discharge?	Will be addressed during the 100% design	Comment noted – storm water will be directed to the Oil/Water Separator

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Comments from Ralph Gunther St Mary s County SMWT Task Force dated September 4 1997 (continued)			
5	Varying flow (see comment one on T210 above) will lead to difficult control at inclined plate separator since they operate best at steady flows Could also lead to over addition of polymer which will clog sand filter quickly	Will be addressed during the 100% design	Pump will transfer fluid through the system at a constant rate Polymer feed tied into operation of P 201 via FS 301
6	Why does T305 (floor sump) have a level prove that leads to plant shutdown?	This is typical for these plants since spills and overflows are sensitive issues	Agree with the ICF Kaiser response
7	Overflows on various tanks will need gooseneck or some other water seal	Will be addressed during the 100% design	Agree with the comment. Water seals will be added to gravity flow discharge lines of the Inclined Plate Separator and Sand Filter
8	Vapor blower rate at ½ inch but no units (water or Hg) Blower must be sized to handle tank(s) level(s) fluctuations	Will be addressed during the 100% design	Comment noted – Blower is sized for 0 5 inches of W C
9	Bag filter not specified	Filter to be removed during 100% design	Agreed with the ICF Kaiser response
10	Could use soda ash for pH adjustments	Caustic chosen for ease of operation and flexibility	Agreed with the ICF Kaiser response