Final
Remedial Design Report
Soil Vapor Extraction and Treatment System
and *In Situ* Bioremediation
Bandera Road Ground Water Plume Superfund Site
Bexar County, Texas

Remedial Action Contract 2 Full Service
Contract: EP-W-06-004
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Prepared for

U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
405 S. Highway 121
Building C, Suite 100
Lewisville, Texas 75067
(972) 315-3922

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ACRONYMS AND ABBREVIATIONS

AMSL	Above mean sea level
AOI	Area of Investigation
ARAR	Applicable or relevant and appropriate requirement
bgs	Below ground surface
btoc	Below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	Contaminant of concern
DCE	Dichoroethene
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	U.S. Environmental Protection Agency
ft	Feet
ft^2	Square feet
GAC	Granular activated carbon
HDPE	High-density polyethylene
HP	Horsepower
in.	Inch
in. wc	Inch water column
ISB	*in situ* bioremediation
MCL	Maximum Contaminant Level
PCE	Tetrachloroethene
POTW	Publicly owned treatment works
PV	Pore volume
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
Report	Remedial Design Report
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of influence

SA	Source area
scfm	Standard cubic feet per minute
Site	Bandera Road Ground Water Plume Superfund Site
SVE	Soil vapor extraction
TAC	Texas Administrative Code
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
trans-1,2-DCE	*trans*-1,2-dichloroethene
VC	Vinyl chloride
VOC	Volatile organic compound

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has prepared this Remedial Design Report (Report) for the Bandera Road Ground Water Plume Superfund Site (Site) under U.S. Environmental Protection Agency (EPA) Response Action Contract No. EP-W-06-004, Remedial Design (RD) Task Order 00143-RDRD-06TY.

The purpose of this Report is to present the RD criteria, basis of the RD and technical documents for construction of the remedial system. The design is developed in support of the Record of Decision (ROD) for the Site (EPA 2013). The *Remedial Design/Remedial Action Handbook* (EPA 1995) has been used as guidance in the development of this Report. The Report describes design criteria, assumptions, design approach, cost estimate, and construction and system startup schedule. Accordingly, this Report will address: (1) the contaminants of concern (COCs) in the source area (SA) within and above the vadose zone; (2) the physical and chemical characteristics and volumes of the media to be remediated; (3) remedial strategy; (4) the estimated timeframe to complete the remedial action (RA); (5) the RA cost estimate.

1.1 REPORT ORGANIZATION

This report is generally organized with the following topics:

- Background information
- Summary of the investigative history
- Summary of subsurface conditions
- Description of contaminants
- Description of design criteria
- Justification of design assumptions
- Description of the RD approach
- Description of RD components
- Discussion of compliance with remedial objectives
- Approach for implementation of the RD
- Proposed implementation schedule
- Cost estimate for implementation of the RD.

1.2 SITE DESCRIPTION AND HISTORY

1.2.1 Site Description

The Bandera Road Superfund Site (Site) includes releases and sources from at least two facilities. During the course of the investigation, EPA identified five (5) Areas of Investigation (AOIs), AOI 1 through AOI 5 (EPA 2013). This design and design report address AOI 1 and AOI 2 only and are referred to as the Site throughout this document. These two (2) areas of investigation (AOIs): AOI 1 – the Savings Square Shopping Center and AOI 2 – Pilgrim Cleaners, are both located in Leon Valley, Bexar County, Texas. See Figure 1, Location Map.

The Savings Square Shopping Center, located at 6707 Bandera Road, is currently in use and is comprised of various active retailers. A former dry-cleaning facility was located at the Savings Square Shopping Center. Pilgrim Cleaners, located at 6600 Bandera Road, is a former dry-cleaning facility. AOI 1 is also referred to as SA 1, and AOI 2 is also referred to as SA 2 in some of the older documentation.

1.2.2 Site Geology and Hydrology

The Austin Group or Austin Chalk overlays the Edwards Group. The Edwards Aquifer is contained within the Edwards Group and the Austin Group is the confining unit for the underlying Edwards Aquifer. The quantity of water produced from wells completed in the Austin Group is highly variable and based on location; some wells are reported to yield over 500 gallons per minute while others are only able to produce small quantities of water. Historical, anecdotal, and other lines of evidence suggest some hydrologic connectivity between the Austin Group water-bearing unit and the Edwards Aquifer. Where present, these are likely due to faulting and dissolution along favored pathways (USGS 2012). The Austin Group has a thickness ranging from 125 feet (ft) to 140 ft at the site and consists of micro-granular chalk and limestone, which generally has low permeability. Based on the site remedial investigation (RI) results (EA 2011), several faults are present in the area, but not at AOI 1 or AOI 2, and the faults may provide communication between water-bearing units within the Austin Group and the underlying Edwards Aquifer.

On 20 October 2019, the water level in flush mount monitoring well USGS-42 at AOI 1 was measured as 82.44 ft below top of casing (btoc) and at an elevation of 747.70 ft above mean sea level (AMSL).

On September 19, 2019 the water level in stick up well DW-404 at AOI 2 was measured as 63.52 ft BTOC and at an elevation of 743.96 ft AMSL.

1.2.3 Nature and Extent of Contamination

The ROD identifies the primary COCs as tetrachloroethene (PCE) and its daughter products trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and vinyl chloride (VC) (EPA 2013). At AOI 1, benzene, 1,1-dichloroethene, and methylene chloride are also listed as COCs for groundwater within the Austin Chalk Aquifer and 1,2-dichloroethane and 1,1,2,2-tetrachlorooethane are also listed as COCs for indoor air. At AOI 2, bromodichloromethane, bromoform, carbon tetrachloride, chloroform, dibromochloromethane also listed as COCs for groundwater within the Austin Chalk.

Characterization has been limited due to several factors:

- The lack of available information about the source-release(s)
- The complex migration patterns due to a fractured karst environment
- Small volumes of PCE can create persistent dissolved plumes
- Mobilization risks have precluded many intrusive characterization activities (EPA 2009).

1.2.4 Soil Vapor Extraction Pilot Testing

During September and October 2019, a soil vapor extraction (SVE) pilot testing was conducted at AOI 1 and AOI 2 within the vadose zone of the Austin Chalk Aquifer to assess the efficacy of SVE to address soil contamination (EA 2020). Based on the results of the pilot test, SVE through horizontal nested, segmented (Vertebrae™) wells and deep horizontal wells was determined to be a viable technology for removing volatile organic compounds (VOCs) at both AOI 1 and AOI 2. The pilot test provided data for potential full scale design and implementation, which includes radius of influence (ROI), flowrate/vacuum regime, and mass removal rates of soil vapor contaminants.

1.3 THE SELECTED REMEDY

The selected remedies identified in the 2013 ROD (EPA 2013) include SVE treatment for volatile contamination present in subsurface soils and vadose zone bedrock at both AOIs 1 and 2. *In situ* bioremediation (ISB) was selected in the ROD to address groundwater contamination.

This Design Report focuses on the SVE system design and ISB and includes the following:

- SVE within the shallow vadose zone through Vertebrae™ wells
- SVE within deeper vadose zone horizontal wells
- Separation of soil vapors from entrained water using air-water separators
- Treatment of soil vapors using granular activated carbon (GAC) prior to discharging to the atmosphere
- ISB of groundwater within the Austin Chalk.

2. REMEDIAL DESIGN CRITERIA

The following sections describe the criteria upon which the design is based. The design criteria are based on the revised Remedial Action Objectives (RAOs) defined in the 2013 ROD.

2.1 REMEDIAL ACTION OBJECTIVES

Site RAOs include (EPA 2013):

- Prevent exposure to COCs associated with the Site in ground water and indoor air concentrations greater than cleanup levels

- Prevent or minimize further migration of COCs associated with the Site in surface soil, subsurface soil, vadose zone bedrock, and ground water concentrations greater than cleanup levels

- Return ground water to their expected beneficial uses wherever practicable (aquifer restoration).

The SVE and ISB design will address each of the RAOs. The RAOs will be achieved once: (1) contaminant mass, volume, and extent are substantially reduced, and (2) mass removal rate and concentrations of soil COCs have reached asymptotic range where continued operation is not practical and/or effective.

2.2 DESIGN CRITERIA

The key design criteria are provided below.

2.2.1 Area of Investigation 1

SVE design at AOI 1 was based on the estimated contamination extent in soil (EPA 2013) and results of the SVE pilot testing (EA 2020).

- Area of remediation in the shallow vadose zone was extrapolated from the extent of passive soil gas survey data from the ROD; this area encompasses approximately 5,800 square feet (ft^2). The zone thickness is assumed to be 10 ft.

- Area of remediation in the deeper vadose zone was extrapolated from the extent of expected contamination in the shallow vadose zone and extrapolated to account for secondary lateral migration during downward migration. This area encompasses approximately 10,100 ft^2. The zone thickness is assumed to be 50 ft thick.

- The number of pore volume (PV) exchanges necessary to achieve remediation was estimated to be approximately 5,000 PV, based on site-specific conditions.

- Vapor emission limits for COCs will be based on EPA Clean Air Act emissions standards, specifically by meeting the emission requirements specified in Texas Administrative Code (TAC) §106.533.g.5.

ISB design at AOI 1 was based on the estimated contamination extent of the source area, data gathered during injection testing, water level measurements, and dye tracing. Falling head tests have been conducted on several wells. Some of the wells accepted less than 100 gallons and exhibited low recovery, e.g. DW-404 and DW-415. While others took greater than 150 gallons and exhibited faster recovery, eg DW-408, DW-414, and USGS-42. It was concluded in the ROD that these wells are hydraulically connected to local fractures, possibly intercepting minor faults and/or Karst dissolution conduits. It was also concluded that groundwater flow is primarily through these same minor faults and dissolution conduits and generalized groundwater flow is therefore not necessarily indicative of localized flow direction and quantities. This was confirmed through a combination of water level measurements and dye trace analysis conducted at USGS-42. Groundwater flow direction based potentiometric surface analysis noted that groundwater flow at AOI 1 was generally to the north, however dye trace analysis on USGS-42 showed that groundwater was flowing to the south-southwest (EPA 2013).

2.2.2 Area of Investigation 2

SVE design at AOI 2 was based on the estimated contamination extent in soil (EPA 2013) and results of the SVE pilot testing (EA 2020) as follows:

- Area of remediation in the shallow vadose zone was extrapolated from the extent of passive soil gas survey data from the ROD; this area encompasses approximately 16,540 ft^2. The zone thickness is assumed to be 10 ft.
- Area of remediation in the deeper vadose zone was assumed to be similar to AOI 1, assumed to be 50 ft thick.
- The number of PV exchanges necessary to achieve remediation was estimated to be approximately 5,000 PV, based on site-specific conditions.
- Vapor emission limits for COCs will be based on EPA Clean Air Act emissions standards specifically by meeting the emission requirements specified in TAC § 106.533.g.5.

ISB design at AOI 2 is based on PCE soil gas data shown on Figures 30 and 40 of the ROD (EPA 2013).

2.3 TECHNICAL DESIGN APPROACH

2.3.1 Soil Vapor Extraction

The SVE system at both AOIs utilize Vertebrae™ wells in the shallow vadose zone and deep horizontal wells in the deeper vadose zone.

2.3.1.1 Soil Vapor Extraction Wells

The location of existing Vertebrae™ wells at AOI 1 and AOI 2 are presented as Figures 2 and 3, respectively. The location of the existing and three proposed deep horizontal wells are shown on Figures 4 and 5.

Shallow Vadose Zone in Area of Investigation 1

Based on the pilot testing results (EA 2020), it is expected that each Vertebrae™ SVE well screen will generate a volumetric flow rate of 17.5 standard cubic foot per minute (scfm) per well screen at an applied vacuum of 145 inches (in.) water column (in. wc.). Each of the ten screens is 20 ft in length. Wells are screened from approximately 6-8 ft below ground surface (bgs) within the shallow vadose zone which is comprised of clayey soil. A total of three Vertebrae™ wells have been installed under Building 1 at AOI 1. One of the wells, SA1-01 has two 20 ft long screens and the other two wells, SA1-02 and SA1-03, have four 20 ft long screens each (Figure 2).

A 7.9 to 8.9 ft ROI was determined during pilot testing. Figure 38 of the ROD defined a previously proposed excavation extent beneath Building 1 (EPA 2013). The two wells with four screens each were set in order to place two of the 20 ft long well screens within the previously proposed excavation area. The remaining screens were placed to capture PCE, TCE, and *cis*-1,2-DCE within hot spots as defined by passive soil gas surveys on Figures 24-26 of the ROD (EPA 2013). Due to the radial geometry of the wells, screen locations range from approximately 11 to 17 ft on center. Based on the geometry and ROI determined during pilot testing, it is anticipated that the well network will capture an area of approximately 5,800 ft^2. Figure 2 shows the Vertebrae™ well locations.

Shallow Vadose Zone in Area of Investigation 2

Based on the pilot testing results (EA 2020), it is expected that each Vertebrae™ SVE well screen will generate a volumetric flow rate of 13.3 scfm per well screen at an applied vacuum of 70 in. wc. Each of the 12 screens is 15 ft in length. Wells are screened from approximately 6 to 8 ft bgs within the shallow vadose zone, which is comprised of clayey soil. A total of four Vertebrae™ wells have been installed under the Pilgrim Cleaners Building and adjacent paved parking area. Each of the four wells has three 15 ft long screens (Figure 3).

A ROI of greater than 26.8 ft was determined during pilot testing. Figures 27, 28, and 30 of the ROD show passive soil gas survey locations set outside of the Pilgrim Cleaners Building (EPA 2013). Based on the data provided in the ROD, the nature and extent of contamination below the building was not well defined. Pilot testing results confirmed the presence of chlorinated volatile organic compounds, PCE, TCE, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), *trans*-1,2-dichloroethene (*trans*-1,2-DCE), and VC. Well screens were set in order to provide full coverage based on the ROI. The well network will capture an area greater than 16,540 ft^2.

Deeper Vadose Zone in Area of Investigation 1

Based on the pilot testing results (EA 2020), it is expected that each deep horizontal well will generate a volumetric flow rate of 35 scfm per well at an applied vacuum of 45 in. wc. Deep horizontal well SA1-HSVE-1 has already been installed and has a single 120 ft long screen. Proposed deep horizontal well SA1-HSVE-2 will also have a 120 ft long screen (Figure 4).

During pilot testing the ROI was determined to be less than 18.7 ft. SA1-HSVE-1 will be placed to set the well screens 30 ft apart and parallel to each other at 32-34 ft bgs. It is anticipated that the well network will capture an area of approximately 15,200 ft^2. Figure 4 shows the deep horizontal well locations.

Deeper Vadose Zone in Area of Investigation 2

Based on the pilot testing results at Pilgrim Cleaners (EA 2020), it is expected that each deep horizontal well will generate a volumetric flow rate of 35 scfm per well at an applied vacuum of 45 in. wc. Proposed deep horizontal wells SA2-HSVE-1 and SA2-HSVE-2 are proposed to have 120 ft long screens. Figure 5 shows the proposed deep horizontal well locations.

2.3.1.2 SVE Conveyance Piping

The well field conveyance piping for the SVE system will be constructed using high-density polyethylene (HDPE) pipe, which will be rated to meet or exceed the maximum expected vacuum for the appropriate SVE system. Dedicated conveyance pipes will be run to each well from the treatment compound to allow operational flexibility on individual wells. Conveyance pipes will be brought into a manifold prior to going to the treatment system. The conveyance piping layout for all of the systems are as well as details of the manifold piping configuration, are shown on the Drawings in Appendix A.

The conveyance pipes will be set in a trench leading to each well location. The trench bottom will be prepared with sand bedding before the piping is laid down. The pipes will be pressure tested, and then the trenches will be backfilled and compacted. Pavement that is removed during the trenching will be restored to match pre-existing conditions.

2.3.1.3 SVE Treatment Systems

All components for the treatment systems will be located within fenced treatment compounds with appropriate signage. At AOI 1, the treatment compound will be located in the eastern corner of the Savings Square parking lot, behind Building 1. At AOI 2, the treatment compound will be located in the eastern side of the Pilgrim Cleaners within the paved parking area and next to the existing three phase power pole. Electrical and mechanical equipment will be enclosed within a prefabricated enclosure inside the fenced Treatment Compound. Process flow diagrams are provided on the drawings in Appendix A.

Each system consists of the following major components:

- The SVE system at AOI 1 (Savings Square) will employ a rotary lobe blower vacuum system. Components of the vacuum system include:
    - SVE conveyance legs will be equipped with control valves, flow meters, sample ports, and air compressor connectors. These will be located at the manifold location immediately before the legs combine into the header pipe
    - Inlet header equipped with a flow meter and vacuum gauge
    - Moisture separator and transfer pump
    - Rotary lobe blower with operating capacity of 490 scfm at 158 in. wc at the inlet header
    - Pump motor that provides 40 horsepower (HP) on a 3-phase, 480V power source.

- The SVE system at AOI 2 (Pilgrim Cleaners) will employ a rotary lobe blower vacuum system. Components of the vacuum system include:
  - SVE conveyance legs will be equipped with control valves, flow meters, sample ports, and air compressor connectors. These will be located at the manifold location immediately before the legs combine into the header pipe
  - Inlet header equipped with a flow meter and vacuum gauge
  - Moisture separator and transfer pump
  - Rotary lobe blower with operating capacity of 230 scfm at 116 in. wc at the inlet header
  - Pump motor that provides 15 HP on a 3-phase, 480V power source.
- The remediation enclosure will measure 8 ft wide by 20 ft long by 8.5 ft tall, with R-8.1 insulated and sound insulated walls. The enclosure will contain the piping manifolds, vacuum systems, liquid transfer pumps, air compressor, and power and monitoring/control systems.
- GAC will be used to treat the soil vapor stream prior to discharging to atmosphere. Each SVE system will have a separate treatment train of two vapor-phase GAC treatment vessels, including a lead and lag treatment vessel, for a total of four vapor-phase GAC treatment vessels. Once breakthrough occurs in the lead vessel, a new lag vessel will be installed and the old lag vessel will be become the new lead vessel.
- At each location water will be stored in a double-walled 550-gallon HDPE surge tank that will allow collection and disposal.

Additional system components are described in the Design Drawings and Technical Specifications, Appendixes A and B, respectively. A list of the proposed components is included in Appendix C.

The SVE exhaust streams will be monitored to ensure that emissions meet appropriate guidelines set by EPA. VOC concentrations will be monitored by a photoionization detector pre-GAC, between GAC, and post-GAC and vapor samples will be periodically collected and analyzed by a laboratory.

2.3.1.4 SVE Electrical Components and Power Source

The electrical service will be 200 amperes at 480VAC 3-phase. All components, such as wires, control panel and enclosures will be weatherproof and constructed to meet the standards of the National Electric Code. All connections will be permanent and all equipment will be grounded, this include connection of electrical service and grounding of all process and supporting equipment.

2.3.1.5 SVE Design Drawings and Specifications

Design drawings and specifications are provided in Appendix A and Appendix B, respectively.

2.3.1.6 Design Calculations

SVE Design calculations are provided in Appendix D.

2.3.2 Amendment Treatment

At AOI 1, the amendment injection approach was to form a permeable reactive barrier formation surrounding Building 1 that intersects with minor faults and/or Karst dissolution conduits, as shown on Figure 6. Groundwater should be sampled and a pump test should be conducted to determine aquifer properties at each amendment injection well. This should be completed after well installation and well development to determine appropriate dosages and estimate injection rates.

At AOI 2 the hot spot identified on Figures 30 and 40 of the ROD (EPA 2013) will be the treatment focus. The well is depicted on Figure 7. Groundwater should be sampled and a pump test should be conducted to determine aquifer properties at the amendment injection well. This should be completed after well installation and well development to determine the appropriate dosage and estimate the injection rate.

2.3.3 Summary of Rationale for Major Design Elements

At both locations, AOI 1 and AOI 2, ISB through enhanced reductive dechlorination SVE were the selected remedies presented in the ROD (EPA 2013).

2.3.3.1 Soil Vapor Extraction System

As designed, each SVE system is comprised of several Vertebrae™ SVE wells and deep horizontal SVE wells, conveyance piping, a valved manifold, a moisture separator with transfer pump and surge tank, a blower and motor assembly, a heat exchanger, and GAC vessels.

At both locations, AOI 1 and AOI 2, the Vertebrae™ SVE wells have already been installed. At AOI 1, one of the deep horizontal SVE wells has been installed. One additional deep horizontal SVE well is proposed for installation at AOI 1. Two deep horizontal SVE wells are proposed for installation at AOI 2; no deep horizontal wells have been installed at AOI 2. The Vertebrae™ SVE wells were installed with screens from 6 to 8 ft bgs to target the upper portion of the vadose zone. The deeper horizontal well was installed and the proposed deep horizontal well are proposed to be installed from 32 to 33 ft bgs to target the deeper vadose zone.

At both locations, AOI 1 and AOI 2, the SVE wells are connected to each SVE system enclosure through buried 2-in. nominal HDPE conveyance lines.

At each SVE system enclosure the conveyance lines are connected to a valved manifold. Each manifold has valves to allow operators to adjust or "tune" each system for optimal performance. In addition, the manifold at AOI 1 includes two orifice plates and the manifold at AOI 2 includes one orifice plate. At both locations each manifold was designed with an orifice plate situated between the Vertebrae™ SVE wells and the deep horizontal SVE well connections. This configuration allows each system to operate with a single treatment train thereby reducing equipment costs. At AOI 1, a second orifice plate was included in the design to dilute the waste stream; this was to size larger GAC vessels in order to reduce the carbon changeout frequency.

After leaving the manifold, each waste stream passes through a moisture separator. Collected liquid waste is pumped and conveyed to a double-walled HDPE surge tank. The tank was sized to reduce the frequency that wastewater produced will need to be removed for disposal. The U-shaped vent on the tank allows the tank to vent to the atmosphere. The gaseous waste stream is pumped from the moisture separator through the motor-blower assembly.

After leaving each motor-blower assembly, each heated gas stream passes through a heat exchanger. Each heat exchanger cools each gaseous waste stream to prevent damage to each GAC vessel. At each location, AOI 1 and AOI 2, two GAC vessels are designed to be set in series (lead-lag) configuration through a valved manifold. Each system was designed so that a single lead GAC vessel provides adequate filtration to capture the waste in each waste stream. The lag GAC vessel in each waste stream is configured to safeguard against contaminant breakthrough after the lead vessel becomes saturated. Once the lead vessel becomes saturated, the lag vessel is configured as the lead vessel and a new vessel is placed in the lag configuration.

Discharge from the GAC system is through a 10-ft high minimum exhaust to the atmosphere.

2.3.3.2 *In Situ* Bioremediation System

In situ amendment injection wells are proposed at both AOI 1 and AOI 2; these wells are shown on Figures 6 and 7, respectively. At AOI 1, 15 wells are proposed for amendment injection, three existing wells and 12 proposed wells. At AOI 2, one proposed well is proposed for amendment injection.

Existing wells at AOI 1, IW-03 and IW-04 were installed open hole from 70-100 ft bgs. New wells at both AOI 1 and AOI 2 were designed similarly. These wells target the saturated zone from 70-100 ft bgs.

Figure 38 of the ROD defined a previously proposed excavation extent beneath Building 1 (EPA 2013). As previously discussed, at USGS-42 generalized flow direction based on potentiometric surfaces and localized flow direction based on dye tracing directions were to the north and south-southwest, respectively (EPA 2013). In order to account for this variability, the wells at AOI 1 were configured to form a U-shaped permeable reactive barrier around Building 1.

During pilot testing, it was determined that the secondary porosity through fractures and dissolution pathways is much greater than primary porosity. As such, a ROI based on primary porosity could not be determined. During injection testing at IW-04, a response was observed in USGS-42, which is located approximately 30 ft away (EA 2020). This indicated a zone of influence of at least 30 ft between these wells.

Amendment injection wells were designed as approximately 20 ft on center for AOI 1. This spacing was chosen in order to increase the likelihood of intersecting and thereby delivering amendment into the secondary porosity pathways.

At AOI 2, amendment injection is targeted to treat a hot spot based on PCE soil gas data shown on Figures 30 and 40 of the ROD (EPA 2013).

3. COMPLIANCE, PERMITTING, AND ACCESS AGREEMENTS

3.1 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENT

The selected remedy for the contaminated soil and groundwater has been designed in compliance with specific applicable or relevant and appropriate requirements (ARARs), which have been established in the 2013 ROD. The ARARs that would apply to the SVE and ISB processes are the following:

- Federal Safe Drinking Water Act and Primary Drinking Water Standards (Maximum Contaminant Levels [MCLs]) 40 Code of Federal Regulations (CFR) 141, 143 establish health-based standards for public water systems. ISB will meet chemical-specific ARARs in the Austin Chalk by reducing contaminant concentrations in groundwater to levels less than MCLs. SVE in soil, subsurface soil, and bedrock will meet chemical-specific ARARs by removing COCs that can continue to leach into groundwater.

- Location Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities 40 CFR 264.18 - These regulations prohibit new treatment, storage, or disposal of hazardous waste within 200 ft of a fault displaced in Holocene time, and require that a facility must be designed and maintained to avoid washout if located within a 100-year floodplain. No faults have been mapped at AOI 1 or AOI 2. A portion of AOI 2 is located within a special flood hazard area, but the system has been designed to avoid washout.

- Floodplain Management Executive Order 11988; 40 CFR 6.302 and Appendix A requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid adverse impacts in a floodplain. A portion of AOI 2 is located within a special flood hazard area, but the facility is temporary and located outside of the flood plain.

- Texas Risk Reduction Program - Ground Water Classification 30 TAC § 350.52 (1)(A) Groundwater-bearing units within 0.5 miles of public drinking water supply wells are Class 1 groundwater resources if they can contribute COCs to the groundwater production zone of such public water supply; considerations include COC chemical properties, the local hydrogeology, and the construction of the wells.

- Texas Risk Reduction Program – Tier 1 Exclusion Criteria Checklist 30 TAC § 350.77(b) is intended to aid the person and the Texas Commission on Environmental Quality (TCEQ) in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program. Exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment because there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media. The Tier 1 Exclusion Criteria Checklist utilized regional information (e.g., topographic map), local information such as proximity to a surface water body, field observations regarding habitat or lack thereof, and site specific data (e.g., soil boring data/groundwater analysis), as a basis of determining that no further action was necessary to protect ecological receptors at the site.

- Texas Department of Licensing and Regulation 16 TAC § 76.1000-1009 are regulations regarding the installation and abandonment of ground water wells. Wells are proposed to be drilled for the purpose of amendment injection and SVE. These wells will be installed in accordance with 16 TAC § 76.1000-1009.

- Texas Surface Water Quality Standards 30 TAC § 307 establishes surface water limits to ensure public health and enjoyment, propagation and protection of terrestrial and aquatic life, operation of existing industries, and economic development of the state. No discharges into adjacent surface waters are proposed.

- Federal Water Pollution Control Act 40 CFR 403 establishes responsibilities of Federal, State, and local government, industry and the public to implement National Pretreatment Standards to control pollutants which pass through or interfere with treatment processes in publicly owned treatment works (POTWs) or which may contaminate sewage sludge. Any groundwater that is collected incidentally by the proposed SVE system is expected to be minimal and will be captured and containerized before hauling off for treatment.

- Federal Safe Drinking Water Act 40 CFR 149 provides for a federally implemented sole source aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area. ARAR applies because the Edwards Aquifer has been designated as a Sole Source Aquifer. No treatment is proposed for the Edwards Aquifer.

- Ground Water Restoration Texas Water Code 26.401 requires ground water quality to be restored, if feasible. ARAR applies because RAO for ground water is to restore through remediation processes.

- National Primary and Secondary Ambient Air Quality Standards (NAAQS) 40 CFR 50.4, 50.6, 50.8, 50.9, 50.11, 50.12 NAAQS define levels of air quality to protect the public health or the public welfare from any known or anticipated adverse effects of a federally regulated pollutant. NAAQS for sulfur dioxide, nitrogen dioxide, and carbon monoxide apply to incineration. Incineration is not proposed.

- Texas Clean Air Act Texas Health and Safety Code Section 382. The policy of this state and the purpose of this chapter are to safeguard the state's air resources from pollution by controlling or abating air pollution and emissions of air contaminants, consistent with the protection of public health, general welfare, and physical property. This ARAR applies as the SVE system will have emissions.

- TAC - Air Quality 30 TAC § 101.4. No person shall discharge from any source whatsoever one or more air contaminants or combinations thereof, in such concentration and of such duration as are or may tend to be injurious to or to adversely affect human health or welfare, animal life, vegetation, or property, or as to interfere with the normal use and enjoyment of animal life, vegetation, or property. Emissions from the SVE system will be treated and comply with 30 TAC §101; Permits by Rule.

- TAC - 30 TAC § 115 Control of air pollution from volatile organic compounds. Emissions from the SVE system will be treated and comply with 30 TAC § 101; Permits by Rule.

- Relocation of Soils Containing Chemicals of Concern for Reuse Purposes 30 TAC § 350.36. A person must comply with this section when relocating soils for reuse purposes from an affected property (onsite or offsite) which is undergoing or has completed a response action under Remedy Standard A or B and the soils contain COCs in excess of naturally occurring background concentrations. Drilling activities will generate soil for offsite disposal.

- Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste 40 CFR 261 provides the criteria for identifying a characteristic or listed waste. Solid waste is a hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, and toxicity or if it is a listed waste. Applicable to offsite waste disposal. Excavated soil will be characterized for ignitability, corrosivity, reactivity, and toxicity prior to offsite disposal.

- Standards Applicable to Generators of Hazardous Waste 40 CFR 262 provides requirements for preparation of waste manifests, waste packaging, labeling and handling. Work will conform with these requirements.

- Standards Applicable to Transporters of Hazardous Waste 40 CFR Part 263, 30 TAC 335.91 requires that hazardous material to be transported off site be labeled and placarded according to the regulations and that contractors who transport the hazardous waste provide proper documentation. Work will conform with these requirements.

- Land Disposal Restrictions 40 CFR 268 restricts the land disposal of most hazardous wastes and specified specific treatment standards that must be met before these wastes can be land disposed. Work will conform with these requirements.

- Procedures of Planning and Implementing Offsite Response Actions 40 CFR 300.440. Hazardous waste generated from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanups must go to Resource Conservation Recovery Act permitted treatment, storage, and disposal facilities that are in compliance with Resource Conservation Recovery Act and state rules and that do not have releases to the environment. Work will conform with these requirements.

- Prevention and Control 30 TAC § 327.4 defines the reportable quantities in the event of a spill or release to environment. Work will conform with these requirements.

- Waste Classification 30 TAC § 335.505, 30 TAC § 335.508 provides procedure for implementation of Texas waste notification system and establishes standards for classification of industrial solid waste managed in Texas, including Class 1, Class 2, and Class 3 wastes. Work will conform with these requirements.

- Permitting by Rule Subchapter X: Waste Processes and Remediation 30 TAC § 106.532 (Water and Wastewater Treatment) § 106.533 (Remediation) provides conditions under which water and wastewater treatment units are permitted by rule and provides conditions for equipment used to extract, handle, process, condition, reclaim, or destroy contaminants for the purpose of remediation are permitted by rule. Work will conform with these requirements.

- Visible and Particulate Emissions Standard 30 TAC § 111.145 requires meeting visible emission standards using fugitive dust controls, such as wetting, and confirm compliance via air monitoring during excavation activities. Work will conform with these requirements.

- Edwards Aquifer Protection Program 30 TAC § 213. The purpose of this chapter is to regulate activities having the potential for polluting the Edwards Aquifer and hydrologically connected surface streams in order to protect existing and potential uses of ground water and maintain Texas Surface Water Quality Standards. The activities addressed are those that pose a threat to water quality. Proposed activities will not pollute the Edwards Aquifer.

- National Pollutant Discharge Elimination System 40 CFR 122, 40 CFR 125 provides conditions that must be incorporated into NPDES permits. Applicable to discharge of storm water from the Site. Work will conform with these requirements.

- Underground Injection Control Program 40 CFR 144 provides minimum requirements for Class 5 injection wells. Applicable to alternative where reagents will be injected below the water table. Amendment injection shall conform with these requirements.

- Pre-treatment Requirements for Discharge to POTW 30 TAC § 315 requires water discharged to City POTW to meet specific allowable contaminant levels. No water is proposed for discharge to a POTW.

- Underground Injection Control Program 30 TAC § 331 requires state approval for reinjection of treated ground water and any treatment amendments. Requirements shall be met prior to injecting amendments.

- TPDES Construction General Permit TXR150000. General permit to discharge water from construction activities. Work will conform with these requirements.

3.2 PERMITS

This section presents the federal, state and local permits that would typically be required to implement the remedy at the site. Activities undertaken on a CERCLA site by authority of CERCLA, as approved or required by EPA, are not required to obtain permits. However, the substantive requirements of such permits must still be met. Permit considerations applicable to RA activities, and the entities that have jurisdiction over these permits, are as follow:

- TCEQ Underground Injection Control Permits and Registrations—Will be applicable to the construction of injection wells and amendment injection. A condition of the permit will be to provide the TCEQ Underground Injection Control division with post injection information throughout the life span of the injection wells and includes notification at termination of the injection activities and decommissioning the wells for injection use.

- National Electrical Code—State of Texas has adopted the *National Electrical Code,* 2014 edition, published by the National Fire Protection Association. It will be applicable to any temporary or permanent electrical work to be performed at the site.

- International Mechanical Code—State of Texas has adopted the *International Mechanical Code,* 2015 edition, published by the International Code Council. It will be applicable to any mechanical systems at the site, specifically the treatment building heating and ventilation system.

3.3 EASEMENT AND ACCESS REQUIREMENT

EA Engineering may assist EPA, if necessary, in obtaining access agreement from property owners prior to any field activities at the site. RA-related activities will be conducted only after a copy of the fully executed access agreement is available onsite. The property owners have granted full access to the EPA to complete the work, but an easement could be required in order to deliver power to the proposed facility at AOI 1 and easement(s) will be required in order to install the proposed deep horizontal wells and conveyance piping at AOI 2.

4. REMEDIATION IMPLEMENTATION APPROACH

This section provides a general approach of RA implementation. The implementation activities will include the following components:

- Update existing access agreements and obtain new access agreements, if necessary
- Mobilization to the site
- Utility clearance
- Surveying and layout staking
- Site preparation
- SVE and ISB well installation
- Amendment injection
- Trenching and piping
- Treatment compound construction
- SVE system installation
- Power connection
- Systems programming
- SVE system start-up
- Site restoration; and
- Demobilization from the site.

4.1 MOBILIZATION

RA Subcontractor will mobilize all personnel, equipment, and materials to the site for field efforts. EA will mobilize construction oversight personnel during the field efforts.

4.2 UTILITY CLEARANCE

Staff from GPRS, Inc., a utility locater service company, marked onsite utility locations within the paved portions at AOI 1 and AOI 2. A ground penetrating radar was used to identify utility locations and these were marked on the pavement. These locations are depicted approximately on the drawings in Appendix A.

All known utilities are shown with their approximate location in the Design Drawings. The construction contractor should determine and confirm the location of all utilities at the Sites.

4.3 SURVEYING

All proposed well locations and the proposed trenching alignment will be marked using flags or paint by a surveyor prior to the start of drilling. Actual drilling locations may be moved by the project Geologist. Actual trenching locations may be moved by the project Engineer. The horizontal drilling entry and exit points will be surveyed.

Surveys will be conducted before and after certain work tasks to determine quantities for payment.

Final well surveys will measure and report, at a minimum, easting, northing, ground surface elevation, and top of well casing elevation. Horizontal coordinates of the monitoring well locations will be surveyed to the nearest 0.1 ft relative to State plane coordinates by a land surveyor registered in Texas. Elevations will be measured relative to mean sea level at ground surface to the nearest 0.01 ft.

4.4 SITE PREPARATION

Site preparation will include documentation of baseline condition at the site, clearance, and setup of the Subcontractor's work and staging areas. These activities are described below.

- Baseline condition will be recorded prior to any field activities during a site visit using photographs and notes.

- Work zones will be set up, a fence will enclose the area where only project personnel will be allowed to enter. This area will include the remediation enclosure for the SVE system, a staging and storage area for construction material and equipment, and a decontamination zone.

- Access for construction vehicles and equipment to the work zone are described in the Design Drawings and Technical Specifications. Traffic control measures will be established.

- Fence installation for the Treatment Compound.

4.5 POWER SUPPLY

The local electrical distribution company has been identified as CPS Energy. Before starting construction activities, CPS Energy will be provided the following information:

- National Electrical Code load analysis
- One-line diagram

- Site plan in AutoCAD format
- Construction starting date.

Then, CenterPoint Energy representatives will:

- Schedule a visit
- Review customer documentation
- Perform preliminary research of the project site
- During the site visit, identify the desired location of the service, potential obstacles, and design preliminary concept based on customer expectations
- After the site visit, EA will receive either a temporary or a permanent account
- Design the project and draft applicable documents
- If necessary, during site preparation, move any obstacles or obstructions (trim trees, clear brush, etc.) to provide access to project site.

Coordination with CPS Energy and installation of the electrical service will occur during the RA phase.

All electrical components will operate on 3-phase, 60-Hertz, 480-Volt power.

4.6 WELL INSTALLATION

One deep horizontal well (SA1-HSVE-1) and three Vertebrae™ well systems (SA1-01, SA1-02, and SA1-03) have already been installed at AOI 1, and four Vertebrae™ well systems (SA2-01 through SA2-04) have already been installed for SVE at AOI 2. Twelve injection wells for amendment injection (IW-01, IW-02, and IW-05 through IW-14) and one deep horizontal well for SVE (SA1-HSVE-2) are proposed for installation at AOI 1 while one injection well for amendment injection (IW2-01) and two deep horizontal wells for SVE (SA2-HSVE-01 and SA2-HSVE-02) are proposed for installation at AOI 2. The proposed layout and details are presented in the Design Drawings and Construction Specifications in Appendix A and Appendix B, respectively. All proposed and existing SVE and wells will be provided with surface completions, including an access vault, vacuum gauge, and connection to the conveyance piping. All proposed injection wells will be include an access vault. The wells will be developed following the completion of each well according the relevant specifications in Appendix B.

4.6.1 Deep Horizontal Well Installation

Deep horizontal wells (SA1-HSVE-02, SA2-HSVE-01, and SA2-HSVE-02) will be drilled to a depth of approximately 32-34 ft bgs and the screened sections shall be horizontal and set at a depth of 32-34 ft bgs; locations are shown in Appendix A. Deep horizontal wells shall be drilled using a directional drilling rig and the progress will be tracked with a specially designed sond that will provide real-time feedback depth and angle information to the driller. The well shall be constructed of 140 ft of 3 in. nominal blank schedule 80 PVC in 20-ft threaded sections with Viton® gaskets between each section and 120 ft of 3 in. nominal schedule 80 PVC in 20-ft

threaded sections with Viton gaskets between each section and four 2-in. long x 0.020-in. openings per linear foot of screen. The well shall be terminated with a 6-in. long 3-in. nominal Schedule 80 PVC cone-shaped sump. Two rubber grout collars shall be installed and secured with hose clamps at the base of the blank screen to prevent grout from reaching the screen. With a tremie pipe a Portland cement and bentonite hole plug mixture shall be pumped from the grout collar to the well entry pit. The well entry pit shall be set within a 24-in. x 24-in. by 24-in. traffic rated vault set within a minimum 3-ft x 3-ft x 6-in. deep concrete pad reinforced with #3 rebar around the vault and sloped to allow water to drain away from the vault.

4.6.2 Amendment Injection Well Installation

Each boring location shall be cleared for utilities by using hand augers or another similar device such as air knife/vacuum excavation. Nominal 12-in. diameter boreholes will be advanced to depths of 70 ft bgs using the air rotary drilling method. The depth of the borehole shall be confirmed with a weighted measuring tape. Seventy ft of 8-in. diameter Schedule 20 carbon steel surface casing will be pressure grouted in place via tremie pipe and the grout shall be allowed minimum 24-hours to cure. A 6.25 in. bit shall be advanced within boreholes to 100 ft inside surface casing. Each injection well shall be completed open hole in limestone/chalk. A 2 ft x 2 ft concrete pad, 4-in. thick shall surround each flush mount manhole. The pad shall be made of high-quality structural type concrete and contains sufficient reinforcing steel to ensure its structural integrity in the event that soil support is lost. The top of the pad shall slightly slope away from the manhole to the edges of the pad to prevent ponding of water around the casing or collar. The new pad will be installed after the annular space is grouted and cured for at least 24 hours. Wells will be completed at grade (flush mount) and shall have a watertight monitoring well manhole with a bolted and gasketed cover. The top of the well casing shall be protected by a sealing liquid-tight, locking well plug inserted into the casing. The manhole will be placed around the well casing and extend approximately 1 foot below the ground surface and a minimum of 6 in. above the top of the well casing and locking well plug. Wells will be spaced approximately 20 ft on center around Building 1 at AOI 1. Full details on well construction can be found in Appendix A and Appendix B.

4.7 WELL DEVELOPMENT

4.7.1 Deep Horizontal Wells

Upon completing well installation a thoroughly mixed solution comprised of 500 gallons of clean water mixed with one pint of liquid enzyme blocker shall be pumped down each well and a jetting tool shall be lowered and raised for six passes along the entire length of screen. Enzyme blocker shall be Minerals Technologies® CETCO® LEB-CD™ Liquid Enzyme Breaker or engineer approved equivalent.

4.7.2 Amendment Injection Wells

The amendment injection wells shall be developed by surging and bailing followed by air lifting.

4.8 CONVEYANCE PIPING AND MANIFOLD INSTALLATION

The conveyance piping will consist of DR-11 HDPE pipe that will be butt-welded in the field. The pipe will appropriately pressure rated for the expected operating conditions. The pipe will be installed in open cut trenches, except where a casing pipes will be horizontally drilled to pass below the building. The pavement will be cut before trenches are excavated, then the bedding material and piping will be placed in the trenches. The surface will be restored with a base aggregate and concrete or asphaltic pavement to match the surrounding surface.

4.9 SVE SYSTEM INSTALLATION

The bulk of the SVE system will be plant-fabricated. Onsite installation will include placement of the enclosure, connection of power supply, placement of treatment vessels, and installation of interconnection piping between the conveyance piping, enclosure, and treatment vessels. Qualified mechanical and electrical subcontractors will be employed for the piping and electrical connections.

4.10 SVE SYSTEM START-UP

System start-up will be conducted in order to ensure all automation and safety controls are functioning correctly. Startup is expected to take one week and will include the following activities:

- A safety review meeting to confirm that the system construction and final installations were done as planned
- Pressure and leak check in all major piping
- Check all motors and electrical equipment for proper grounding
- Verify all instrument signals and calibrate if required
- Set all valves to proper start position
- Baseline sampling
- Monitor vacuum pressure and airflow data.

4.11 AMENDMENT INJECTION

A food grade emulsified vegetable oil equivalent shall be injected into wells IW-01 through IW-14 and USGS-42 at AOI 1 and IW2-01 at AOI 2. An inflatable sliding head packer shall be used to inject the emulsified vegetable oil into the water-bearing zone at each well, ±80-100 ft bgs. The inflatable sliding packer will be set to inject amendment into the saturated zone. Amendment will be injected at up to and approximately 10 gallons per minute at a delivery pressure from 5 to 100 pounds per square inch at a maximum pressure of 100 pounds per square inch. The injectate quantities were preliminarily estimated based on the substrate estimating tool Appendix D, 1087.5 pounds of emulsified vegetable oil per well. This is an equivalent weight, so the actual injection quantities of amendment, dilution water, and chase water will be dependent on the actual substrate used per the manufacturer's instruction. The actual injection

quantities should be based on contaminant concentrations present at each well, well properties, and manufacturer's instructions.

5. FINAL REMEDIAL ACTION COST ESTIMATE

The final remedial cost estimate is detailed in Appendix E. The costs are based on values provided in cost estimating software (RS Means 2020), vendor estimates, and engineer estimates. Quantities are based on estimated design quantities and calculations.

6. REFERENCES

EA Engineering, Science, and Technology, Inc., PBC (EA). 2011. "Remedial Investigation Report, Bandera Road Plume Superfund Site, Leon Valley, Bexar County, Texas, Revision 01. July.

———. 2020. "Soil Vapor Extraction Pilot Tests Technical Memorandum, Bexar County, Texas, EPA ID No. TXN000606565." 25 March.

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———. 2009. "Bandera Road Case Study EPA Technical Support Project Meeting" presentation. 18 November.

———. 2013. "Record of Decision, Bandera Road Ground Water Plume Superfund Site, Bexar County, Texas, EPA ID No. TXN000606565." 30 September.

U.S Geological Survey (USGS). 2012. *Groundwater Levels and Water-Quality Observations Pertaining to the Austin Group, Bexar County, Texas, 2009–11.* Reston, Virginia. Scientific Investigations Report 2012–5278.

Figures

Appendix A

Design Drawings

Appendix B

Design Specifications

Appendix C

Supporting Calculations

Appendix D

Construction Cost Estimate

Appendix E

Equipment Data

Figures

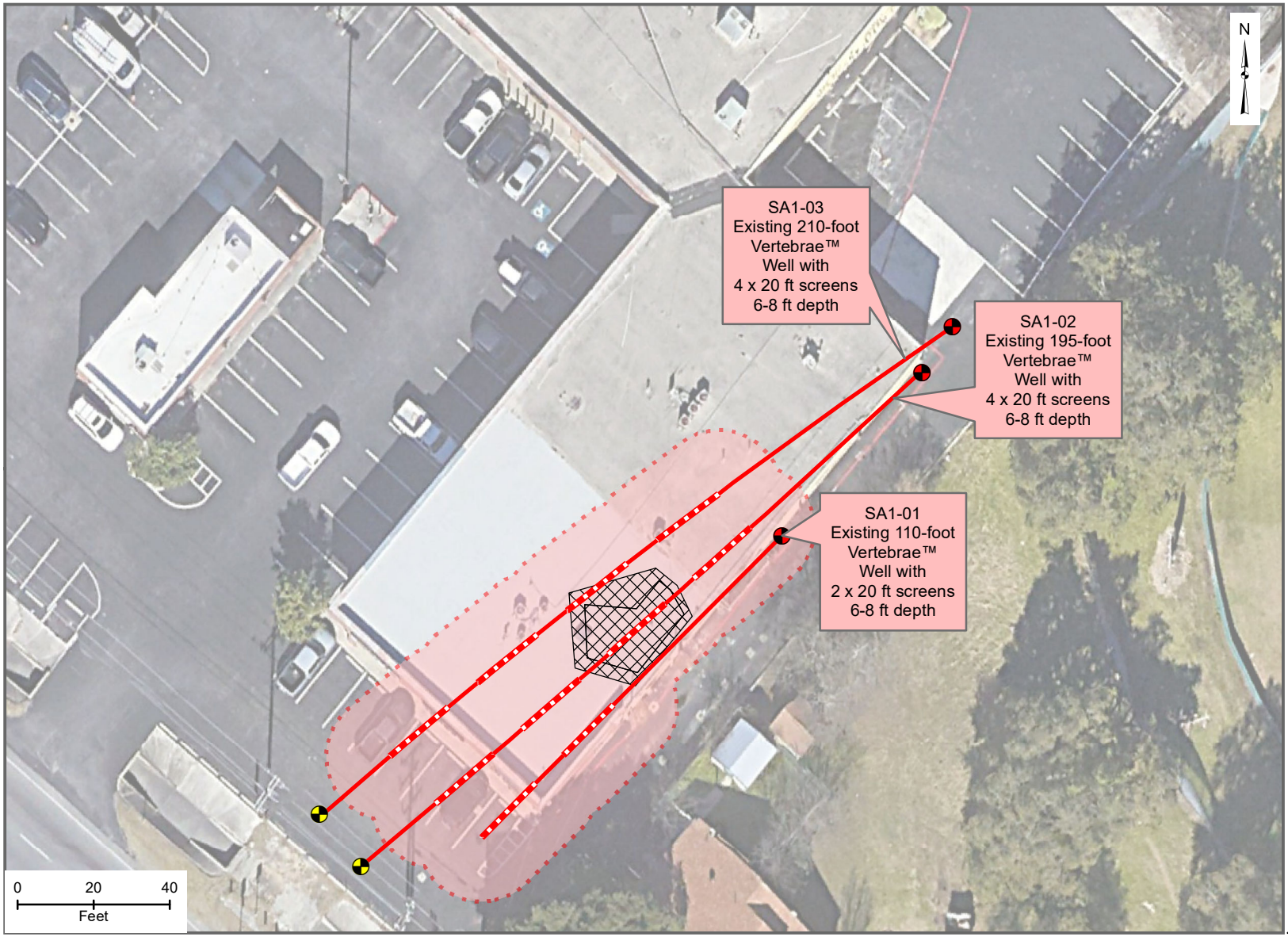
Legend

City of Leon Public Water Supply Well

Figure 1. Location Map

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

H:\projects\1434223\MXD\2011\AOI



Recently Installed Vertebrae™ Well Entry Vault

Recently Installed Vertebrae™ Well Exit Vault

Recently Installed Vertebrae™ Well Blank Casing

Recently Installed Vertebrae™ Well Screen

Approximate SVE Zone of Influence

Approximate Location of Estimated Excavation Area[1]

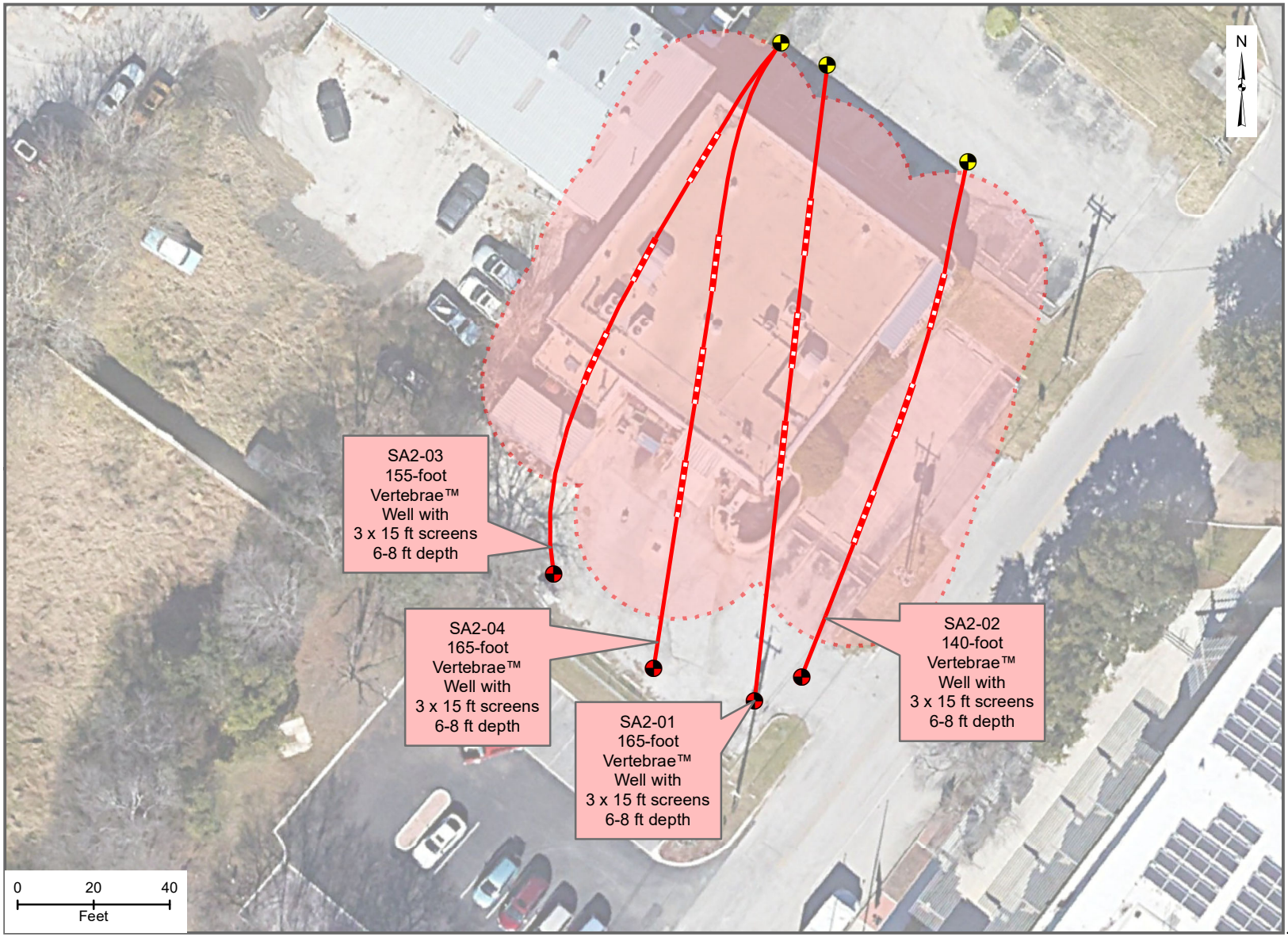
Notes:
1. Estimated excavation source is Figure 5 of Appendix G of the Supplemental Remedial Investigation Report - Area of Interest 1, Bandera Groundwater Plume Site, August 2012.
2. Depths are relative to ground level at point of entry.

AOI = Area of Investigation
ft = feet
TM = trademark

Image Source: December 2018 imagery downloaded from Google Earth Pro on October 23, 2019

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

Figure 2
Existing Vertebrae™ Well Locations
AOI 1 Savings Square



Recently Installed Vertebrae™ Well Entry Vault

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Recently Installed Vertebrae™ Well Screen

Approximate SVE Zone of Influence

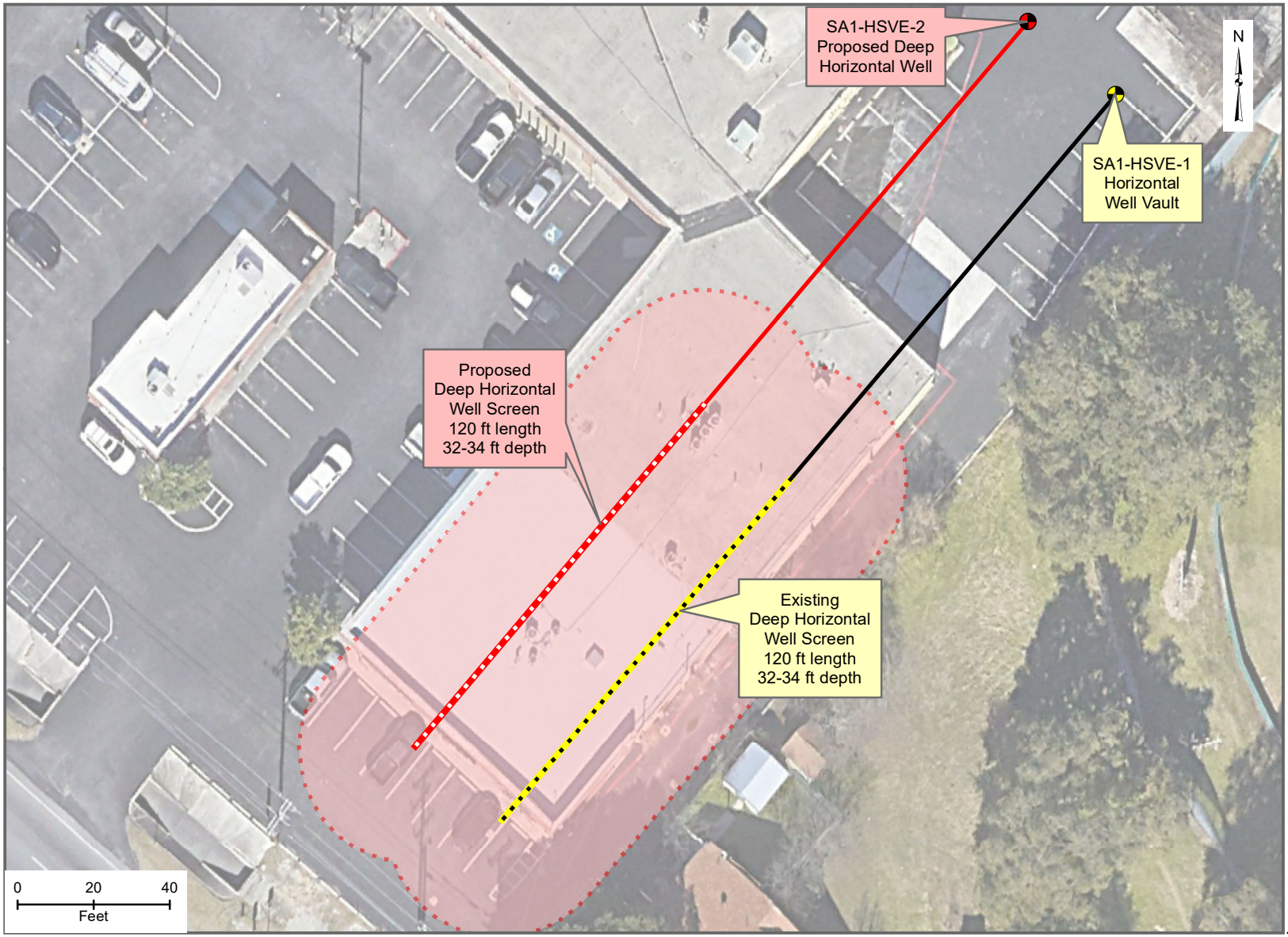
Note:
Depths are relative to ground level at point of entry

AOI = Area of Investigation
ft = feet
TM = trademark

Image Source: December 2018 imagery downloaded from Google Earth Pro on October 23, 2019

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

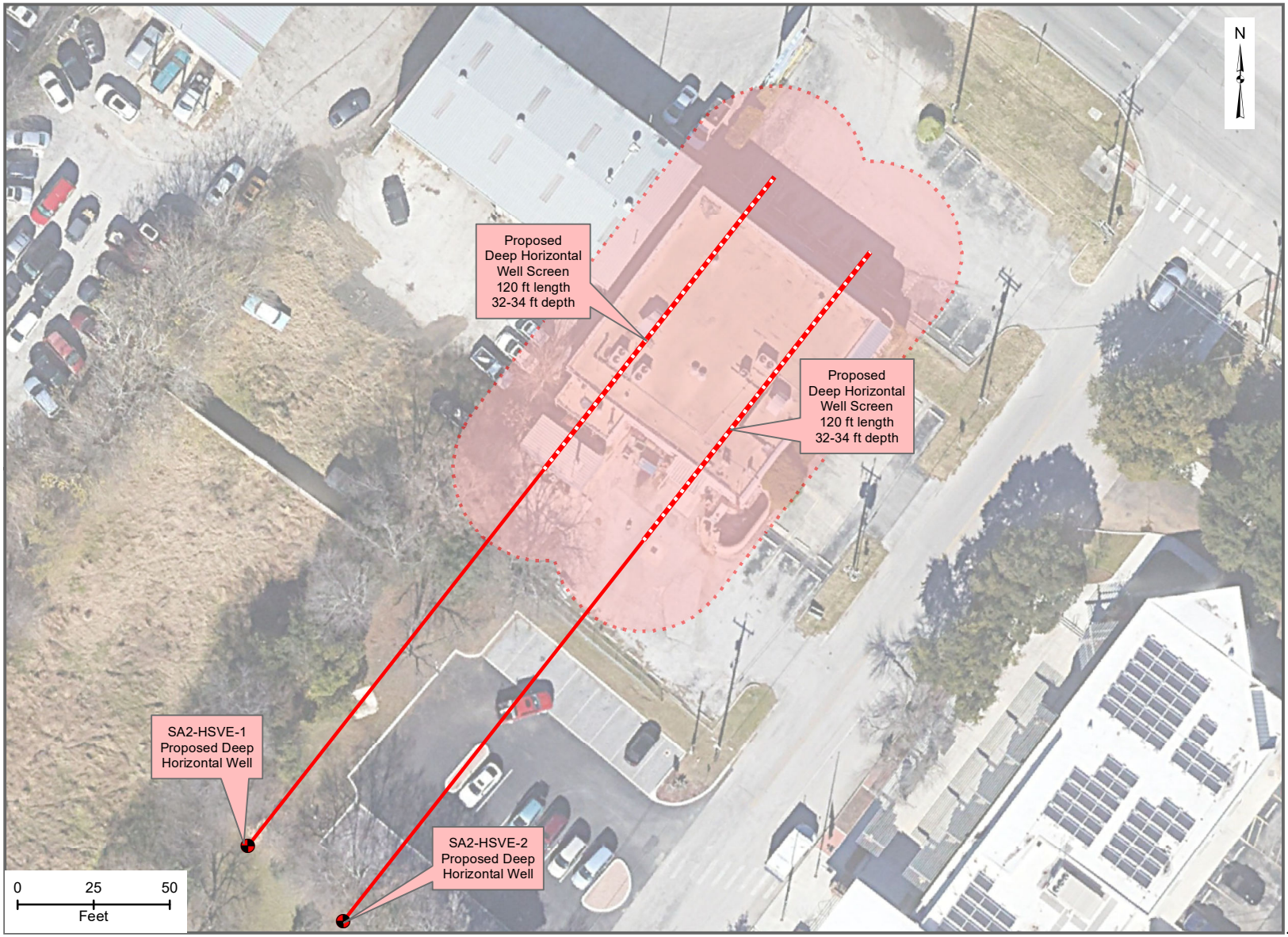
Figure 3
Existing Vertebrae™ Well Locations
AOI 2 Pilgrim Cleaners



Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

Figure 4
Deep Horizontal Well Locations
AOI 1 Savings Square

2020-09-28 C:\Users\aspiller\Documents\GIS\Projects\Bandera\MXD\Remedial Design\Figure 4 Savings_Square_EPA - Deep_Horiz.mxd EA-Dallas aspiller



Proposed Deep Horizontal Well Vault

Proposed Deep Horizontal Well Blank Casing

Proposed Deep Horizontal Well Screen

Approximate SVE Zone of Influence

Note:
Depths are relative to ground level at point of entry

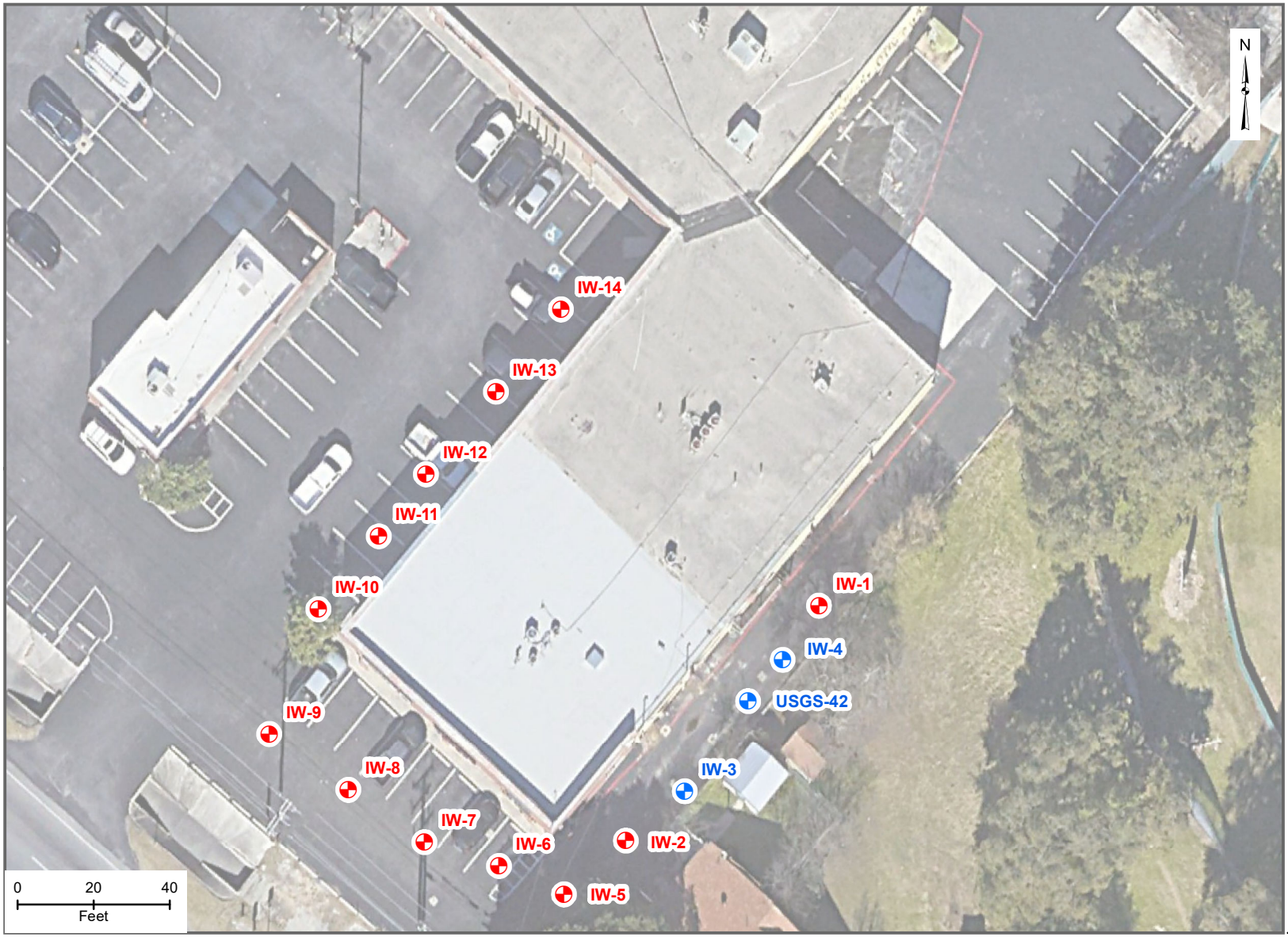
AOI = Area of Investigation
ft = feet

Image Source: December 2018 imagery downloaded from Google Earth Pro on October 23, 2019

Figure 5
Proposed Deep Horizontal Well Locations
AOI 2 Pilgrim Cleaners

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

2020 -09-28 C:\Users\aspiller\Documents\GIS\Projects\Bandera\MXD\Remedial Design\Figure 5 Pilgrim_EPA - Proposed_Deep_Horiz.mxd EA-Dallas aspiller



Existing Amendment Injection Well

Proposed Amendment Injection Well

AOI = Area of Investigation

Image Source: December 2018 imagery downloaded from Google Earth Pro on October 23, 2019

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

Figure 6
Amendment Injection Well Locations
AOI 1 Savings Square

2020-09-28 C:\Users\aspiller\Documents\GIS\Projects\Bandera\MXD\Remedial Design\Figure 6 Savings_Square_EPA - Injection_Wells.mxd EA-Dallas aspiller

Proposed Amendment Injection Well

AOI = Area of Investigation

Image Source: December 2018 imagery downloaded from Google Earth Pro on October 23, 2019

Bandera Road Ground Water Plume Superfund Site
Leon Valley, Bexar County, Texas

Figure 7
Amendment Injection Well Location
AOI 2 Pilgrim Cleaners

2020-09-28 C:\Users\aspiller\Documents\GIS\Projects\Bandera\MXD\Remedial Design\Figure 7 Pilgrim_EPA - Injection_Wells.mxd EA-Dallas aspiller

Appendix A

Design Drawings

SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
REMEDIAL DESIGN
BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
BEXAR COUNTY, TEXAS

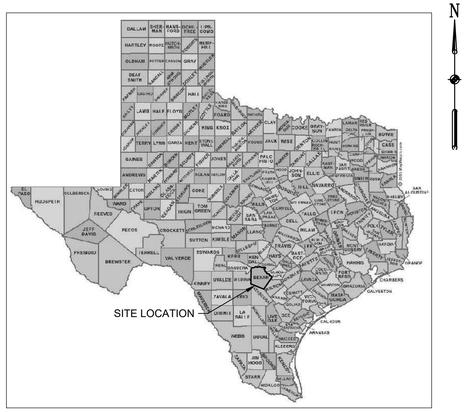


IMAGE SOURCE: COUNTYMAPOFTEXAS.COM

TEXAS MAP
NOT TO SCALE

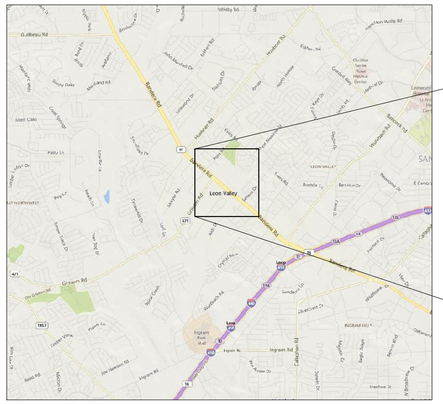


IMAGE SOURCE: BING MAPS

LOCAL AREA MAP
NOT TO SCALE

IMAGE SOURCE: BING MAPS 2020

VICINITY MAP
NOT TO SCALE

Sheet List Table		
Drawing Number	Sheet Number	Sheet Title
G-001	1	COVER SHEET
G-002	2	GENERAL NOTES AND LEGEND
C-101	3	EXISTING CONDITIONS AT AOI 1
C-102	4	EXISTING CONDITIONS AT AOI 2
C-103	5	SITE DEMOLITION, CLEARING AND ACCESS AT AOI 1
C-104	6	SITE DEMOLITION, CLEARING AND ACCESS AT AOI 2
C-105	7	PROPOSED SVE SYSTEM AND AMENDMENT INJECTION WELLS AT AOI 1
C-106	8	PROPOSED SVE SYSTEM LAYOUT AT AOI 2
C-107	9	PROPOSED TREATMENT COMPOUND AND INJECTION WELL LAYOUT AT AOI 1
C-108	10	PROPOSED TREATMENT COMPOUND AT AOI 2
C-109	11	SVE CONVEYANCE LINE TRENCHING PLAN AT AOI 1
C-110	12	SVE CONVEYANCE LINE TRENCHING PLAN AT AOI 2
C-201	13	BORING PROFILE AT AOI 2
C-401	14	TREATMENT COMPOUND AT AOI 1
C-402	15	TREATMENT COMPOUND AT AOI 2
C-501	16	SVE SYSTEM DETAILS
C-502	17	WELL CONSTRUCTION DETAILS
C-503	18	PIPE CONSTRUCTION DETAILS
C-504	19	TREATMENT COMPOUND FENCE DETAILS
C-505	20	VESSEL DETAILS
C-506	21	BLOWER ASSEMBLY AND MOISTURE SEPARATOR DETAILS
C-507	22	SVE SYSTEM FLOW DIAGRAM
C-508	23	SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM AT AOI 1
C-509	24	SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM AT AOI 2
E-101	25	ELECTRICAL ABBREVIATIONS, SYMBOLS, AND GENERAL NOTES
E-102	26	SAVINGS SQUARE SITE PLAN
E-103	27	PILGRIM SITE PLAN
E-104	28	SAVINGS SQUARE TREATMENT COMPOUND PLAN
E-105	29	PILGRIM TREATMENT COMPOUND PLAN
E-501	30	I-LINE DIAGRAM, PANEL BOARD SCHEDULE, AND DETAILS
E-601	31	CONTROL PANEL
E-602	32	CONTROL PANEL ELEMENTARY - 1
E-603	33	CONTROL PANEL ELEMENTARY - 2
E-604	34	ELEMENTARIES

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

COVER SHEET

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

G-001

SHEET: 1 OF 34

FINAL SUBMITTAL

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342143\BANDERA RD\CAD\SHEETS\CIVIL\G-001 COVER SHEET.DWG [G-001] | BRANDON, CHRISTOPHER 10/29/2020 1:28 PM

GENERAL CONSTRUCTION NOTES:

1. ALL WORK ON THIS PROJECT SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS, ORDINANCES AND REGULATIONS CONCERNING CONSTRUCTION SAFETY AND HEALTH.

2. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL REQUIRED CONSTRUCTION PERMITS AND APPROVALS OF LIKE KIND PRIOR TO START OF CONSTRUCTION.

3. PROJECT DOCUMENTS CONSISTS OF THESE PLAN SHEETS, PROJECT SPECIFICATIONS, PROJECT CONTRACTS, AND ANY AND ALL SUBSEQUENT EXECUTED PROJECT DOCUMENTATION ISSUED AS, OR WITH, CHANGE ORDERS, AND RFI'S (REQUEST FOR INFORMATION). THE CONTRACTOR SHALL REVIEW ALL PROJECT DOCUMENTS AND VERIFY ALL DIMENSIONS, QUANTITIES, AND FIELD CONDITIONS. ANY CONFLICTS OR OMISSIONS WITH THE DOCUMENTS SHALL BE REPORTED TO THE ENGINEER/PROJECT MANAGER FOR CLARIFICATION PRIOR TO PERFORMANCE OF ANY WORK IN QUESTION. IN THE EVENT THE CONSTRUCTOR DOES NOT NOTIFY THE ENGINEER/PROJECT MANAGER, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND ANY AND ALL EXPENSE FOR ANY REVISIONS NECESSARY OR CORRECTIONAL WORK REQUIRED.

4. HORIZONTAL UTILITY LOCATIONS ARE APPROXIMATE AND ARE BASED ON FIELD LOCATED UTILITIES. CONTRACTOR IS RESPONSIBLE FOR LOCATING UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR COORDINATING CONSTRUCTION ACTIVITIES WITH UTILITIES PROVIDERS. EXISTING BURIED UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL USE ANY MEANS APPROVED BY THE ENGINEER/PROJECT MANAGER TO LOCATE UNDERGROUND UTILITIES INCLUDING, BUT NOT LIMITED TO, ELECTRONIC LOCATING EQUIPMENT AND/OR POT HOLING. ANY DAMAGE TO ANY OTHER UTILITIES AND/OR COLLATERAL DAMAGE CAUSED BY THE CONTRACTOR SHALL BE THE FULL RESPONSIBILITY OF THE CONTRACTOR.

5. EXISTING FENCING OR WALLS THAT ARE NOT DESIGNATED FOR REMOVAL SHALL NOT BE DISTURBED. ANY FENCING OR WALLS THAT ARE DISTURBED OR ALTERED BY THE CONTRACTOR SHALL BE RESTORED TO ITS ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE. IF THE CONTRACTOR DESIRES TO REMOVE FENCING TO ACCOMMODATE CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL OBTAIN THE OWNER'S WRITTEN PERMISSION BEFORE FENCE IS REMOVED. CONTRACTOR SHALL RESTORE THE FENCE TO ITS ORIGINAL CONDITION AT THE EARLIEST OPPORTUNITY TO THE SATISFACTION OF THE OWNER. WHILE ANY FENCING IS REMOVED, THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR SECURITY OF THE SITE UNTIL THE FENCE IS RESTORED.

6. AT THE END OF EACH WORK DAY, THE CONTRACTOR SHALL CLEAN AND PICK UP THE WORK AREA TO THE SATISFACTION OF THE ENGINEER/PROJECT MANAGER OR THEIR REPRESENTATIVE. AT NO TIME SHALL THE WORK BE LEFT IN A MANNER THAT COULD ENDANGER WORKERS OR THE PUBLIC.

7. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE PROJECT SPECIFICATION AND PLANS, AS AMENDED AND REVISED BY THE ENGINEER. ALL INSTALLATION DETAILS ARE TYPICAL AND MAY BE CHANGED TO BETTER FIT EXISTING LOCAL CONDITIONS UPON APPROVAL BY THE ENGINEER/PROJECT MANAGER.

8. ONLY THE CONTRACTOR SHALL BE RESPONSIBLE FOR SAFETY OF ALL WORK. ALL WORK, INCLUDING WORK WITHIN TRENCHES, AND EXCAVATIONS SHALL BE IN ACCORDANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA).

9. THE CONTRACTOR SHALL NOT INSTALL ITEMS AS SHOWN ON THESE PLANS WHEN IT IS OBVIOUS THAT FIELD CONDITIONS ARE DIFFERENT THAN SHOWN IN THE PLANS. SUCH CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IN A TIMELY MANNER. IN THE EVENT OF REWORK CAUSED BY DIFFERING FIELD CONDITIONS, THE CONTRACTOR ASSUMES FULL RESPONSIBILITY AND EXPENSE FOR ANY REVISIONS NECESSARY, INCLUDING ENGINEERING DESIGN FEES.

10. EXISTING SITE IMPROVEMENTS WHICH ARE DAMAGED OR DISPLACED BY THE CONTRACTOR SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE. REPAIRS SHALL BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION OF THE REPAIRS. REPAIRS SHALL BE ACCEPTED BY THE ENGINEER PRIOR TO FINAL PAYMENT.

11. CONTRACTOR SHALL COORDINATE CONSTRUCTION ACTIVITIES WITH OTHER CONTRACTORS AND UTILITY COMPANIES WORKING IN THE SAME AREA.

TEMPORARY TRAFFIC CONTROL GENERAL NOTES

1. IF WORK WITHIN THE RIGHT-OF-WAY IS REQUIRED, THEN CONTRACTOR MUST OBTAIN AN APPROPRIATE PERMIT FROM BEXAR COUNTY AT LEAST FIVE WORKING DAYS BEFORE ENGAGING IN ANY CONSTRUCTION, MAINTENANCE, OR REPAIR WORK IN ANY OF THE RIGHTS-OF-WAY.

2. CONTRACTOR SHALL AT THE TIME OF PERMIT REQUEST, SUBMIT FOR REVIEW BY ENGINEER, A TRAFFIC CONTROL PLAN DETAILING ALL EXISTING CONDITIONS SUCH AS LANE WIDTH, DRIVEWAYS, AND BUSINESS/RESIDENTIAL ACCESSES. THE TRAFFIC CONTROL PLAN SHALL INCLUDE ALL PHASES OF WORK AND SCHEDULES INVOLVED IN THE CONSTRUCTION PROJECT.

3. ALL CONSTRUCTION TRAFFIC CONTROL DEVICES SHALL COMPLY TO THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD), LATEST EDITION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO INSTALL, SERVICE AND MAINTAIN ALL TRAFFIC CONTROL DEVICES. TRAFFIC CONTROL DEVICES SHALL NOT BE REMOVED OR ALTERED IN ANY WAY WITHOUT THE APPROVAL OF THE ENGINEER.

4. IF REQUIRED, CONTRACTOR IS RESPONSIBLE TO MAINTAIN AND SERVICE ALL TRAFFIC CONTROL DEVICES 24 HOURS A DAY, 7 DAYS A WEEK THROUGHOUT LENGTH OF PROJECT, CONTRACTOR IS RESPONSIBLE THAT ALL TRAFFIC CONTROL DEVICES COMPLY WITH THE TMUTCO, LATEST EDITION.

5. EQUIPMENT OR MATERIALS SHALL NOT BE STORED WITHIN 15 FEET OF A TRAVELED TRAFFIC LANE DURING NON-WORKING HOURS WITHOUT THE APPROVAL OF ENGINEER.

6. CONTRACTOR SHALL PROVIDE AND MAINTAIN A SAFE AND ADEQUATE MEANS OF CHANNELIZING PEDESTRIAN AND VEHICLE TRAFFIC AROUND AND THROUGH THE CONSTRUCTION AREA TO BUSINESSES AT THE SITE.

7. CONTRACTOR SHALL MAINTAIN ACCESS TO ALL FACILITIES, BUSINESSES AND/OR RESIDENCES AT ALL TIMES.

8. ANY FIELD ADJUSTMENTS SHALL BE APPROVED BY ENGINEER.

9. CONTRACTORS SHALL AT ALL TIMES COMPLY WITH THE STANDARDS AND REQUIREMENTS SET FORTH IN THE TMUTCD, LATEST EDITION.

10. FAILURE TO COMPLY WITH ANY OF THE ABOVE MENTIONED WILL BE ADEQUATE CAUSE TO CEASE ALL WORK ON ANY CONSTRUCTION PROJECT. WORK WILL NOT RESUME UNTIL ALL REQUIREMENTS ARE ADDRESSED AND APPROVED BY ENGINEER.

11. ALL TRAFFIC CONTROL DEVICES SHALL BE KEPT IN NEW/CLEAN CONDITION, WASHING OF EQUIPMENT IS INCIDENTAL TO ITS PLACEMENT AND MAINTENANCE.

WORK WITHIN ADJACENT RIGHT-OF-WAY OR PROPERTIES

1. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITIES WITHIN ADJACENT RIGHT-OF-WAYS OR WITHIN PROPERTY NOT OWNED BY THE OWNER OF THE PROJECT SITE, THE CONTRACTOR SHALL ENSURE THAT ALL PERMITS AND PERMISSIONS REQUIRED HAVE BEEN OBTAINED IN WRITING BY THE ENGINEER.

SURVEY MONUMENTS, PROPERTY CORNERS, BENCHMARKS

1. THE CONTRACTOR SHALL NOTIFY THE ENGINEER BEFORE BEGINNING ANY CONSTRUCTION ACTIVITY THAT COULD DAMAGE OR DISPLACE SURVEY MONUMENTS, PROPERTY CORNERS, OR PROJECT BENCHMARKS SO THESE ITEMS MAY BE RELOCATED.

2. ALL HORIZONTAL LOCATIONS ARE REFERENCED TO TEXAS STATE PLAN COORDINATE SYSTEM, SOUTH CENTRAL ZONE, NORTH AMERICAN DATUM 1983 (NAD83)

UTILITIES

1. UTILITY LINES, PIPELINES, OR UNDERGROUND UTILITY LINES SHOWN ON THESE DRAWINGS ARE SHOWN IN AN APPROXIMATE LOCATION ONLY BASED ON THE INFORMATION PROVIDED TO THE ENGINEER BY OTHERS. THIS INFORMATION MAY BE INACCURATE OR INCOMPLETE; UNDERGROUND LINES MAY EXIST THAT ARE NOT SHOWN. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ANY UTILITY LINE, PIPELINE, OR UNDERGROUND UTILITY LINE IN OR NEAR THE AREA OF THE WORK.

2. THE CONTRACTOR SHALL CONTACT THE STATEWIDE UTILITY LOCATOR SERVICE AT LEAST TWO WORKING DAYS BEFORE BEGINNING CONSTRUCTION. AFTER THE UTILITIES ARE SPOTTED, THE CONTRACTOR SHALL EXPOSE ALL PERTINENT UTILITIES TO VERIFY THEIR VERTICAL AND HORIZONTAL LOCATION. IF A CONFLICT EXISTS BETWEEN EXISTING UTILITIES AND PROPOSED CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER SO THAT THE CONFLICT CAN BE RESOLVED WITH MINIMAL DELAY.

3. THE CONTRACTOR SHALL EXERCISE DUE CARE TO AVOID DISTURBING ANY EXISTING UTILITIES, ABOVE OR BELOW THE GROUND. UTILITIES THAT ARE DAMAGED BY CONSTRUCTION SHALL BE REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE.

4. THE CONTRACTOR SHALL COORDINATE ANY REQUIRED UTILITY INTERRUPTIONS WITH THE AFFECTED PROPERTY OWNERS, ENGINEER, AND AFFECTED UTILITY COMPANY A MINIMUM OF THREE (3) WORKING DAYS BEFORE THE INTERRUPTION.

5. THE CONTRACTOR SHALL MAINTAIN A RECORD DRAWING SET OF PLANS AND PROMPTLY LOCATE ALL UTILITIES, EXISTING OR NEW, IN THEIR CORRECT LOCATION, HORIZONTAL AND VERTICAL. THIS RECORD SET OF DRAWINGS SHALL BE MAINTAINED ON THE PROJECT SITE AND SHALL BE AVAILABLE TO THE OWNER AND ENGINEER AT ANY TIME DURING CONSTRUCTION. RECORD INFORMATION SHALL INCLUDE HORIZONTAL AND VERTICAL COORDINATE CALLOUTS, LINE SIZES, LINE TYPES, BURIAL DEPTHS, AND ALL OTHER PERTINENT INSTALLATION INFORMATION. IN ADDITION ALL ITEMS THAT ARE INSTALLED EXACTLY DESIGNED SHALL BE NOTED AS SUCH.

EROSION CONTROL, ENVIRONMENTAL PROTECTION, AND STORM WATER POLLUTION PREVENTION PLAN

1. THE CONTRACTOR SHALL CONFORM TO ALL STATE AND FEDERAL DUST AND EROSION CONTROL REGULATIONS. THE CONTRACTOR SHALL PREPARE AND OBTAIN ANY DUST CONTROL AND EROSION CONTROL PERMITS FROM THE APPROPRIATE REGULATORY AGENCIES.

2. THE CONTRACTOR SHALL PROMPTLY REMOVE OR STABILIZE ANY MATERIAL EXCAVATED WITHIN THE RIGHT-OF-WAY OR ADJACENT PROPERTY TO KEEP IT FROM WASHING OFF THE PROJECT SITE.

3. THE CONTRACTOR SHALL ENSURE THAT NO SOIL ERODES FROM THE SITE ONTO ADJACENT PROPERTY BY CONSTRUCTION OF TEMPORARY EROSION CONTROL BERMS OR INSTALLING SILT FENCES AT THE PROPERTY LINES (OR LIMITS OF CONSTRUCTION WHERE DESIGNATED) AND WETTING SOIL TO PREVENT IT FROM BLOWING.

4. WATERING, AS REQUIRED FOR CONSTRUCTION DUST CONTROL, SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION AND NO MEASUREMENT OR PAYMENT SHALL BE MADE. CONSTRUCTION AREAS SHALL BE WATERED FOR DUST CONTROL IN COMPLIANCE WITH STATE ORDINANCES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE AVAILABILITY AND USE OF WATER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING ALL EQUIPMENT AND MATERIALS NECESSARY FOR OBTAINING WATER.

5. THE CONTRACTOR SHALL COORDINATE FINAL TREATMENT OF ALL DISTURBED AREAS WITH THE ENGINEER.

6. CONTRACTOR SHALL PROPERLY HANDLE AND DISPOSE OF ALL ASPHALT AND CONCRETE REMOVED ON THE PROJECT BY HAULING TO AN APPROVED DISPOSAL SITE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STATE OF TEXAS.

7. ALL WASTE PRODUCTS FROM THE CONSTRUCTION SITE, INCLUDING ITEMS DESIGNED FOR REMOVAL, CONSTRUCTION WASTE, CONSTRUCTION EQUIPMENT WASTE PRODUCTS (OIL, GAS, TIRES, ETC.), GARBAGE, GRUBBING, EXCESS CUT MATERIAL, VEGETATIVE DEBRIS, ETC. SHALL BE APPROPRIATELY DISPOSED OF OFFSITE. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ANY PERMITS REQUIRED FOR HAUL OR DISPOSAL OF WASTE PRODUCTS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FOLLOW APPROPRIATE REGULATIONS REGARDING THE ENVIRONMENT, ENDANGERED SPECIES, AND ARCHAEOLOGICAL RESOURCES.

8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CLEANUP AND REPORTING OF SPILLS OF HAZARDOUS MATERIALS ASSOCIATED WITH THE CONSTRUCTION SITE. HAZARDOUS MATERIALS INCLUDES GASOLINE, DIESEL FUEL, MOTOR OIL, SOLVENTS, CHEMICALS, PAINT, ETC. WHICH MAY BE A THREAT TO THE ENVIRONMENT. THE CONTRACTOR SHALL REPORT THE DISCOVERY OF PAST OR PRESENT SPILLS TO THE ENGINEER.

9. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING SURFACE AND UNDERGROUND WATER. CONTACT WITH SURFACE WATER BY CONSTRUCTION EQUIPMENT AND PERSONNEL SHALL BE MINIMIZED. EQUIPMENT MAINTENANCE AND REFUELING OPERATIONS SHALL BE PERFORMED IN AN ENVIRONMENTALLY SAFE MANNER IN COMPLIANCE WITH STATE AND FEDERAL REGULATIONS.

10. THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS CONCERNING CONSTRUCTION NOISE AND HOURS OF OPERATION AS STATED IN THE SPECIFICATIONS OR IMPOSED BY THE ENGINEER OR STATE OR LOCAL AUTHORITIES.

ABBREVIATIONS

AC	ACRES
AC	ALTERNATING CURRENT
APPRX	APPROXIMATELY
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BGS	BENEATH GROUND SURFACE
BLDG	BUILDING
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
DA	DRAINAGE AREA
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DOT	DEPARTMENT OF TRANSPORTATION
DR	DIMENSION RATIO
EL/ELEV	ELEVATION
EPA	ENVIRONMENTAL PROTECTION AGENCY
ESD	ENVIRONMENTAL SITE DESIGN
EX/EXIST	EXISTING
FM	FORCEMAIN
FT	FEET
FT BGS	FEET BELOW GROUND SURFACE
GAC	GRANULATED ACTIVATED CARBON
GAL	GALLON
GALV	GALVANIZED
GPS	GLOBAL POSITIONING SYSTEM
HDPE	HIGH DENSITY POLY ETHYLENE
HMAC	HOT MIX ASPHALT CONCRETE
INV	INVERT
MAX	MAXIMUM
MHW	MEAN HIGH WATER
MIN	MINIMUM
MSL	MEAN SEA LEVEL
NA	NOT APPLICABLE
NAD 83	NORTH AMERICAN DATUM OF 1983
NAVD 88	NORTH AMERICAN VERICAL DATUM OF 1988
NEC	NATIONAL ELECTRIC CODE
NGS	NATIONAL GEODETIC SURVEY
NO.	NUMBER
NRCS	NATIONAL RESOURCE CONSERVATION SERVICE
NTS	NOT TO SCALE
PSI	POUNDS PER SQUARE INCH
PR	PROPOSED
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
RTK	REAL-TIME KINEMATIC
SCH	SCHEDULE
SD	STORM DRAIN
SQ FT	SQUARE FEET
SVE	SOIL VAPOR EXTRACTION
SWM	STORMWATER MANAGEMENT
SWPPP	STORMWATER POLLUTION PREVENTION PLAN
TYP	TYPICAL
U.S.	UNITED STATES
USACE	U.S. ARMY CORPS OF ENGINEERS
USDA	U.S. DEPARTMENT OF AGRICULTURE
USGS	U.S. GEOLOGICAL SURVEY
W/	WITH
WSEL	WATER SURFACE ELEVATION

LEGEND

LOD	LIMITS OF BOUNDARY
OHE	OVERHEAD ELECTRIC
	EXISTING ROAD
W	EXISTING WATER MAIN
	EXISTING POWER POLE
T	EXISTING TRANSFORMER
	EXISTING LIGHT POLE
WV	EXISTING WATER VALVE
	EXISTING BUILDING
	EXISTING TREES
SA1-02	EXISTING EVO INJECTION WELL
SA1-IW-1	PROPOSED EVO INJECTION WELL
SA1-01	EXISTING HORIZONTAL NESTED, SEGMENTED WELL
SA1-HSVE-2	PROPOSED DEEP WELLS
SA1-HSVE-1	EXISTING DEEP WELLS
G	EXISTING UNDERGROUND GAS LINE
SD	EXISTING STORM
X X	SECURITY FENCE
	TREE LINE
SF SF	SILT FENCE
	CONVEYANCE LINES

NOTE:

1. IF THE SECTION, DETAIL, SCHEMATIC, OR DIAGRAM IS REFERENCED ON MULTIPLE SHEETS, ALL SHEETS ARE REFERENCED WITHIN THE DETAIL BUBBLE.

FINAL DESIGN

FILE PATH: P:\FEDERAL\NON DOD\EPA\PROJECTS\14342143\BANDERA RD\CAD\SUBMITTALS\FINAL\GENERAL NOTES AND LEGEND\G002.DWG [SAVED] SWANSON, CHRIS 1/5/2020 1:37 PM

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION	
DESIGNED BY:	AS / DY
DRAWN BY:	CNS / JRM
CHECKED BY:	AS
PROJECT MANAGER:	PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

GENERAL NOTES AND LEGEND

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

G-002

SHEET: 2 OF 34

FINAL SUBMITTAL

FINAL DESIGN

LEGEND

- LOD — LIMITS OF BOUNDARY
- OHE — OVERHEAD ELECTRIC
- EXISTING ROAD
- W — EXISTING WATER MAIN
- EXISTING POWER POLE
- T — EXISTING TRANSFORMER
- EXISTING LIGHT POLE
- WV — EXISTING WATER VALVE
- EXISTING BUILDING
- EXISTING TREES
- SA1-02 — EXISTING EVO INJECTION WELL
- SA1-01 — EXISTING HORIZONTAL NESTED, SEGMENTED WELL
- G — EXISTING UNDERGROUND GAS LINE
- SD — EXISTING STORM
- x — x — SECURITY FENCE
- TREE LINE
- CONVEYANCE LINES

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GRAPHIC SCALE IN FEET

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

EXISTING CONDITIONS AT AOI 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

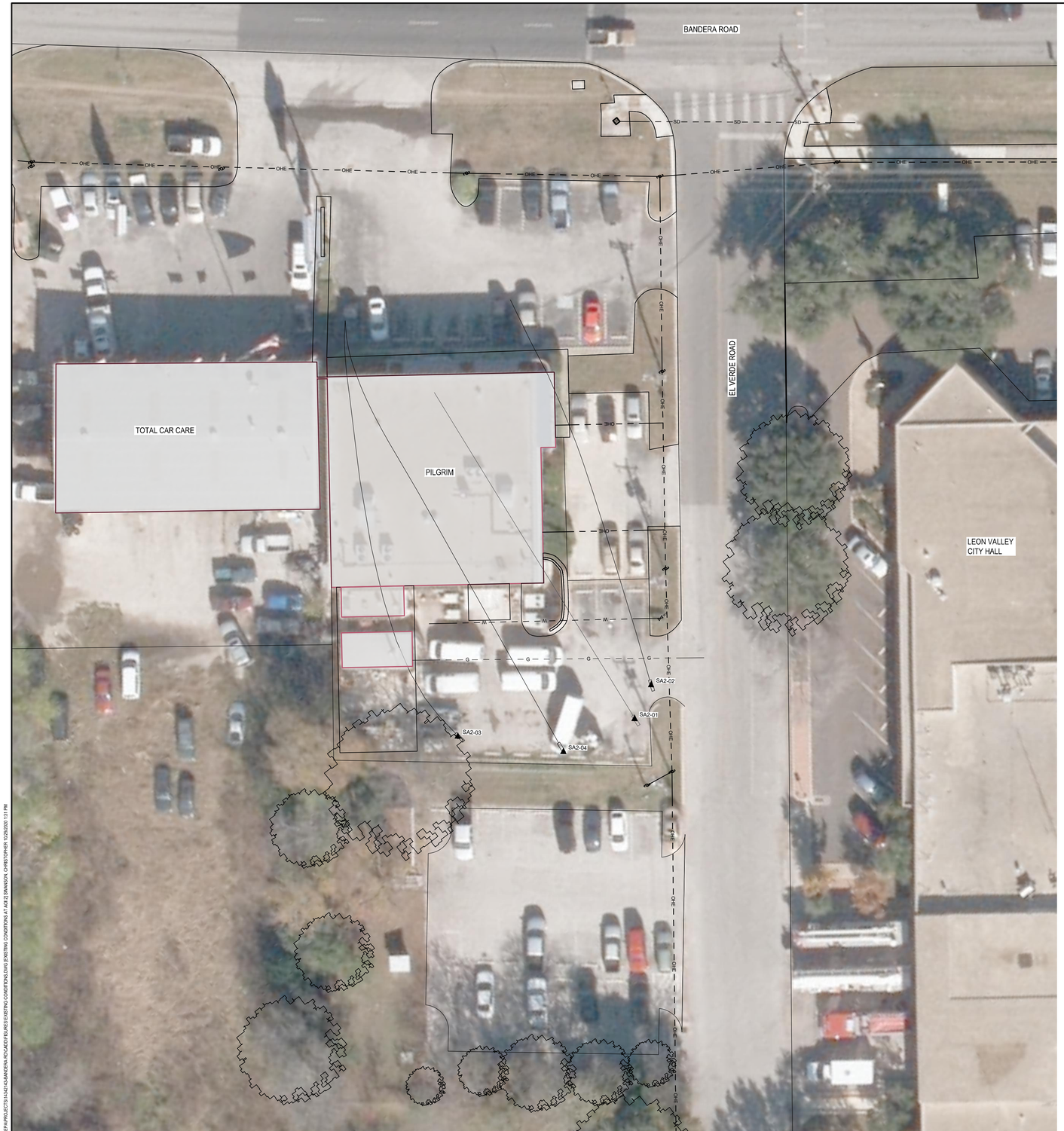
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-101

SHEET: 3 OF 34

FINAL SUBMITTAL



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N

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GRAPHIC SCALE IN FEET

FINAL DESIGN

NO.	DATE	BY	REVISIONS DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

EXISTING CONDITIONS AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

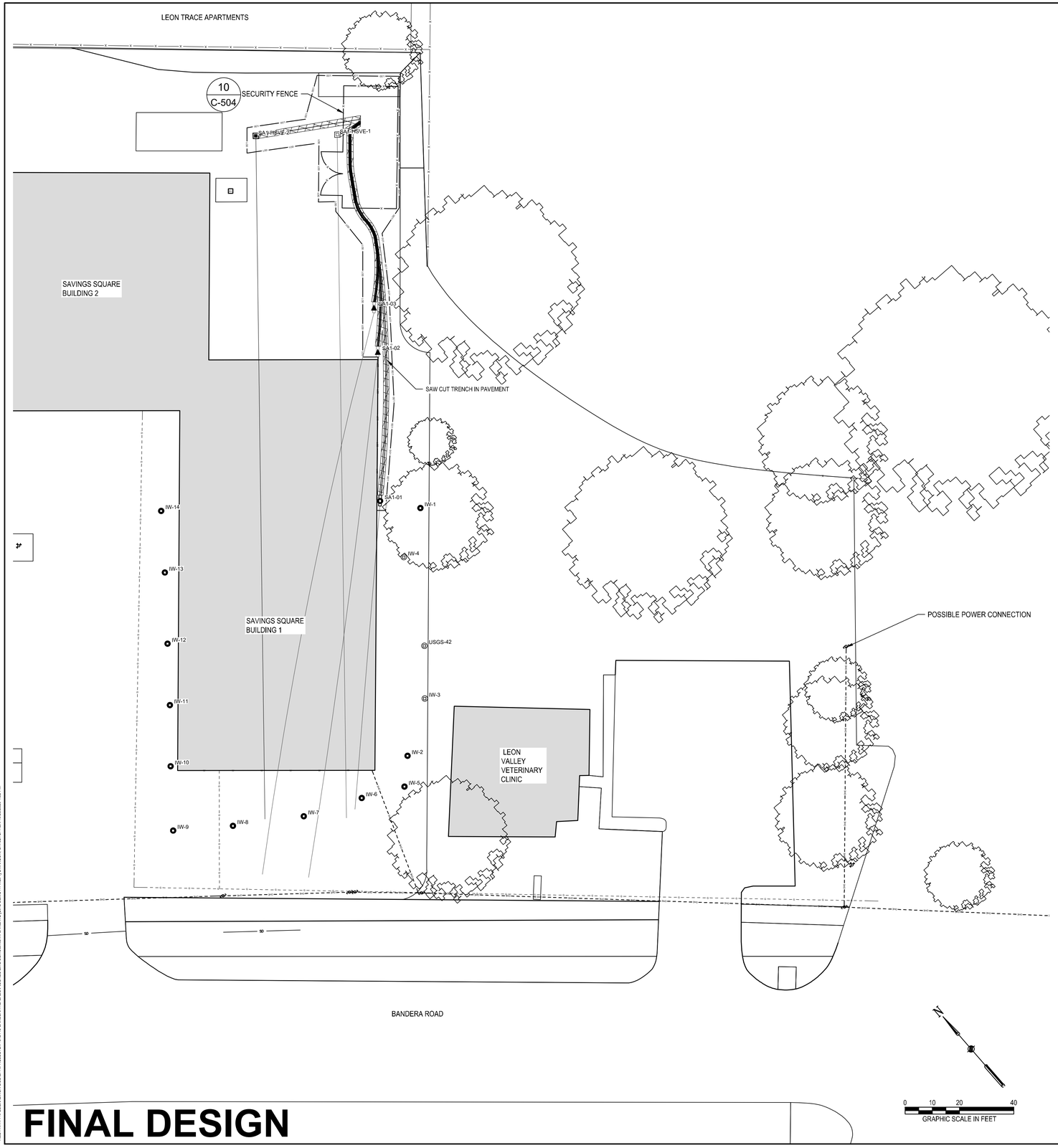
PROJECT NUMBER: 14342143

G-001

SHEET: 4 OF 34

FINAL SUBMITTAL

FILE PATH: P:\FEDERAL\NCH.DOD\EPA\PROJECTS\14342143\BANDERA RD\ADD'L FIGURES\EXISTING CONDITIONS\LDWG [EXISTING CONDITIONS AT AOI 2] MANSON, CHRISTOPHER 10/29/2020 1:31 PM



LEGEND

- LIMITS OF BOUNDARY
- OVERHEAD ELECTRIC
- EXISTING ROAD
- EXISTING WATER MAIN
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- SA1-HSVE-2 — PROPOSED DEEP WELLS
- SA1-HSVE-1 — EXISTING DEEP WELLS
- EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- SILT FENCE
- CONVEYANCE LINES
- SAW CUT TRENCH IN PAVEMENT

FINAL DESIGN

NO.	DATE	BY	DESCRIPTION

REVISIONS

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SITE DEMOLITION, CLEARING AND ACCESS AT AOI 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

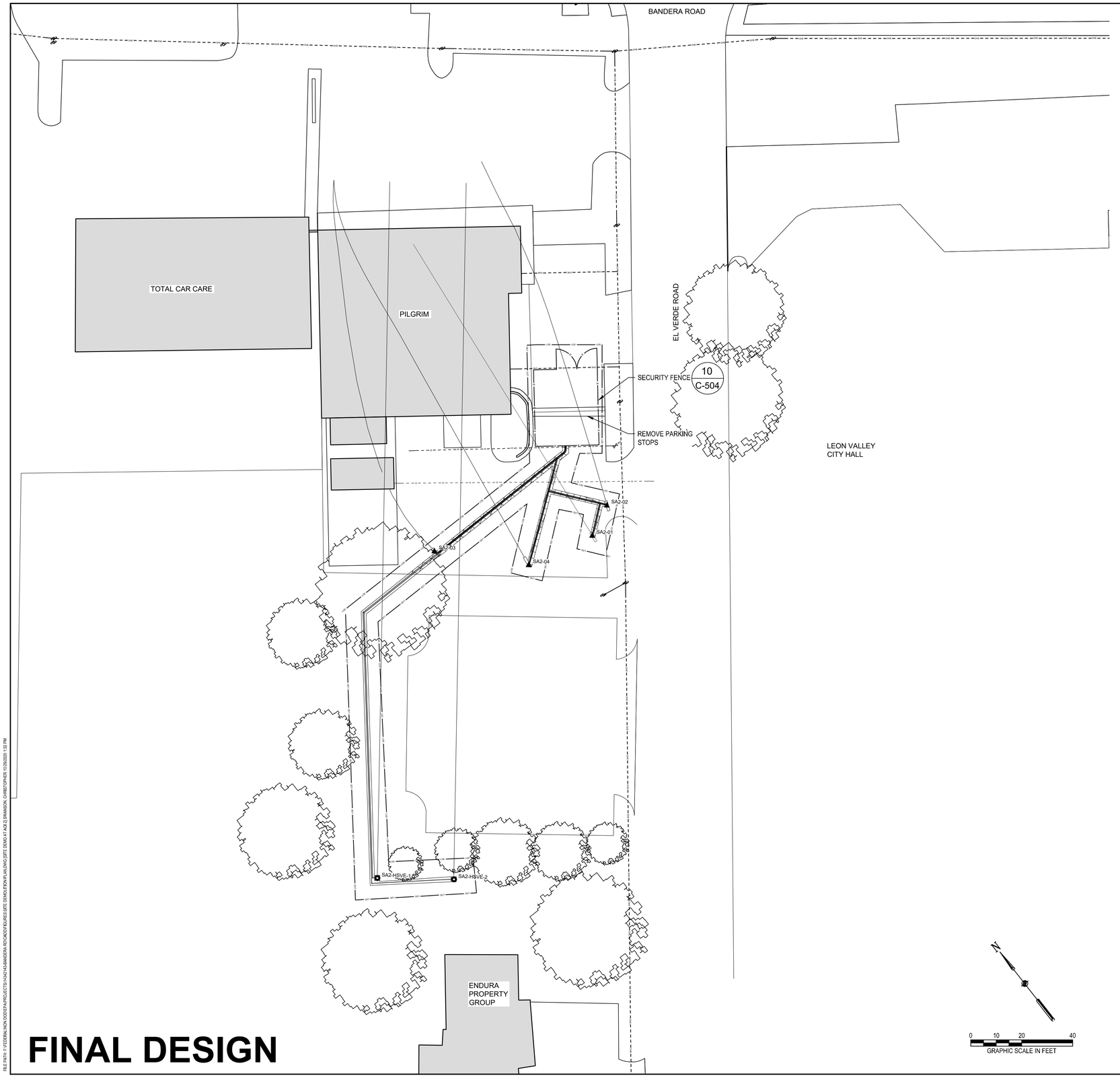
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-103

SHEET: 5 OF 34

FINAL SUBMITTAL



LEGEND

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- SA1-HSVE-1 — EXISTING DEEP WELLS
- EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- SILT FENCE
- CONVEYANCE LINES
- REMOVAL

N

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GRAPHIC SCALE IN FEET

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SITE DEMOLITION, CLEARING AND ACCESS AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

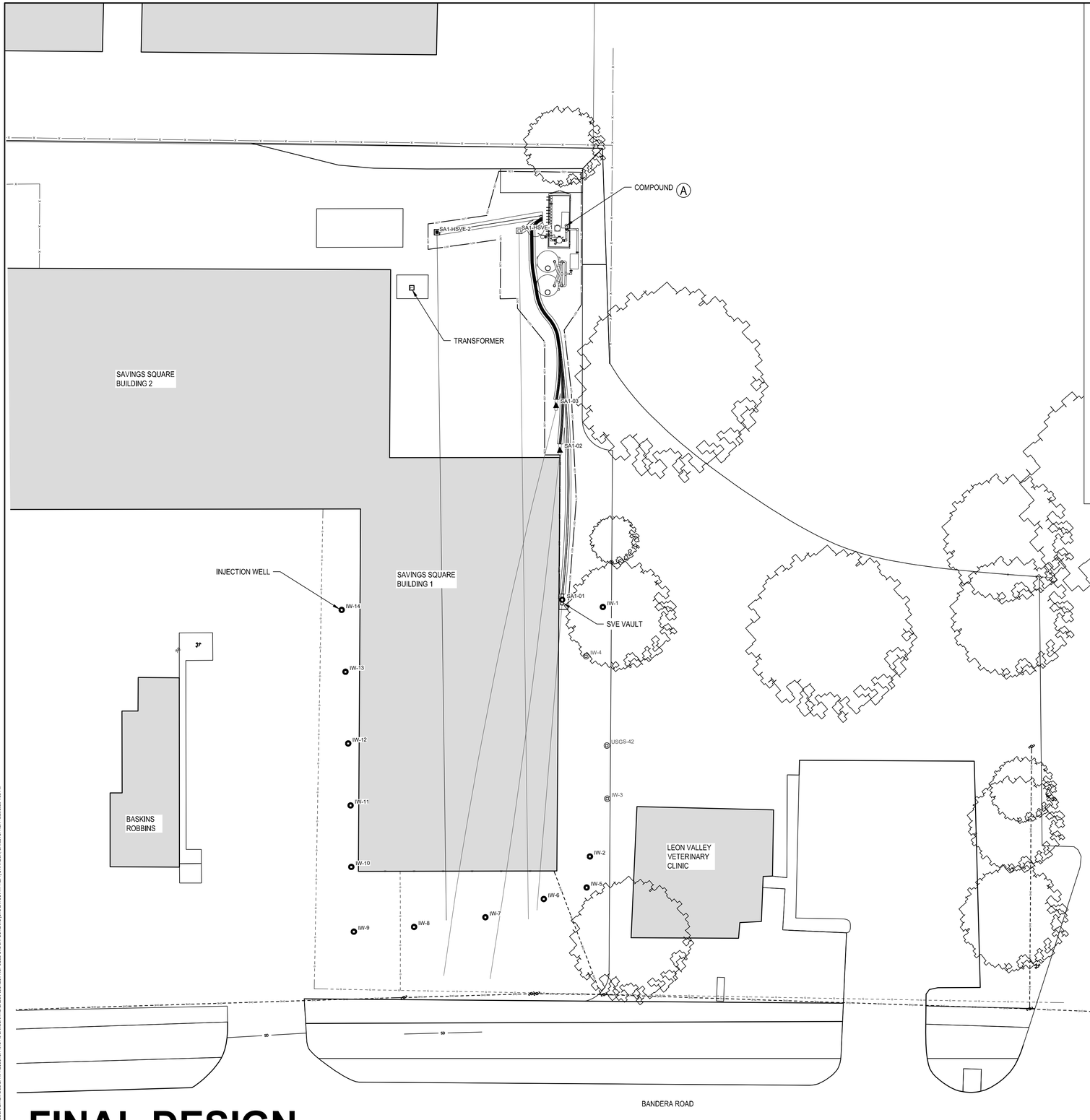
DATE: OCTOBER 2020

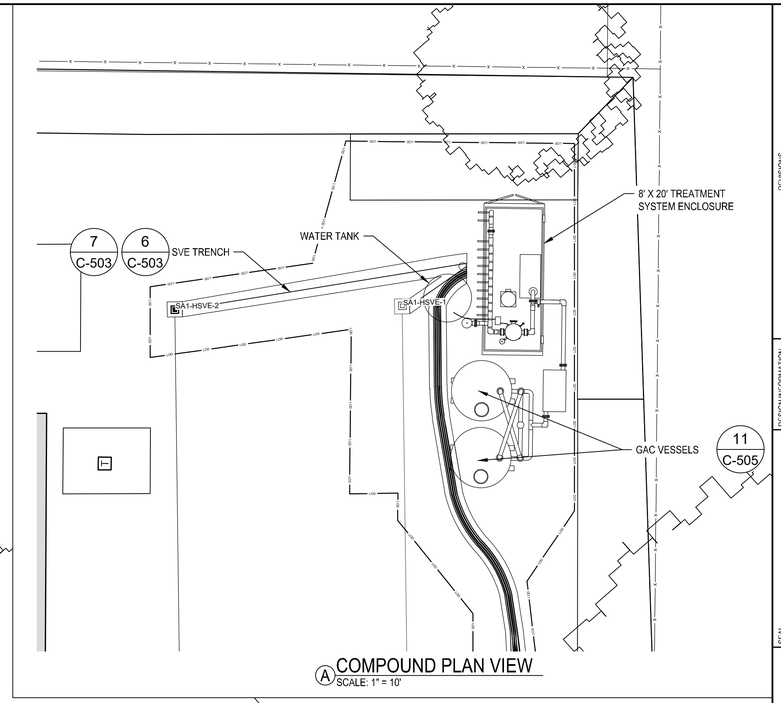
PROJECT NUMBER: 14342143

C-104

SHEET: 6 OF 34

FINAL SUBMITTAL





A COMPOUND PLAN VIEW
SCALE: 1" = 10'

LEGEND

- LIMITS OF BOUNDARY
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GRAPHIC SCALE IN FEET

FINAL DESIGN

FILE PATH: F:\FEDERAL\NON DOD\EPA\PROJECTS\14342-143-BANDERA ROAD\DESIGN\FIGURES\PROPOSED SVE LAYOUT\DWG\SVE LAYOUT.DWG 8.5"X11" LAYOUT AT A1 | SHANNON, CHRISTOPHER 10/29/2020 1:33 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

SEAL

DESIGN INFORMATION

DESIGNED BY:	DRAWN BY:	CHECKED BY:	PROJECT MANAGER:
AS/ DY	CNS/ JRM	AS	PA

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PROPOSED SVE SYSTEM AND AMENDMENT INJECTION WELLS AT AOI 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-105

SHEET: 7 OF 34

FINAL SUBMITTAL

TOTAL CAR CARE

PILGRIM

EL VERDE ROAD

LEON VALLEY
CITY HALL

WATER TANK

GAC VESSELS

12
C-505

8' X 20' TREATMENT
SYSTEM ENCLOSURE

INJECTION WELL

IW2-01

12" WELL VAULT

7
C-503

6
C-503

SVE TRENCH

SA2-02

SA2-01

SA2-03

SA2-04

SVE VAULT

LEGEND

- LIMITS OF BOUNDARY
- OVERHEAD ELECTRIC
- EXISTING ROAD
- EXISTING WATER MAIN
- EXISTING POWER POLE
- EXISTING TRANSFORMER
- EXISTING LIGHT POLE
- WV EXISTING WATER VALVE
- EXISTING BUILDING
- EXISTING TREES
- SA1-02 EXISTING EVO INJECTION WELL
- SA1-01 EXISTING HORIZONTAL NESTED, SEGMENTED WELL
- EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- CONVEYANCE LINES

N

0 15 30 60
GRAPHIC SCALE IN FEET

FINAL DESIGN

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342143-BANDERA ROAD\DFB\GIS\PROPOSED SVE LAYOUT\2MXD\[SVE LAYOUT AT AOI 2].MXD|BRANDON, CHRISTOPHER 10/29/2020 1:33 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION

DESIGNED BY:	DRAWN BY:	CHECKED BY:	PROJECT MANAGER:
AS/ DY	CNS/ JRM	AS	PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PROPOSED SVE SYSTEM LAYOUT AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

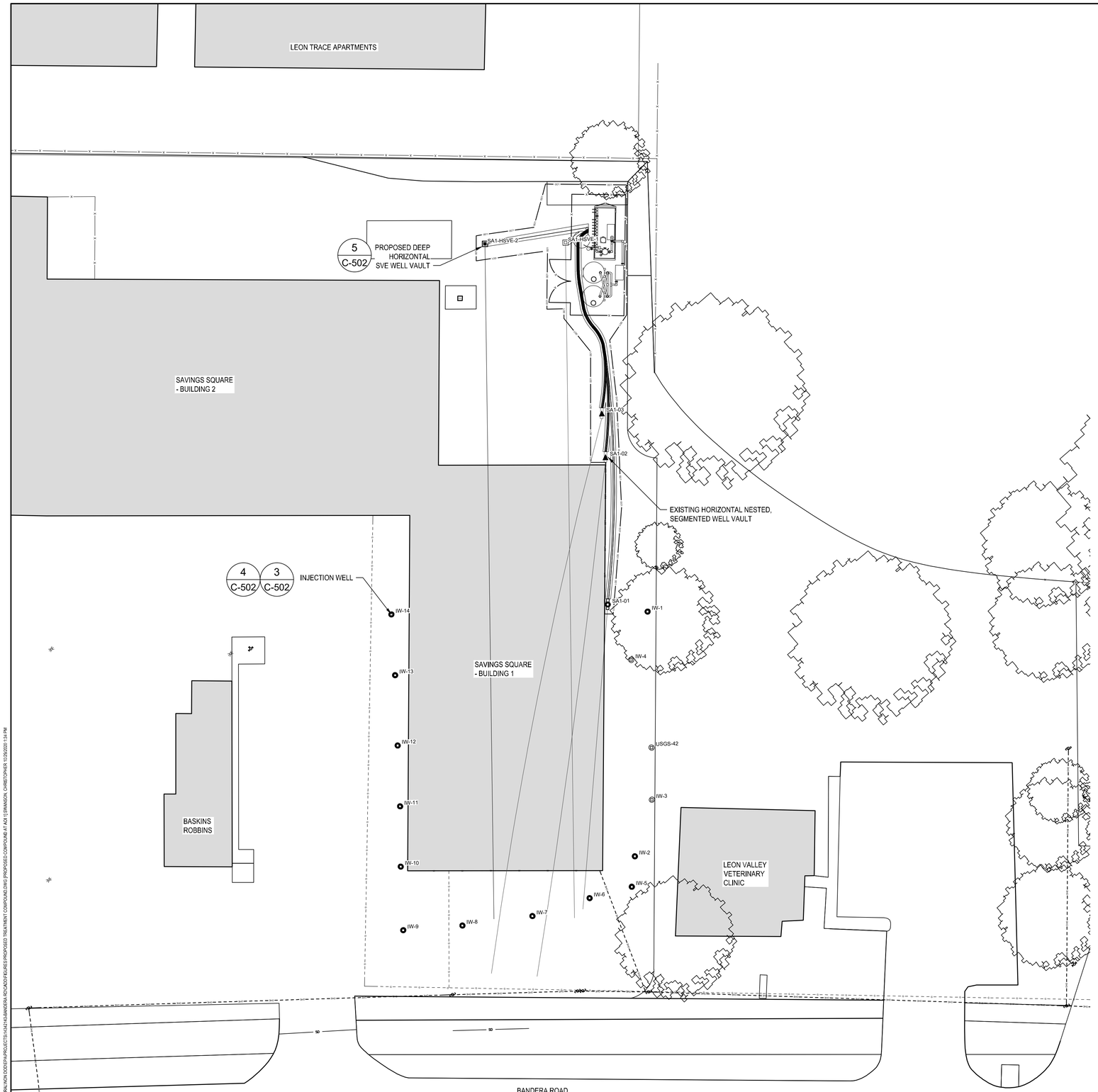
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-106

SHEET: 8 OF 34

FINAL SUBMITTAL



LEGEND

- LIMITS OF BOUNDARY
- OHE — OVERHEAD ELECTRIC
- EXISTING ROAD
- EXISTING WATER MAIN
- EXISTING POWER POLE
- T — EXISTING TRANSFORMER
- EXISTING LIGHT POLE
- WV — EXISTING WATER VALVE
- EXISTING BUILDING
- EXISTING TREES
- SA1-02 — EXISTING EVO INJECTION WELL
- SA1-01 — EXISTING HORIZONTAL NESTED, SEGMENTED WELL
- C — EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- CONVEYANCE LINES

AMENDMENT INJECTION WELL LOCATION TABLE

WELL ID	NORTHING	EASTING	PROPOSED OR EXISTING WELL
IW-1	13,728,107.18	2,089,849.83	PROPOSED
IW-2	13,728,041.49	2,089,786.45	PROPOSED
IW-3	13,728,053.24	2,089,805.06	EXISTING
IW-4	13,728,097.60	2,089,833.38	EXISTING
IW-5	13,728,033.68	2,089,778.13	PROPOSED
IW-6	13,728,040.80	2,089,763.52	PROPOSED
IW-7	13,728,049.75	2,089,743.05	PROPOSED
IW-8	13,728,064.17	2,089,721.06	PROPOSED
IW-9	13,728,077.31	2,089,703.30	PROPOSED
IW-10	13,728,095.78	2,089,718.14	PROPOSED
IW-11	13,728,112.92	2,089,732.69	PROPOSED
IW-12	13,728,130.58	2,089,746.87	PROPOSED
IW-13	13,728,150.98	2,089,763.32	PROPOSED
IW-14	13,728,168.97	2,089,777.13	PROPOSED
USGS-42	13,728,067.95	2,089,817.69	EXISTING

NOTE:
1. SA1-01, SA1-02, AND SA1-03 ARE HORIZONTAL NESTED, SEGMENTED WELLS THAT WERE PREVIOUSLY INSTALLED. HSVE-1 IS A DEEP HORIZONTAL WELL THAT WAS PREVIOUSLY INSTALLED. HSVE-2 IS A PROPOSED DEEP HORIZONTAL WELL.

N

0 10 20 40
GRAPHIC SCALE IN FEET

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PROPOSED TREATMENT COMPOUND AND INJECTION WELL LAYOUT AT AOI 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

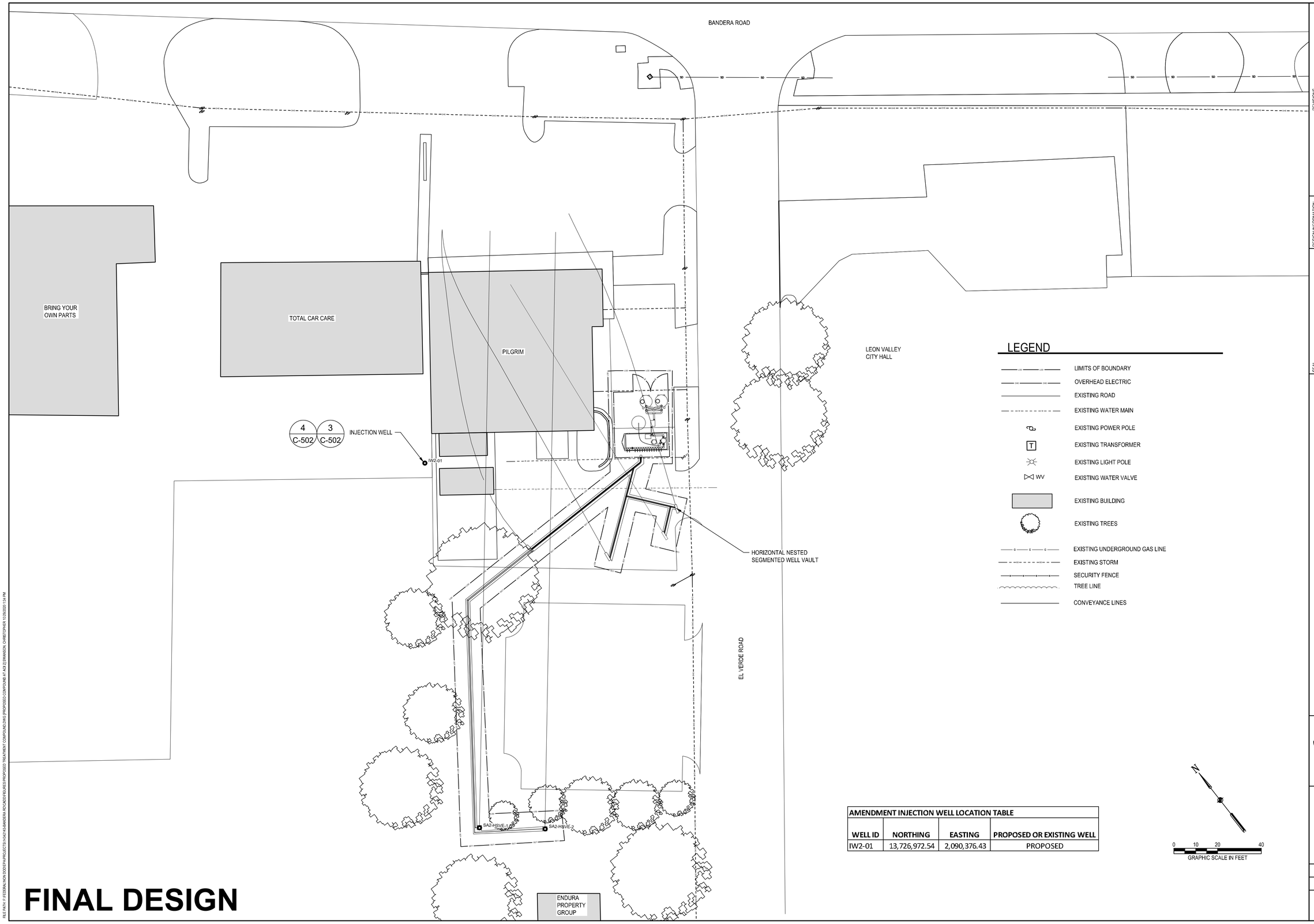
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-107

SHEET: 9 OF 34

FINAL SUBMITTAL



AMENDMENT INJECTION WELL LOCATION TABLE

WELL ID	NORTHING	EASTING	PROPOSED OR EXISTING WELL
IW2-01	13,726,972.54	2,090,376.43	PROPOSED

N

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GRAPHIC SCALE IN FEET

FINAL DESIGN

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342143\BANDERA ROAD\DGN\FIGURES\PROPOSED TREATMENT COMPOUND\DWG\PROPOSED COMPOUND AT AOI 2.DWG BRANSON, CHRISTOPHER 1/29/2020 1:14 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION

DESIGNED BY:	DRAWN BY:	CHECKED BY:	PROJECT MANAGER:
AS/ DY	CNS/ JRM	AS	PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PROPOSED TREATMENT COMPOUND AND INJECTION WELL LAYOUT AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

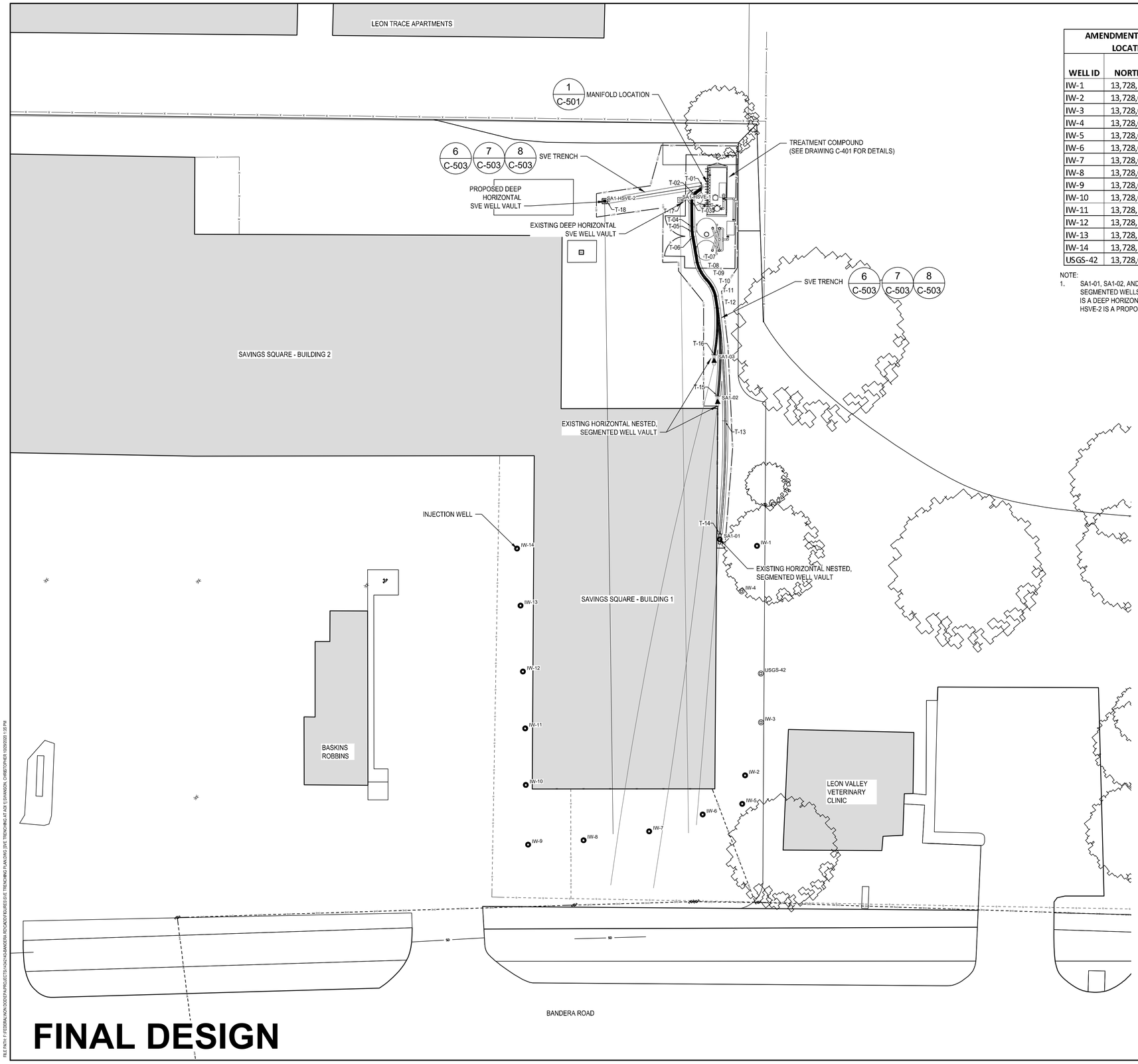
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-108

SHEET: 10 OF 34

FINAL SUBMITTAL



AMENDMENT INJECTION WELL LOCATION TABLE

WELL ID	NORTHING	EASTING
IW-1	13,728,107.18	2,089,849.83
IW-2	13,728,041.49	2,089,786.45
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IW-6	13,728,040.80	2,089,763.52
IW-7	13,728,049.75	2,089,743.05
IW-8	13,728,064.17	2,089,721.06
IW-9	13,728,077.31	2,089,703.30
IW-10	13,728,095.78	2,089,718.14
IW-11	13,728,112.92	2,089,732.69
IW-12	13,728,130.58	2,089,746.87
IW-13	13,728,150.98	2,089,763.32
IW-14	13,728,168.97	2,089,777.13
USGS-42	13,728,067.95	2,089,817.69

NOTE:
1. SA1-01, SA1-02, AND SA1-03 ARE HORIZONTAL NESTED, SEGMENTED WELLS THAT WERE PREVIOUSLY INSTALLED. HSVE-1 IS A DEEP HORIZONTAL WELL THAT WAS PREVIOUSLY INSTALLED. HSVE-2 IS A PROPOSED DEEP HORIZONTAL WELL.

TRENCH CENTER LINE AOI-1

POINT #	NORTHING	EASTING
T-01	13,728,228.98	2,089,927.18
T-02	13,728,228.91	2,089,922.62
T-03	13,728,227.90	2,089,920.34
T-04	13,728,219.88	2,089,913.50
T-05	13,728,218.32	2,089,912.27
T-06	13,728,216.67	2,089,911.17
T-07	13,728,207.74	2,089,905.73
T-08	13,728,204.29	2,089,904.49
T-09	13,728,200.65	2,089,904.07
T-10	13,728,196.71	2,089,903.77
T-11	13,728,192.99	2,089,902.46
T-12	13,728,188.93	2,089,899.89
T-13	13,728,153.09	2,089,872.76
T-14	13,728,120.47	2,089,841.81
T-15	13,728,162.40	2,089,877.13
T-16	13,728,175.59	2,089,886.83
T-17	13,728,230.31	2,089,917.67
T-18	13,728,249.68	2,089,894.76

LEGEND

- LIMITS OF BOUNDARY
- OVERHEAD ELECTRIC
- EXISTING ROAD
- EXISTING WATER MAIN
- EXISTING POWER POLE
- T — EXISTING TRANSFORMER
- EXISTING LIGHT POLE
- WV — EXISTING WATER VALVE
- EXISTING BUILDING
- EXISTING TREES
- SA1-02 — EXISTING EVO INJECTION WELL
- SA1-IW-1 — PROPOSED EVO INJECTION WELL
- SA1-01 — EXISTING HORIZONTAL NESTED, SEGMENTED WELL
- SA1-HSVE-2 — PROPOSED DEEP WELLS
- SA1-HSVE-1 — EXISTING DEEP WELLS
- EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- SILT FENCE
- CONVEYANCE LINES

N

0 10 20 40
GRAPHIC SCALE IN FEET

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE CONVEYANCE LINE TRENCHING PLAN AT AOI 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

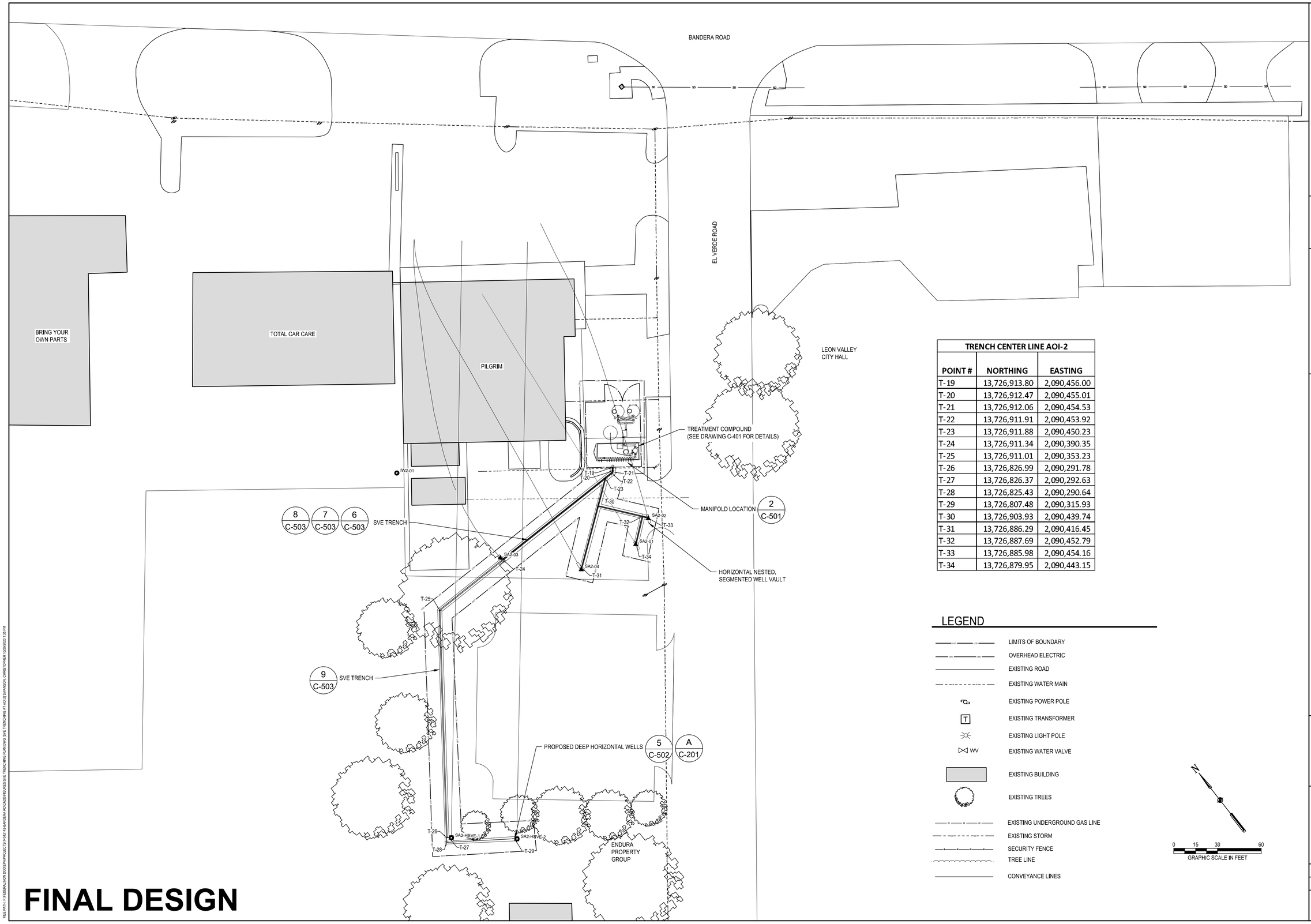
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-109

SHEET: 11 OF 34

FINAL SUBMITTAL



TRENCH CENTER LINE AOI-2		
POINT #	NORTHING	EASTING
T-19	13,726,913.80	2,090,456.00
T-20	13,726,912.47	2,090,455.01
T-21	13,726,912.06	2,090,454.53
T-22	13,726,911.91	2,090,453.92
T-23	13,726,911.88	2,090,450.23
T-24	13,726,911.34	2,090,390.35
T-25	13,726,911.01	2,090,353.23
T-26	13,726,826.99	2,090,291.78
T-27	13,726,826.37	2,090,292.63
T-28	13,726,825.43	2,090,290.64
T-29	13,726,807.48	2,090,315.93
T-30	13,726,903.93	2,090,439.74
T-31	13,726,886.29	2,090,416.45
T-32	13,726,887.69	2,090,452.79
T-33	13,726,885.98	2,090,454.16
T-34	13,726,879.95	2,090,443.15

LEGEND

- LIMITS OF BOUNDARY
- OVERHEAD ELECTRIC
- EXISTING ROAD
- EXISTING WATER MAIN
- EXISTING POWER POLE
- EXISTING TRANSFORMER
- EXISTING LIGHT POLE
- WV EXISTING WATER VALVE
- EXISTING BUILDING
- EXISTING TREES
- EXISTING UNDERGROUND GAS LINE
- EXISTING STORM
- SECURITY FENCE
- TREE LINE
- CONVEYANCE LINES

N

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GRAPHIC SCALE IN FEET

FINAL DESIGN

FILE PATH: P:\FEDERAL\NOV2020\EPA\PROJECTS\14342143\BANDERA ROAD\CAD\REVISED\SVE TRENCHING PLAN\DWG [SVE TRENCHING AT AOI 2] SVANSON, CHRISTOPHER 10/29/2020 1:05 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE CONVEYANCE LINE TRENCHING PLAN AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

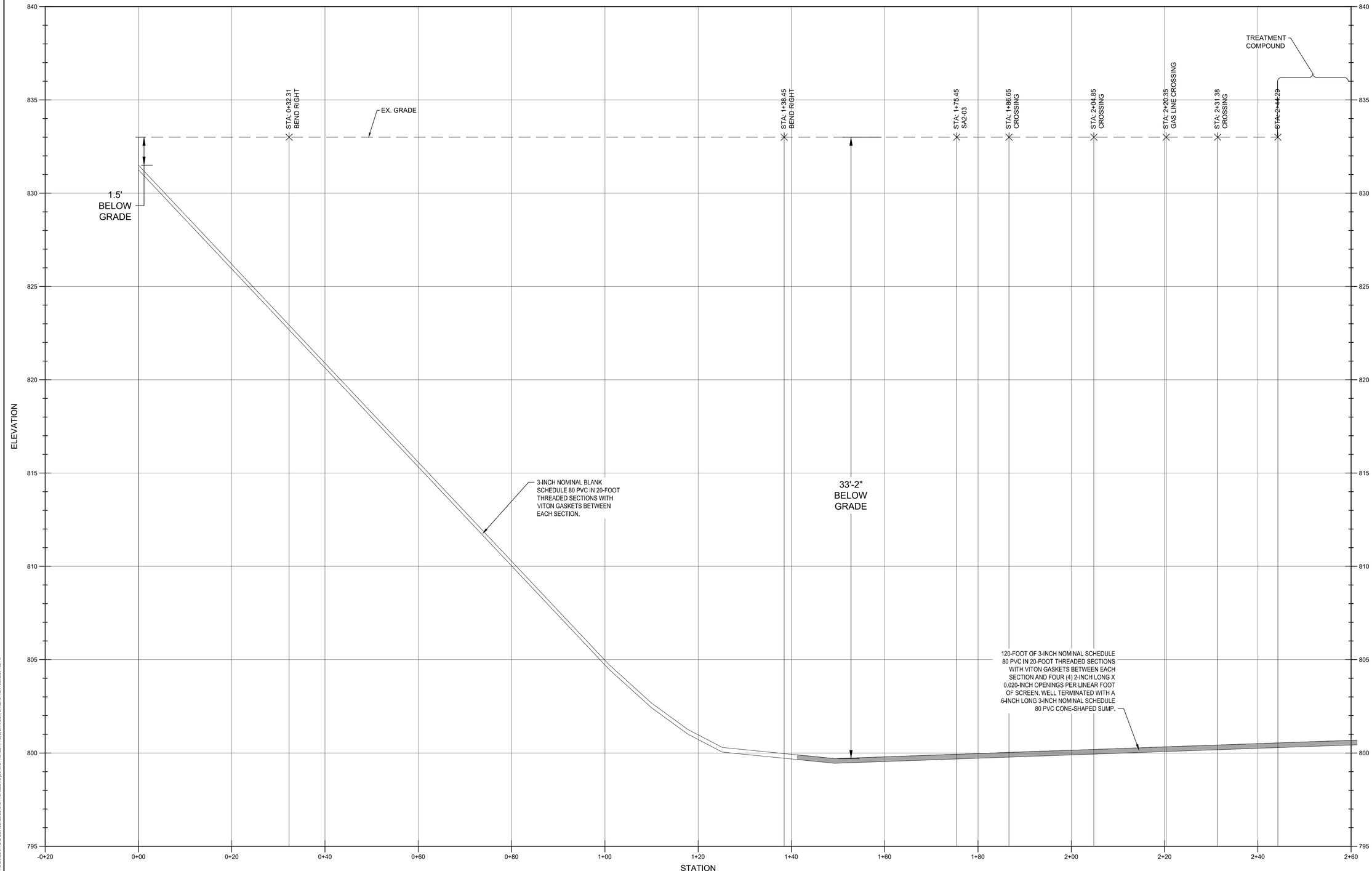
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-110

SHEET: 12 OF 34

FINAL SUBMITTAL



A
C-110 DIRECTIONAL BORING FOR DEEP HORIZONTAL WELLS - PROFILE

0 5 10 20
GRAPHIC SCALE IN FEET
HORIZONTAL

0 1.25 2.5 5
GRAPHIC SCALE IN FEET
VERTICAL

FINAL DESIGN

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342-143-BANDERA ROAD\DESIGN\CAD\PLANS\BORING PROFILE AT AOI 2\BORING PROFILE.DWG [BORING PROFILE AT AOI 2] SHANNON, CHRISTOPHER 10/29/2020 1:37 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

BORING PROFILE AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

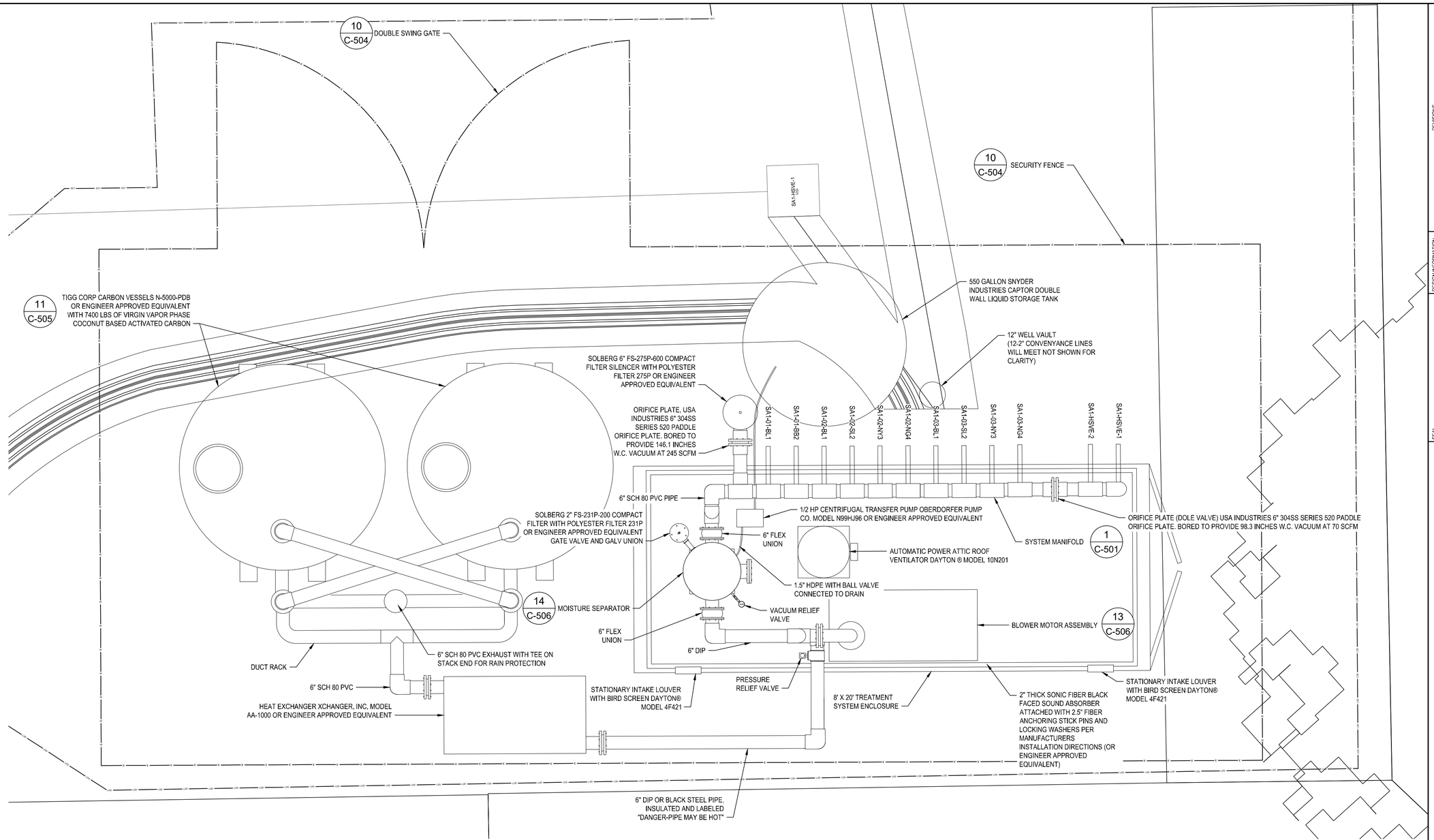
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-201

SHEET: 13 OF 34

FINAL SUBMITTAL



FINAL DESIGN

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342-143-BANDERA ROAD\DESIGN\CAD\TREATMENT COMPOUND\DWG\TREATMENT COMPOUND AT AOI 1.DWG BY:SWANSON, CHRISTOPHER 10/29/2020 1:58 PM

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION				
DESIGNED BY: AS/ DY	DRAWN BY: CNS/ JRM	CHECKED BY: AS	PROJECT MANAGER: PA	SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

TREATMENT COMPOUND AT AOI 1

PREPARED FOR:

EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-401

SHEET: 14 OF 34

FINAL SUBMITTAL

PILGRIM

10 / C-504 DOUBLE SWING GATE

12 / C-505 TIGG CORP CARBON VESSELS M-2500-PDB OR ENGINEER APPROVED EQUIVALENT WITH 2,300 LBS OF VIRGIN VAPOR PHASE COCONUT BASED ACTIVATED CARBON

10 / C-504 SECURITY FENCE

550 GALLON SNYDER INDUSTRIES CAPTOR DOUBLE WALL LIQUID STORAGE TANK

6" SCH 80 PVC EXHAUST PIPE WITH TEE ON STACK END FOR RAIN PROTECTION

6" SCH 80 PVC

HEAT EXCHANGER XCHANGER, INC. MODEL AA-250 OR ENGINEER APPROVED EQUIVALENT

STATIONARY INTAKE LOUVER WITH BIRD SCREEN DAYTON® MODEL 4F421

8' X 20' TREATMENT SYSTEM ENCLOSURE

6" DIP OR BLACK STEEL PIPE, INSULATED AND LABELED "DANGER PIPE MAY BE HOT"

PRESSURE RELIEF VALVE

STATIONARY INTAKE LOUVER WITH BIRD SCREEN DAYTON® MODEL 4F421

6" DIP

6" FLEX UNION

13 / C-506 BLOWER MOTOR ASSEMBLY

VACUUM RELIEF VALVE

SOLBERG FS-231P-200 COMPACT FILTER WITH POLYESTER FILTER 231P OR ENGINEER APPROVED EQUIVALENT GATE VALVE AND GALV UNION

MOISTURE SEPARATOR 14 / C-506

AUTOMATIC POWER ATTIC ROOF VENTILATOR DAYTON ® MODEL 10N201

2 / C-501 DEEP SYSTEM MANIFOLD

6" FLEX UNION

ORIFICE PLATE (DOLE VALVE), USA INDUSTRIES 6" 304SS SERIES 520 PADDLE ORIFICE PLATE. BORED TO PROVIDE 18.2 INCHES W.C. VACUUM AT 70 SCFM

1/2 HP CENTRIFUGAL TRANSFER PUMP OBERDORFER PUMP CO. MODEL N994HJ96 OR ENGINEER APPROVED EQUIVALENT

SAMPLE PORT

6" SCH 80 PVC PIPE

1.5" HDPE WITH BALL VALVE CONNECTED TO DRAIN

2" THICK SONIC FIBER BLACK FACED SOUND ABSORBER ATTACHED WITH 2.5" FIBER ANCHORING STICK PINS AND LOCKING WASHERS PER MANUFACTURERS INSTALLATION DIRECTIONS (OR ENGINEER APPROVED EQUIVALENT)

SA2-HSVE-1 SA2-HSVE-2 SA2-02-NY3 SA2-02-SL2 SA2-02-BL1 SA2-04-NY3 SA2-04-SL2 SA2-04-BL1 SA2-01-BL3 SA2-01-BB2 SA2-01-M1 SA2-03-NY3 SA2-03-SL2 SA2-03-BL1

12" WELL VAULT (10-2" CONVENYANCE LINES WILL MEET NOT SHOWN FOR CLARITY)

N

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GRAPHIC SCALE IN FEET

FINAL DESIGN

FILE PATH: F:\FEDERAL\NON DOD\EPA\PROJECTS\14342\BANDERA ROAD\DGN\PLANS\TREATMENT COMPOUND\DWG\TREATMENT COMPOUND AT AOI2\SWANSON, CHRISTOPHER 10/29/2020 1:38 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION

DESIGNED BY:	DRAWN BY:	CHECKED BY:	PROJECT MANAGER:
AS/ DY	CNS/ JRM	AS	PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

TREATMENT COMPOUND AT AOI 2

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(972) 315-3922
Texas PE Firm Registration No. F003896

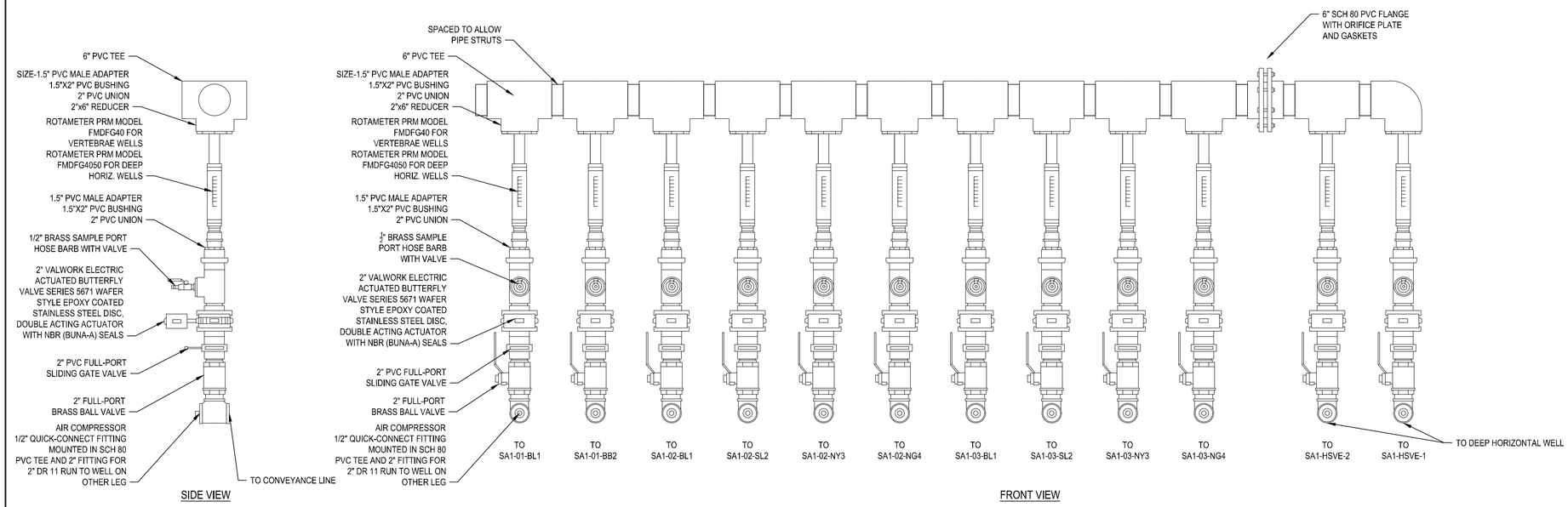
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

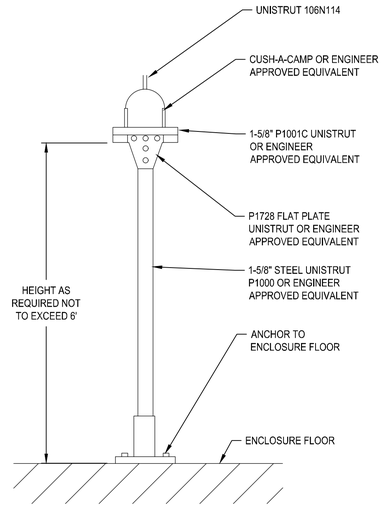
C-402

SHEET: 15 OF 34

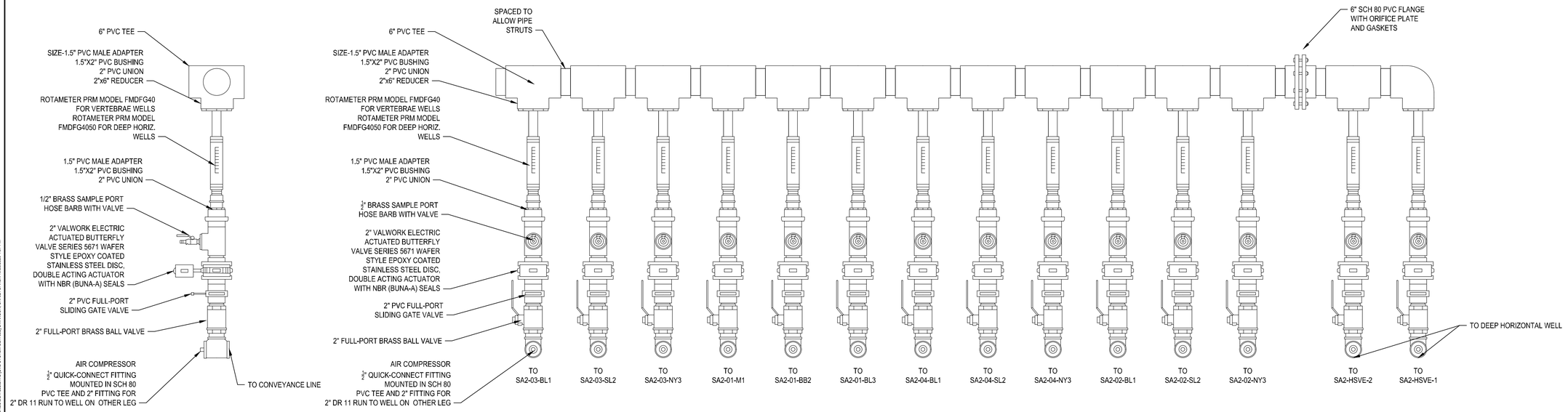
FINAL SUBMITTAL



1 C-501 / 1 C-109 AOI 1 SVE SYSTEM MANIFOLD DETAIL
SCALE:NOT TO SCALE



PIPE SUPPORT DETAIL
SCALE: NOT TO SCALE



2 C-501 / 2 C-110 AOI 2 SVE SYSTEM MANIFOLD DETAIL
SCALE:NOT TO SCALE

FINAL DESIGN

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REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE SYSTEM DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

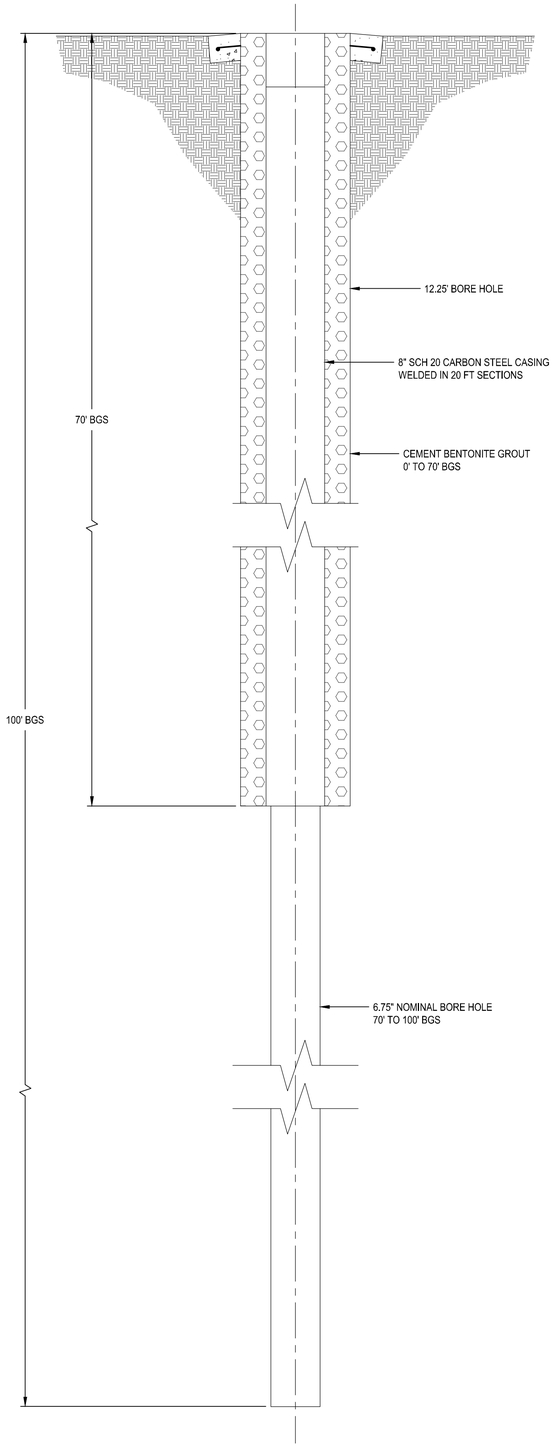
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-501

SHEET: 16 OF 34

FINAL SUBMITTAL



3 C-107 C-108 VERTICAL AMENDMENT INJECTION WELL DETAIL
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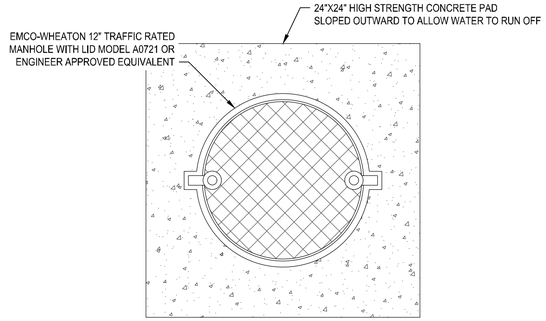
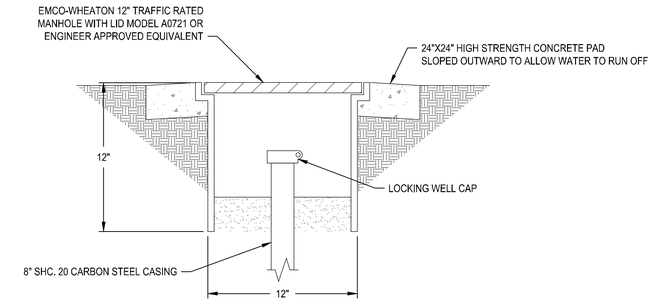


PLAN VIEW



ELEVATION VIEW

4 C-107 C-108 VERTICAL AMENDMENT INJECTION WELL VAULT DETAIL
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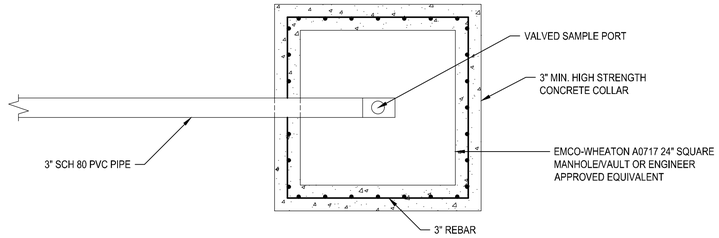
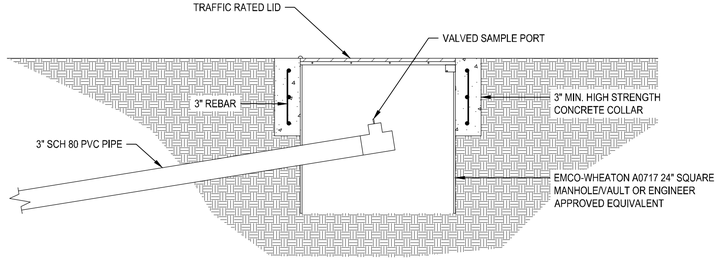


PLAN VIEW



ELEVATION VIEW

5 C-107 HORIZONTAL SVE VAULT
SCALE:NOT TO SCALE

FILE PATH: P:\FEDERAL\NON_DOD\EPA\PROJECTS\14342-143-BANDERA ROAD\DEP\EARS\2021\ETM\LD\WG\WELL CONSTRUCTION DETAILS.DWG | PLOTTED BY: CHRISTOPHER SWANSON | 10/29/2020 - 2:37 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

WELL CONSTRUCTION DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

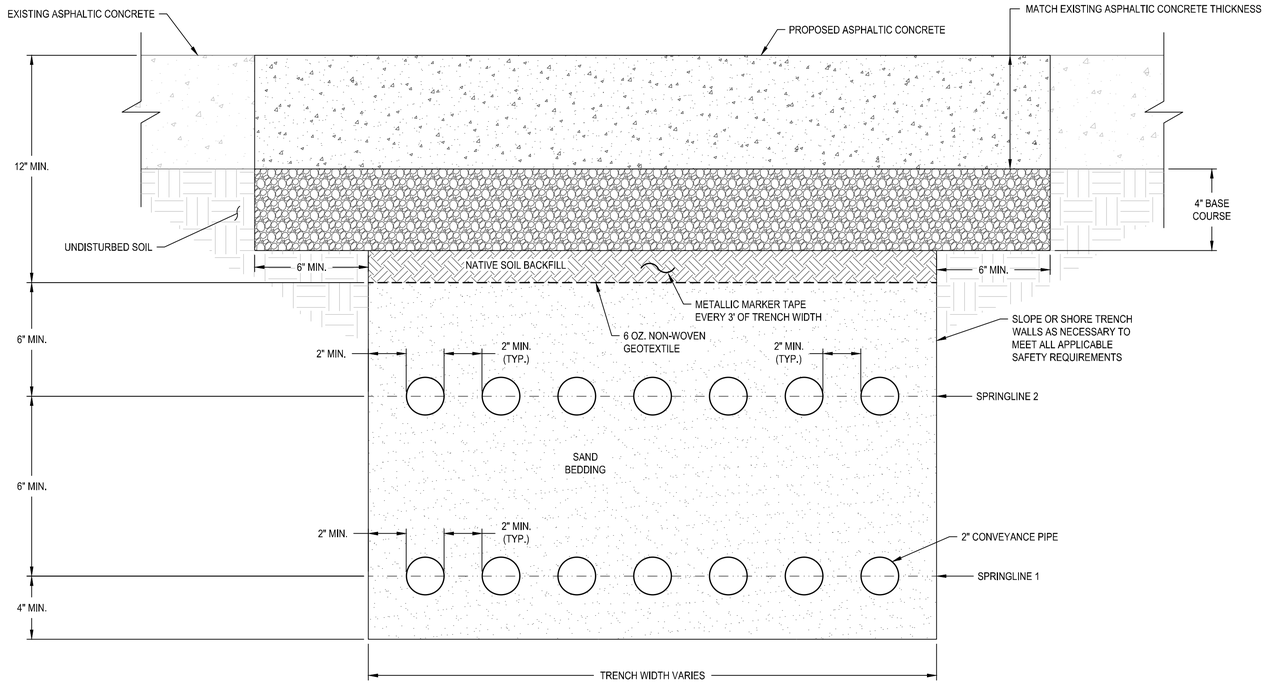
PROJECT NUMBER: 14342143

C-502

SHEET: 17 OF 34

FINAL SUBMITTAL

FINAL DESIGN



6 C-109 C-110 TYPICAL MULITPLE SVE PIPE TRENCH SECTION
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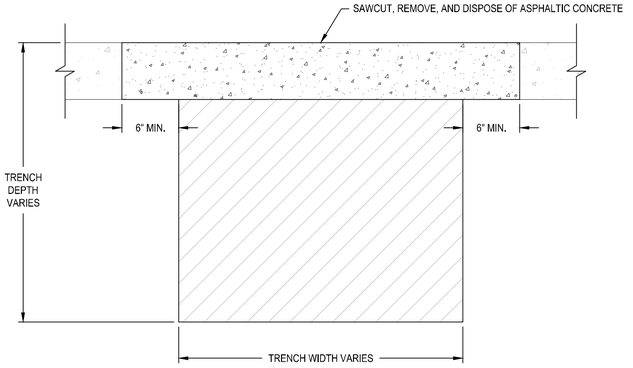

7 C-109 C-110 TRENCH CONCRETE CUTTING DETAIL
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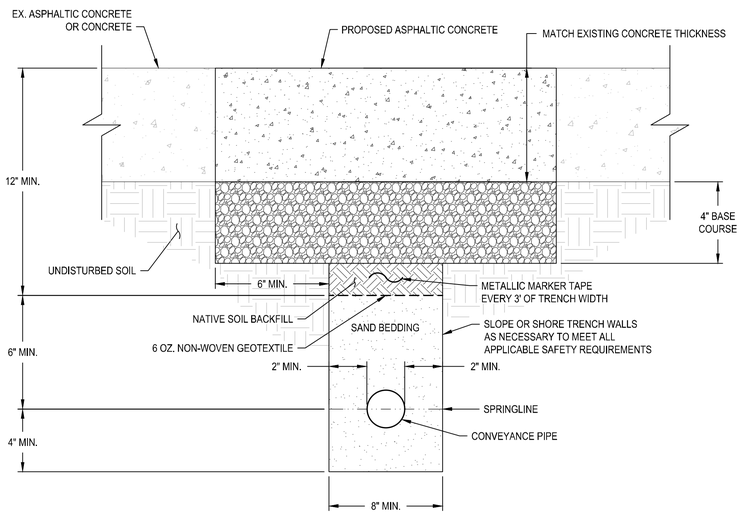
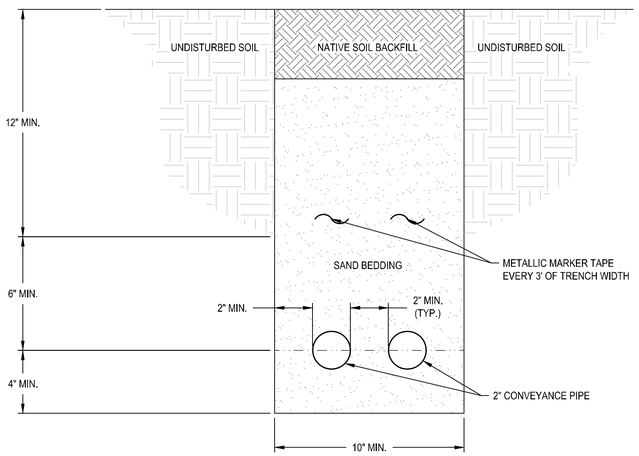


8 C-109 C-110 TYPICAL SVE PIPE TRENCH SECTION IN ASPHALTIC CONCRETE
SCALE:NOT TO SCALE



9 C-110 TYPICAL SVE PIPE TRENCH SECTION IN UNPAVED AREAS
SCALE:NOT TO SCALE

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
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CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PIPE CONSTRUCTION DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

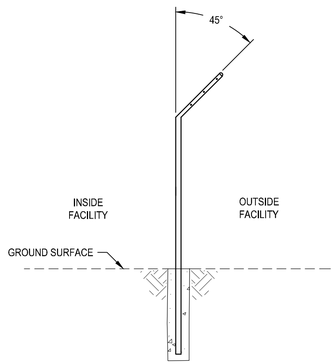
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

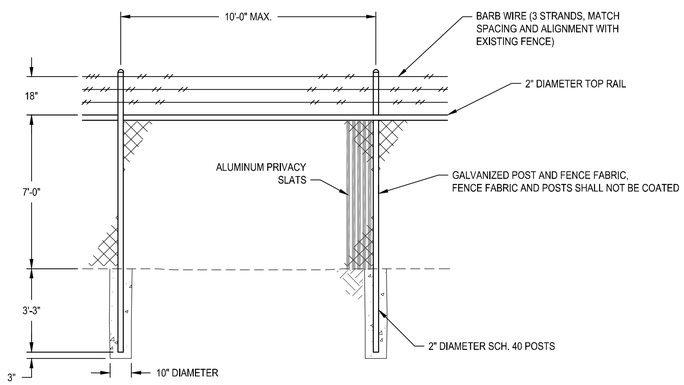
C-503

SHEET: 18 OF 34

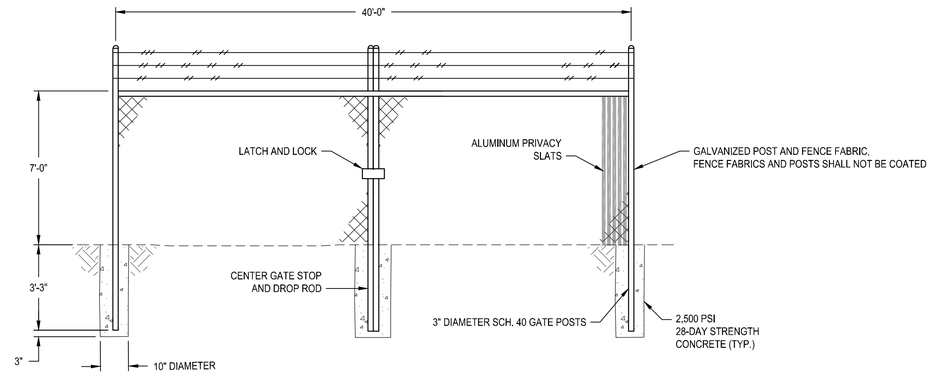
FINAL SUBMITTAL



FENCE POST - PROFILE



TYPICAL FENCE SECTION



DOUBLE SWING GATE

10 / C-103 SECURITY FENCE DETAIL
SCALE:NOT TO SCALE

C-104
C-401
C-402

FINAL DESIGN

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REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

TREATMENT COMPOUND FENCE DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

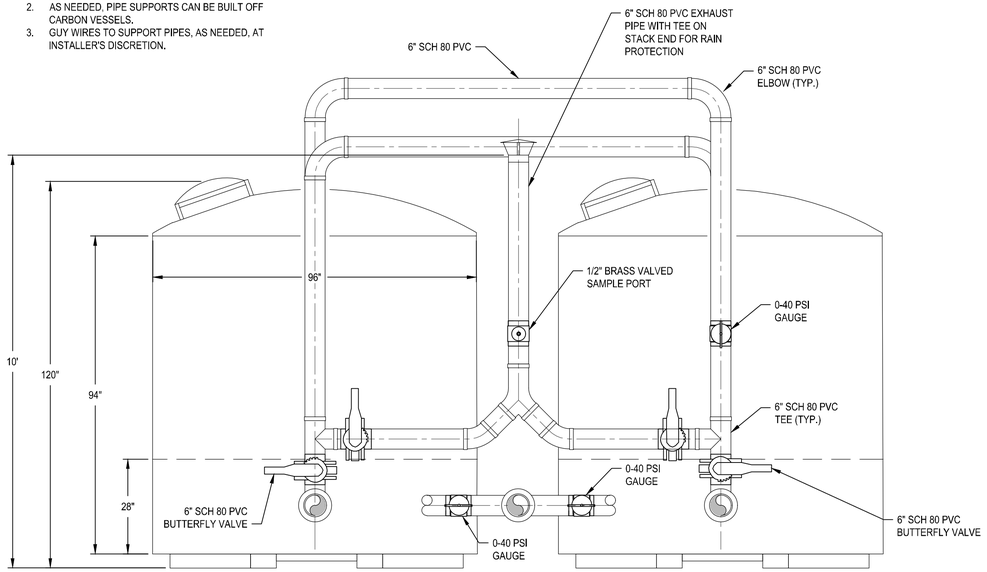
PROJECT NUMBER: 14342143

C-504

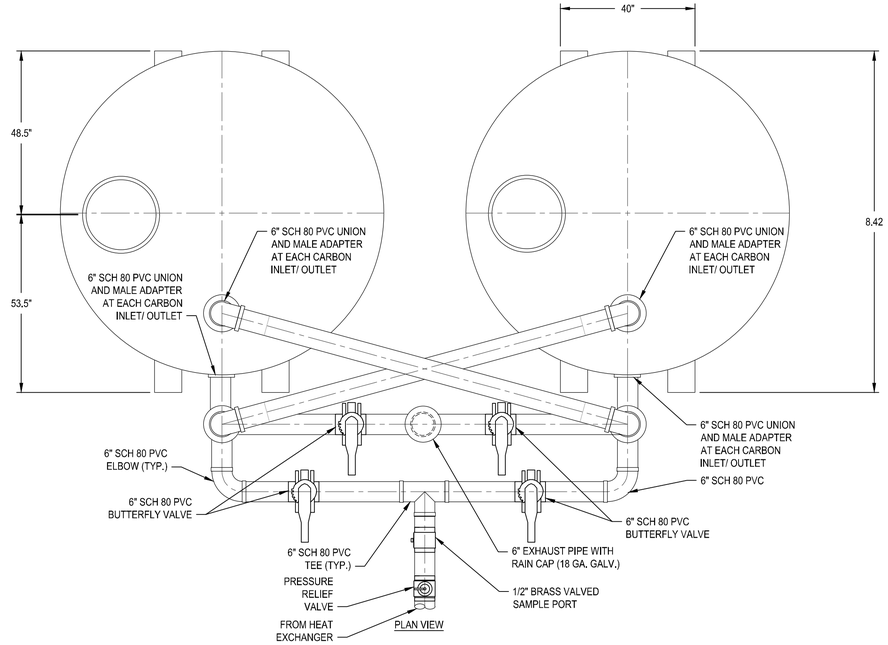
SHEET: 19 OF 34

FINAL SUBMITTAL

GENERAL NOTES:
1. CARBON VESSELS SHALL BE SHIPPED INDIVIDUALLY AND PLUMBING SHALL BE INSTALLED ON-SITE.
2. AS NEEDED, PIPE SUPPORTS CAN BE BUILT OFF CARBON VESSELS.
3. GUY WIRES TO SUPPORT PIPES, AS NEEDED, AT INSTALLER'S DISCRETION.

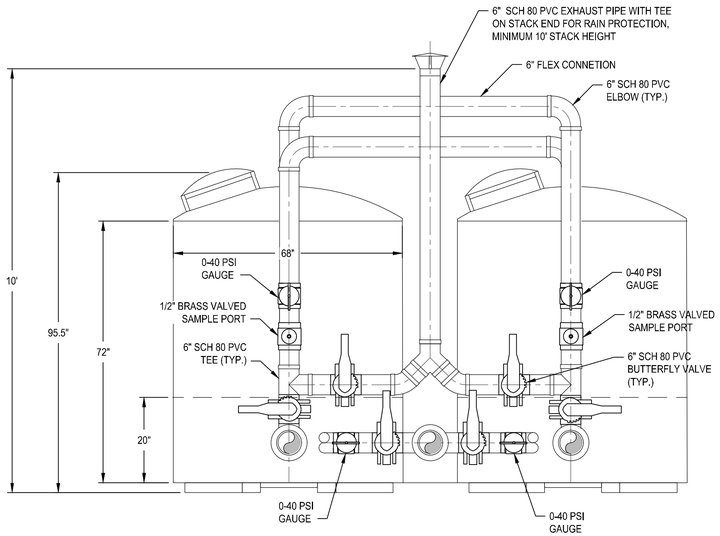


ELEVATION VIEW

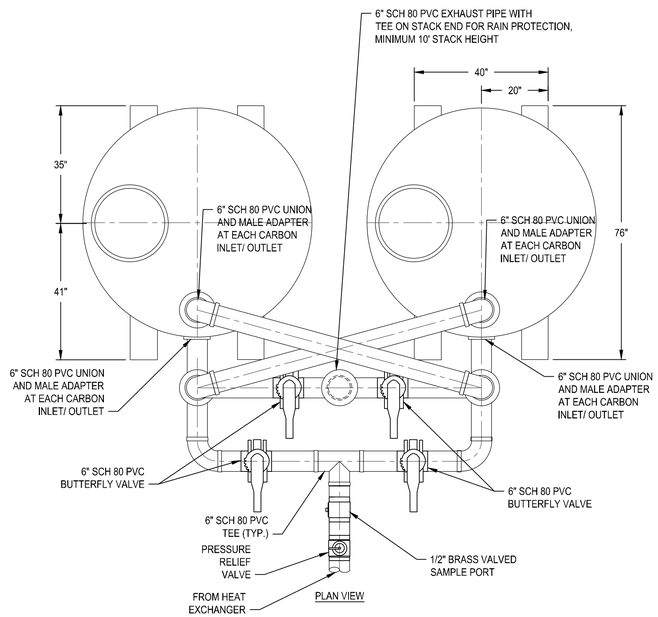


PLAN VIEW

11 C-105 **AOI 1 VESSEL DETAILS**
SCALE:NOT TO SCALE
C-401
C-402



ELEVATION VIEW



PLAN VIEW

12 C-106 **AOI 2 VESSEL DETAILS**
SCALE:NOT TO SCALE
C-401
C-402

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

VESSEL DETAILS

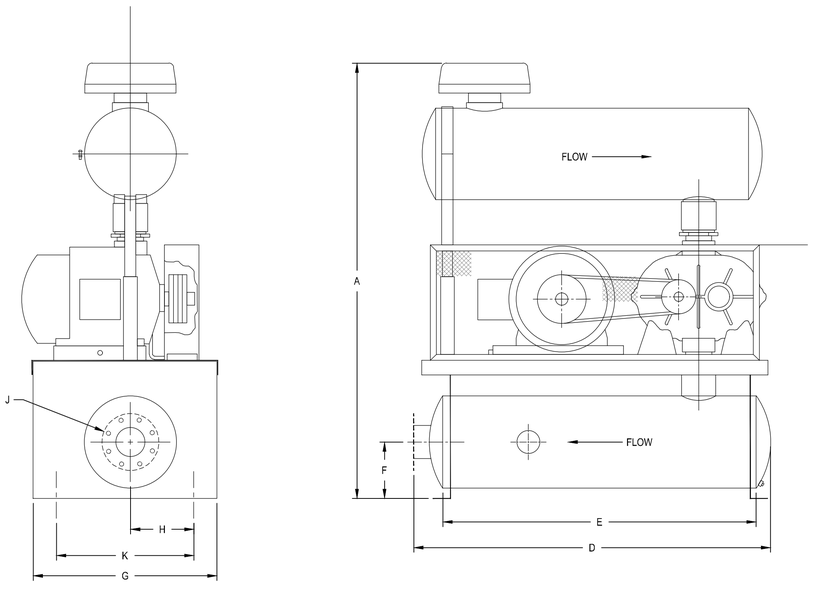
PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020
PROJECT NUMBER: 14342143

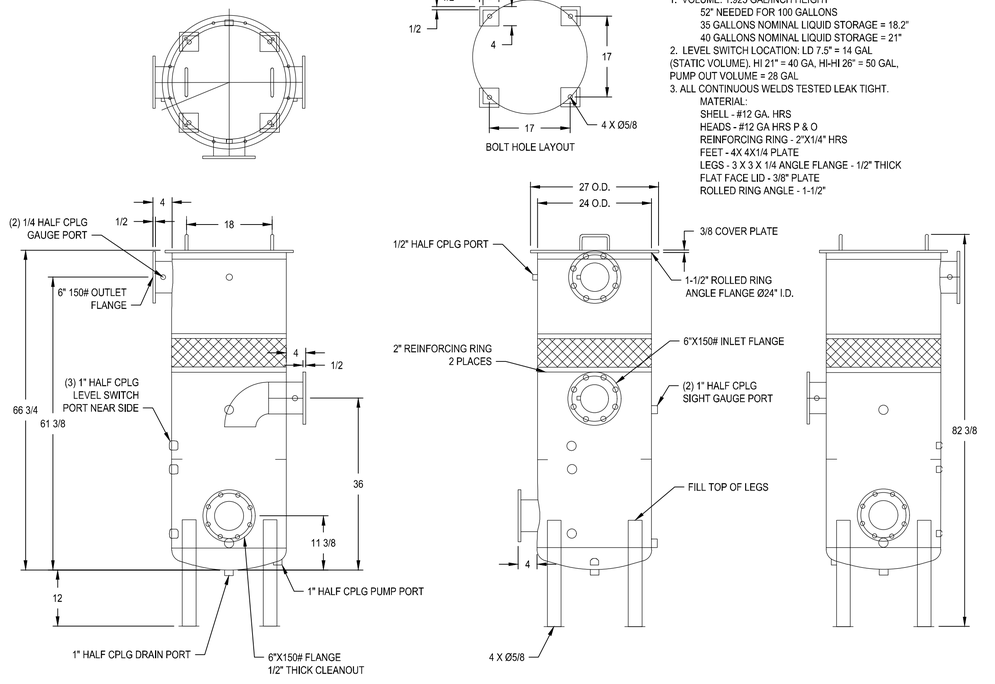
C-505
SHEET: 20 OF 34

FINAL SUBMITTAL



DIMENSION TABLE										
SITE	BLOWER ASSEMBLY	BLOWER MODEL	A	D	E	F	G	H	J	K
AOI 1	33-60	7011	91.44	69	62	12	33	12.5	6" FLG	24
AOI 2	33-30	4005	61.38	49.5	44	7	27	7.5	3" NPT	18

13 C-401 C-402 BLOWER MOTOR ASSEMBLY DETAIL
SCALE:NOT TO SCALE



NOTES:
1. VOLUME: 1.925 GAL/INCH HEIGHT
   52" NEEDED FOR 100 GALLONS
   35 GALLONS NOMINAL LIQUID STORAGE = 18.2"
   40 GALLONS NOMINAL LIQUID STORAGE = 21"
2. LEVEL SWITCH LOCATION: LD 7.5" = 14 GAL (STATIC VOLUME). HI 21" = 40 GA, HI-HI 26" = 50 GAL, PUMP OUT VOLUME = 28 GAL
3. ALL CONTINUOUS WELDS TESTED LEAK TIGHT.
   MATERIAL:
   SHELL - #12 GA. HRS
   HEADS - #12 GA HRS P & O
   REINFORCING RING - 2"X1/4" HRS
   FEET - 4X 4X1/4 PLATE
   LEGS - 3 X 3 X 1/4 ANGLE FLANGE - 1/2" THICK
   FLAT FACE LID - 3/8" PLATE
   ROLLED RING ANGLE - 1-1/2"

14 C-401 C-402 MOISTURE SEPARATOR DETAIL
SCALE:NOT TO SCALE

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
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PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

BLOWER ASSEMBLY AND MOISTURE SEPARATOR DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

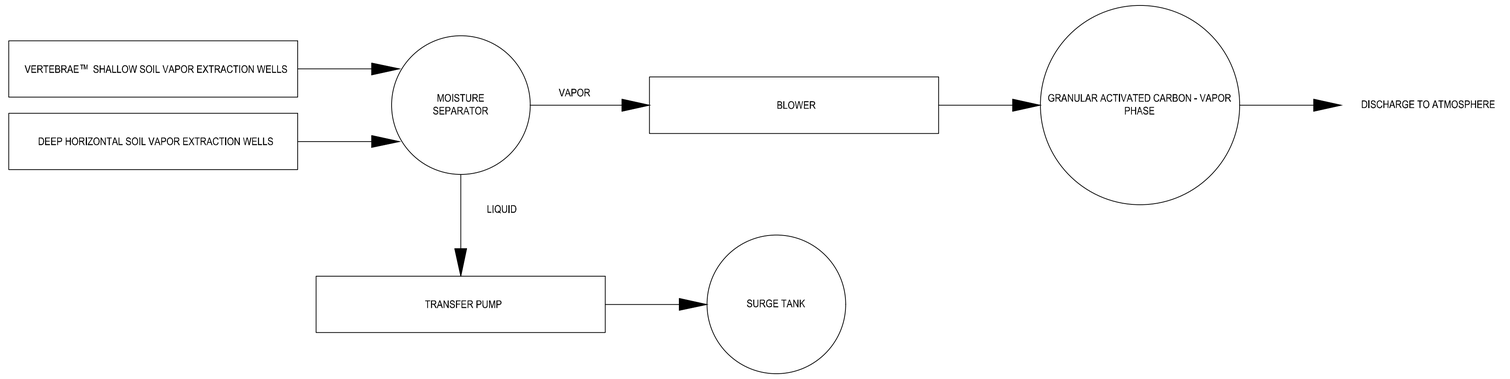
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

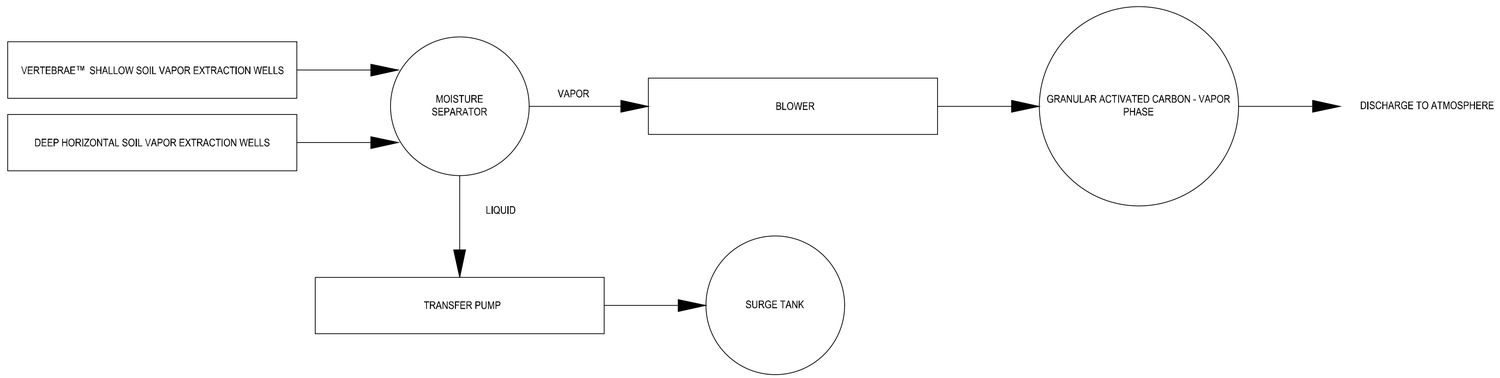
C-506

SHEET: 21 OF 34

FINAL SUBMITTAL



SOIL VAPOR EXTRACTION SYSTEM PROCESS FLOW DIAGRAM AT AOI 1



SOIL VAPOR EXTRACTION SYSTEM PROCESS FLOW DIAGRAM AT AOI 2

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
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PROJECT MANAGER: PA

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BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE SYSTEM FLOW DIAGRAM

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

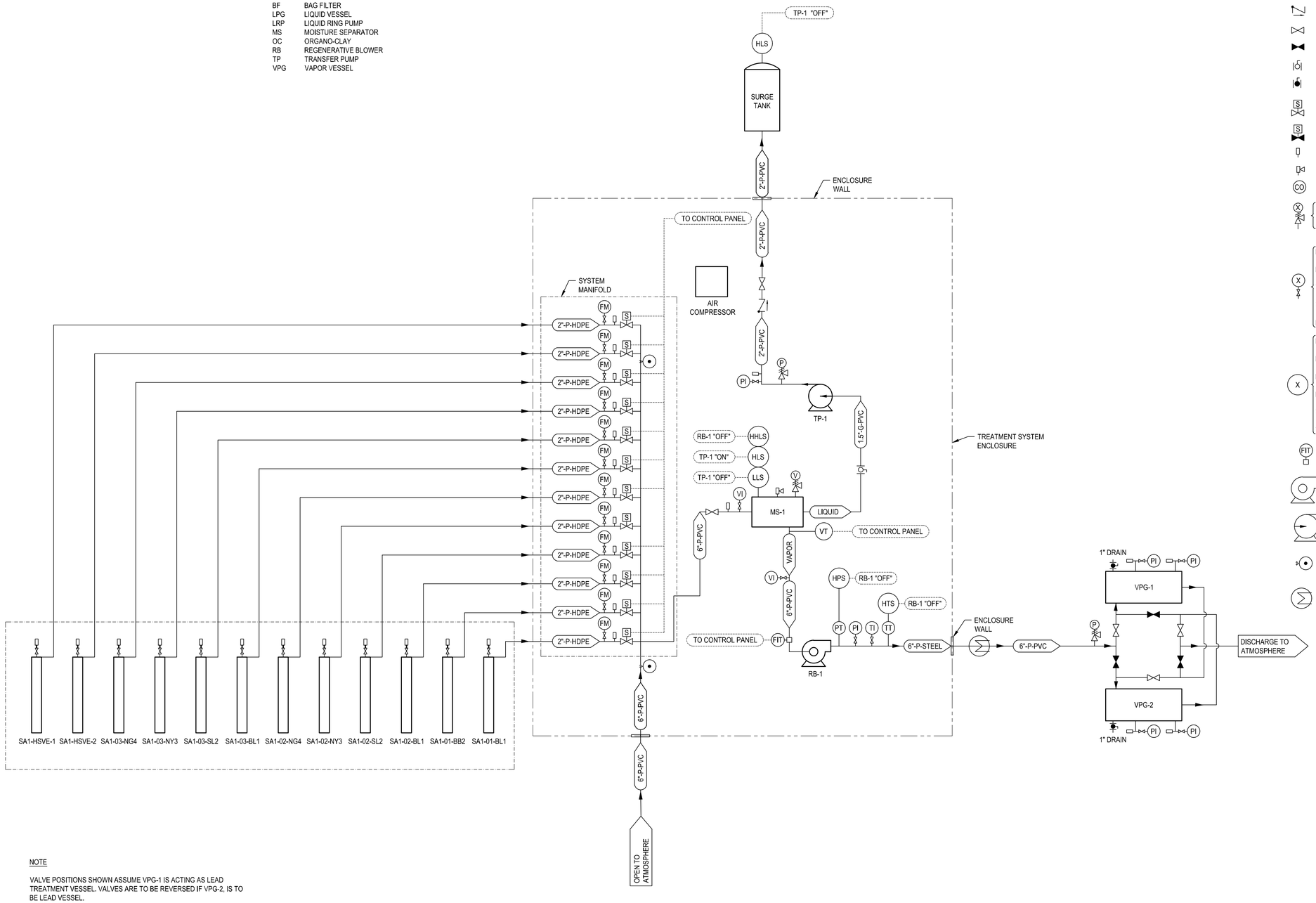
C-507

SHEET: 22 OF 34

FINAL SUBMITTAL

EQUIPMENT IDENTIFICATION

BF	BAG FILTER
LPG	LIQUID VESSEL
LRP	LIQUID RING PUMP
MS	MOISTURE SEPARATOR
OC	ORGANO-CLAY
RB	REGENERATIVE BLOWER
TP	TRANSFER PUMP
VPG	VAPOR VESSEL



NOTE

VALVE POSITIONS SHOWN ASSUME VPG-1 IS ACTING AS LEAD TREATMENT VESSEL. VALVES ARE TO BE REVERSED IF VPG-2, IS TO BE LEAD VESSEL.

LEGEND

- PIPE IDENTIFICATION (FLOW DIRECTION, PIPE MATERIAL, GRAVITY OR PRESSURE, PIPE SIZE — e.g. 6"-P-PVC)
- SIGNAL IDENTIFICATION (SIGNAL COMMAND, EQUIPMENT ID — e.g. RB-1 "OFF" OR "CLOSE")
- CHECK VALVE
- GATE VALVE - NORMALLY OPEN
- GATE VALVE - NORMALLY CLOSED
- BALL VALVE - NORMALLY OPEN
- BALL VALVE - NORMALLY CLOSED
- SOLENOID VALVE - NORMALLY OPEN
- SOLENOID VALVE - NORMALLY CLOSED
- SAMPLE PORT
- AIR DILATION PORT
- CLEANOUT
- P — PRESSURE RELIEF VALVE
- V — VACUUM RELIEF VALVE
- P — PRESSURE GAUGE PORT
- PI — PRESSURE INDICATOR
- TI — TEMPERATURE INDICATOR
- VI — VACUUM INDICATOR
- FM — FLOW METER
- HTS — HIGH TEMP SWITCH
- HHLS — HIGH HIGH-LEVEL ALARM SWITCH
- HLS — HIGH-LEVEL SWITCH
- LLS — LOW-LEVEL SWITCH
- VT — VACUUM TRANSMITTER
- TT — TEMPERATURE TRANSMITTER
- FIT — FLOW INDICATING TRANSMITTER
- BLOWER
- PUMP
- ORIFICE PLATE
- HEAT EXCHANGER

SAVINGS SQUARE (AOI 1) SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

NOT TO SCALE

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION: DESIGNED BY: AS/ DY | DRAWN BY: CNS/ JRM | CHECKED BY: AS | PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM AT AOI 1

PREPARED FOR:

EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-508

SHEET: 23 OF 34

FINAL SUBMITTAL

EQUIPMENT IDENTIFICATION

BF	BAG FILTER
LPG	LIQUID VESSEL
LRP	LIQUID RING PUMP
MS	MOISTURE SEPARATOR
OC	ORGANO-CLAY
RB	REGENERATIVE BLOWER
TP	TRANSFER PUMP
VPG	VAPOR VESSEL

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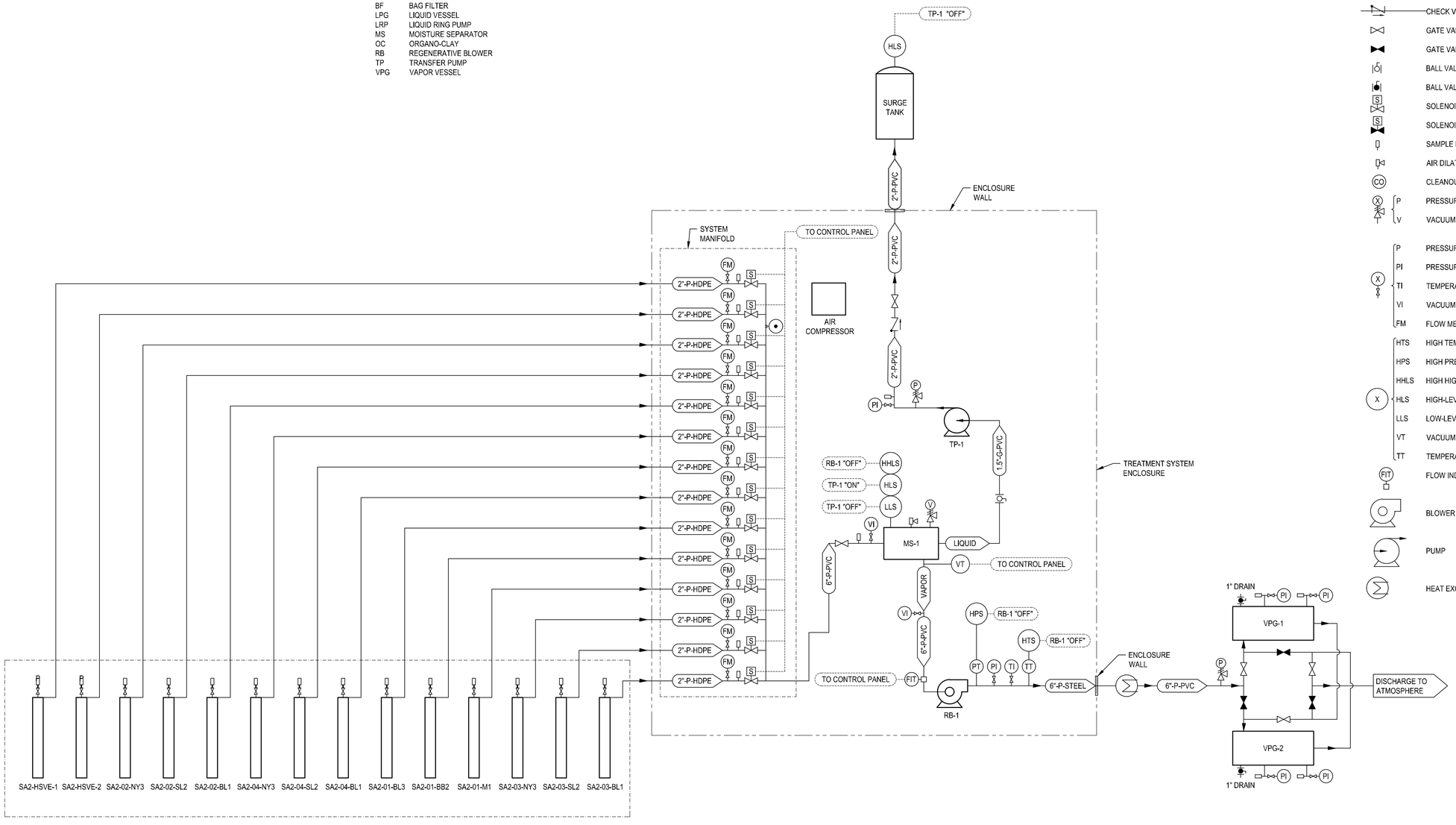
- BALL VALVE - NORMALLY CLOSED
- SOLENOID VALVE - NORMALLY OPEN
- SOLENOID VALVE - NORMALLY CLOSED
- SAMPLE PORT
- AIR DILATION PORT
- CO — CLEANOUT
- P — PRESSURE RELIEF VALVE
- V — VACUUM RELIEF VALVE
- P — PRESSURE GAUGE PORT
- PI — PRESSURE INDICATOR
- TI — TEMPERATURE INDICATOR
- VI — VACUUM INDICATOR
- FM — FLOW METER
- HTS — HIGH TEMP SWITCH
- HPS — HIGH PRESSURE SWITCH
- HHLS — HIGH HIGH-LEVEL ALARM SWITCH
- HLS — HIGH-LEVEL SWITCH
- LLS — LOW-LEVEL SWITCH
- VT — VACUUM TRANSMITTER
- TT — TEMPERATURE TRANSMITTER
- FIT — FLOW INDICATING TRANSMITTER
- BLOWER
- PUMP
- HEAT EXCHANGER



NOTE

VALVE POSITIONS SHOWN ASSUME VPG-1 IS ACTING AS LEAD TREATMENT VESSEL. VALVES ARE TO BE REVERSED IF VPG-2, IS TO BE LEAD VESSEL.

PILGRIM CLEANERS (AOI 2) SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

NOT TO SCALE

FINAL DESIGN

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SVE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM AT AOI 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

C-509

SHEET: 24 OF 34

FINAL SUBMITTAL

ABBREVIATIONS

A	AMPERE
AC	ALTERNATING CURRENT
AF	AMPS FRAME
APPROX.	APPROXIMATELY
AT	AMPS TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AWG	AMERICAN WIRE GAGE
BKR	BREAKER
BLDG.	BUILDING
CB	CIRCUIT BREAKER
C.E.P.	CONCRETE EQUIPMENT PAD
CFR	CODE OF FEDERAL REGULATIONS
CKT,CIRC.	CIRCUIT
CP,C.P.	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
DC	DIRECT CURRENT
DIA	DIAMETER
D.S.	DISCONNECT SWITCH
DWG	DRAWING
ELEC	ELECTRICAL
ENCL.	ENCLOSURE
EX.,EXIST	EXISTING
G	GREEN OR GROUNDING CONDUCTOR
GRD	GROUND
HOA	HAND-OFF-AUTOMATIC
HZ	HERTZ
JB OR JB-()	JUNCTION BOX OR JUNCTION BOX W/DESIGNATION
KCMIL	KILO (THOUSAND) CIRCULAR MILS
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KW	KILOWATT
LP	LIGHTING PANELBOARD
LTG.	LIGHTING
M-()	MOTOR STARTER COIL W/DESIGNATION
MAX	MAXIMUM
MCM	THOUSAND CIRCULAR MILS
MIN.	MINIMUM
MTG	MOUNTING
N	NEUTRAL
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NFSS	NON-FUSED SAFETY SWITCH
NO.	NUMBER
NTS	NOT TO SCALE
OL	OVERLOAD
PF-()	POWER FEEDER W/SOURCE DESIGNATION & CIRCUIT DESIGNATION
PH	PHASE
PP-()	POWER PANELBOARD
PT	POTENTIAL TRANSFORMER
P-()	PUMP W/DESIGNATION
QTY	QUANTITY
SDBC	SOFT DRAWN BARE COPPER
S.E.	SERVICE ENTRANCE
SH	SHIELDED
SP	SURGE PROTECTOR
S.S.	STAINLESS STEEL
SYS.	SYSTEM
T-()	TRANSFORMER W/DESIGNATION
TB-()	TERMINAL BOX W/DESIGNATION
TEMP	TEMPERATURE
TSP	TWISTED SHIELED PAIR
TYP.	TYPICAL
UTIL.	UTILITY
V	VOLT
VAC	VOLTS ALTERNATING CURRENT
VFD	VARIABLE FREQUENCY DRIVE
W/	WITH
XFMR	TRANSFORMER

SYMBOLS

CIRCUIT CONNECTION

CIRCUIT BREAKER

CODED NOTE.

COMBINATION MAGNETIC OR MANUAL MOTOR STARTER

COMBINATION MOTOR STARTER

CONTACTOR

DELTA, Y

DISCONNECT SWITCH

DISCRETE INPUT SIGNAL

DISCRETE OUTPUT SIGNAL

FE — FLOW ELEMENT

FIT — FLOW INDICATING TRANSMITTER

PE — PRESSURE ELEMENT

PIT — PRESSURE INDICATING TRANSMITTER

INDICATOR LIGHT

MS# — MOTOR STARTER COIL

CR# — RELAY COIL

CR# — RELAY CONTACT

TRANSFORMER

ANALOG INPUT SIGNAL

ANALOG OUTPUT SIGNAL

F — FUSED DISCONNECT SWITCH, 30A, 3P, 600V, HD, NEMA 4X ENCLOSURE UNLESS OTHERWISE NOTED

J — JUNCTION BOX

HANDHOLE

OR M — PUMP MOTOR

— MOTOR, W/ HP

OVERLOAD

PANELBOARD

TRANSFORMER

GROUND ROD

GROUND TEST WELL

ISRF-# — INTRINSICALLY SAFE SIGNAL BARRIER

UNDERGROUND DUCT BANK

LP1-() (PP# OR PF) — HOME RUN TO LIGHTING OR POWER PANELBOARD - INCLUDES CONDUIT AND CIRCUIT (CONDUCTORS)

CONDUIT EXPOSED

CONDUIT CONCEALED BELOW SLAB OR GRADE (UNLESS NOTED OTHERWISE)

CONDUIT DOWN

CONDUIT UP

GROUND GRID OR CONNECTING CONDUCTOR

EQUIPMENT OR MATERIALS TO BE REMOVED

DB # — DUCT BANK SECTION MARKER W/ DESIGNATION NUMBER

UTILITY POLE

GENERAL NOTE

1. ALL WORK SHOWN ON THE DRAWINGS IS NEW UNLESS OTHERWISE NOTED AS EXISTING. FOR THE CONVENIENCE OF THE CONTRACTOR, ON THE DRAWINGS WHICH CONTAIN BOTH NEW AND EXISTING FEATURES, A DISTINCTION BETWEEN NEW AND EXISTING MATERIALS, EQUIPMENT, AND STRUCTURES HAS BEEN MADE BY LINE WEIGHT. HEAVY LINE WEIGHT REPRESENTS NEW FEATURES AND LIGHT LINE WEIGHT REPRESENTS EXISTING FEATURES.

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

ELECTRICAL ABBREVIATIONS, SYMBOLS, AND GENERAL NOTES

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-101

SHEET: 25 OF 34

FINAL SUBMITTAL

SAVINGS SQUARE AOI 1 SITE PLAN
SCALE: 1" = 20'

0 10 20 40
GRAPHIC SCALE IN FEET

NOTES

1. OBTAIN NEW THREE PHASE SERVICE FOR THE SVE SYSTEM FROM CPS ENERGY. MODIFICATIONS TO EXISTING DISTRIBUTION SYSTEM AND INSTALLATION OF NEW UTILITY TRANSFORMER BY CPS ENERGY. COORDINATE WORK WITH CPS ENERGY.
2. COORDINATE WITH CPS ENERGY TO INSTALL NEW ELECTRICAL SERVICE (THREE PHASE 480VAC). INSTALL METER BASE IN TREATMENT COMPOUND IN ACCORDANCE WITH CPS ENERGY STANDARDS. INSTALL SERVICE ENTRANCE CONDUCTORS FROM METER TO PANELBOARD PP1.
3. COORDINATE WITH CPS ENERGY TO OBTAIN NEW ELECTRICAL SERVICE. PROPOSE INTERCEPTING AND TAPPING EXISTING PRIMARY CONDUCTORS ROUTED TO EXISTING TRANSFORMER.

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL:

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SAVINGS SQUARE SITE PLAN

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

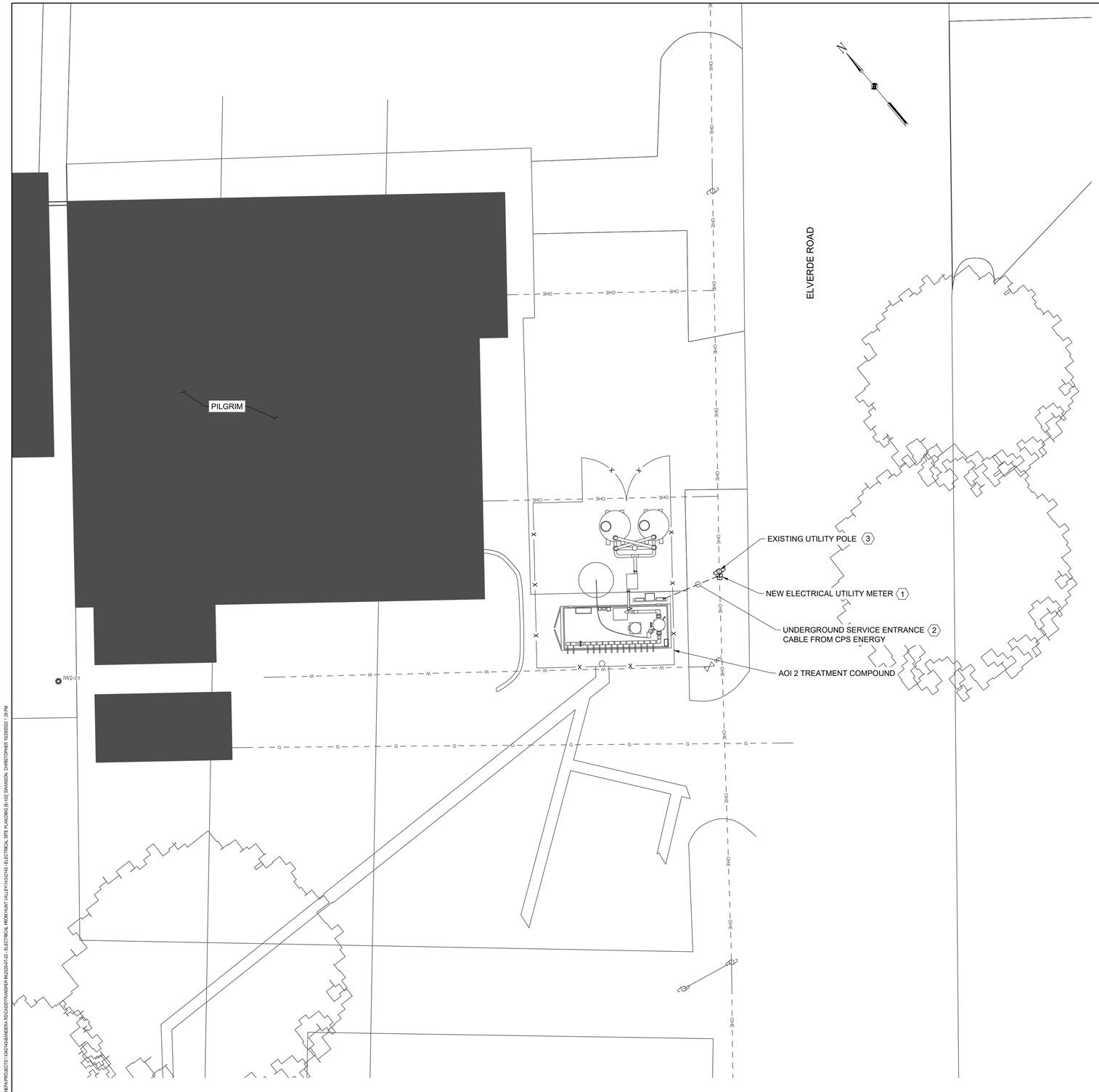
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-102

SHEET: 26 OF 34

FINAL SUBMITTAL



PILGRIM AOI 2 SITE PLAN
SCALE: 1" = 10'

0 5 10 20
GRAPHIC SCALE IN FEET

NOTES

1. OBTAIN NEW THREE PHASE SERVICE FOR THE SVE SYSTEM FROM CPS ENERGY. MODIFICATIONS TO EXISTING DISTRIBUTION SYSTEM AND INSTALLATION OF UTILITY TRANSFORMER BY CPS ENERGY. COORDINATE WORK WITH CPS ENERGY.
2. COORDINATE WITH CPS ENERGY TO INSTALL NEW ELECTRICAL SERVICE (THREE PHASE 480VAC). INSTALL METER BASE IN TREATMENT COMPOUND IN ACCORDANCE WITH CPS ENERGY STANDARDS. INSTALL SERVICE ENTRANCE CONDUCTORS FROM METER TO PANELBOARD PP1.
3. COORDINATE WITH CPS ENERGY TO OBTAIN NEW ELECTRICAL SERVICE. PROPOSE MOUNTING NEW DISTRIBUTION TRANSFORMERS ON EXISTING UTILITY POLE.

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PILGRIM SITE PLAN

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

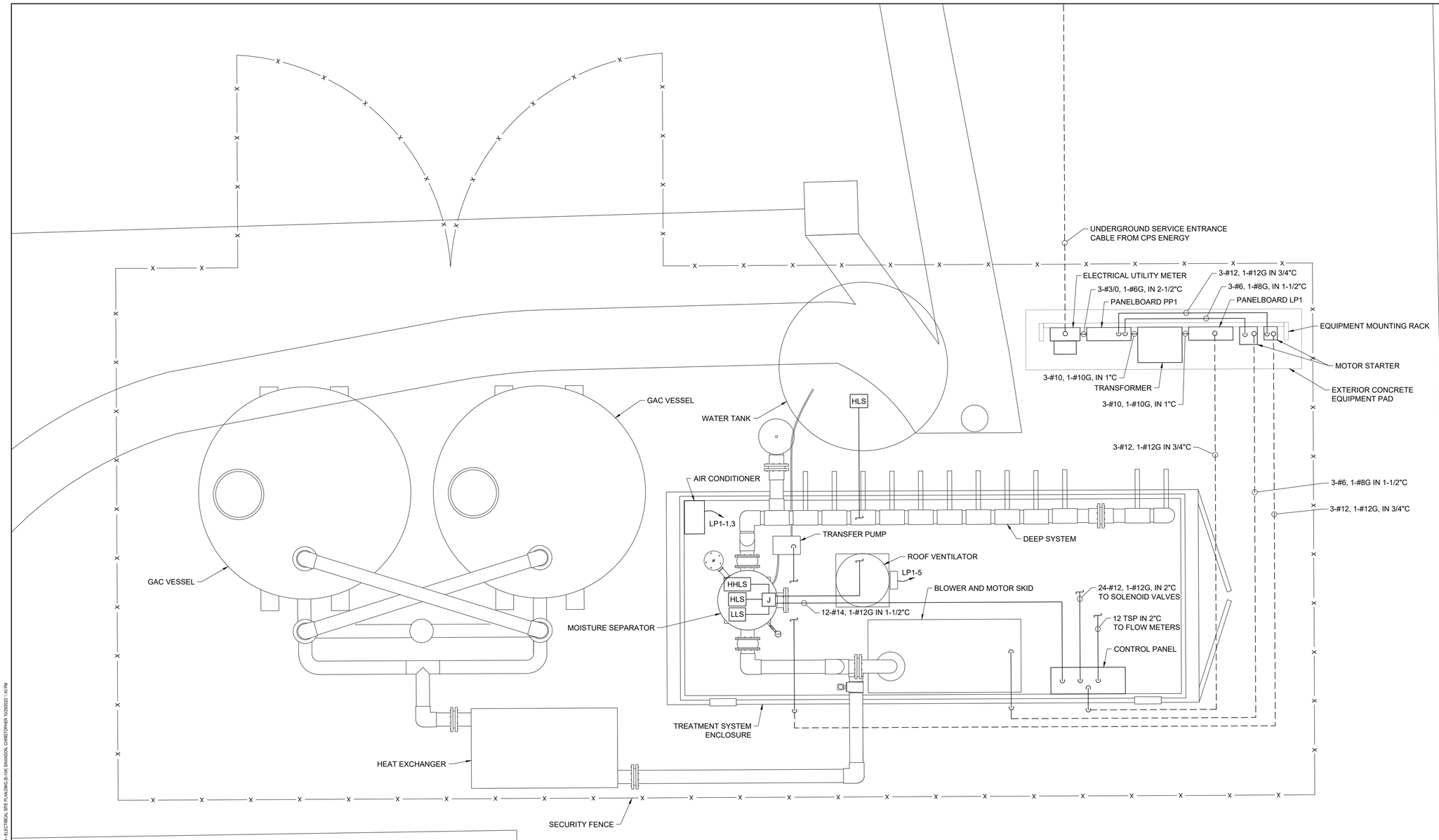
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-103

SHEET: 27 OF 34

FINAL SUBMITTAL



SAVINGS SQUARE TREATMENT COMPOUND PLAN
SCALE: 1" = 2'

0 1 2 4
GRAPHIC SCALE IN FEET

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
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PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

SAVINGS SQUARE TREATMENT COMPOUND PLAN

PREPARED FOR:
EPA
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DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

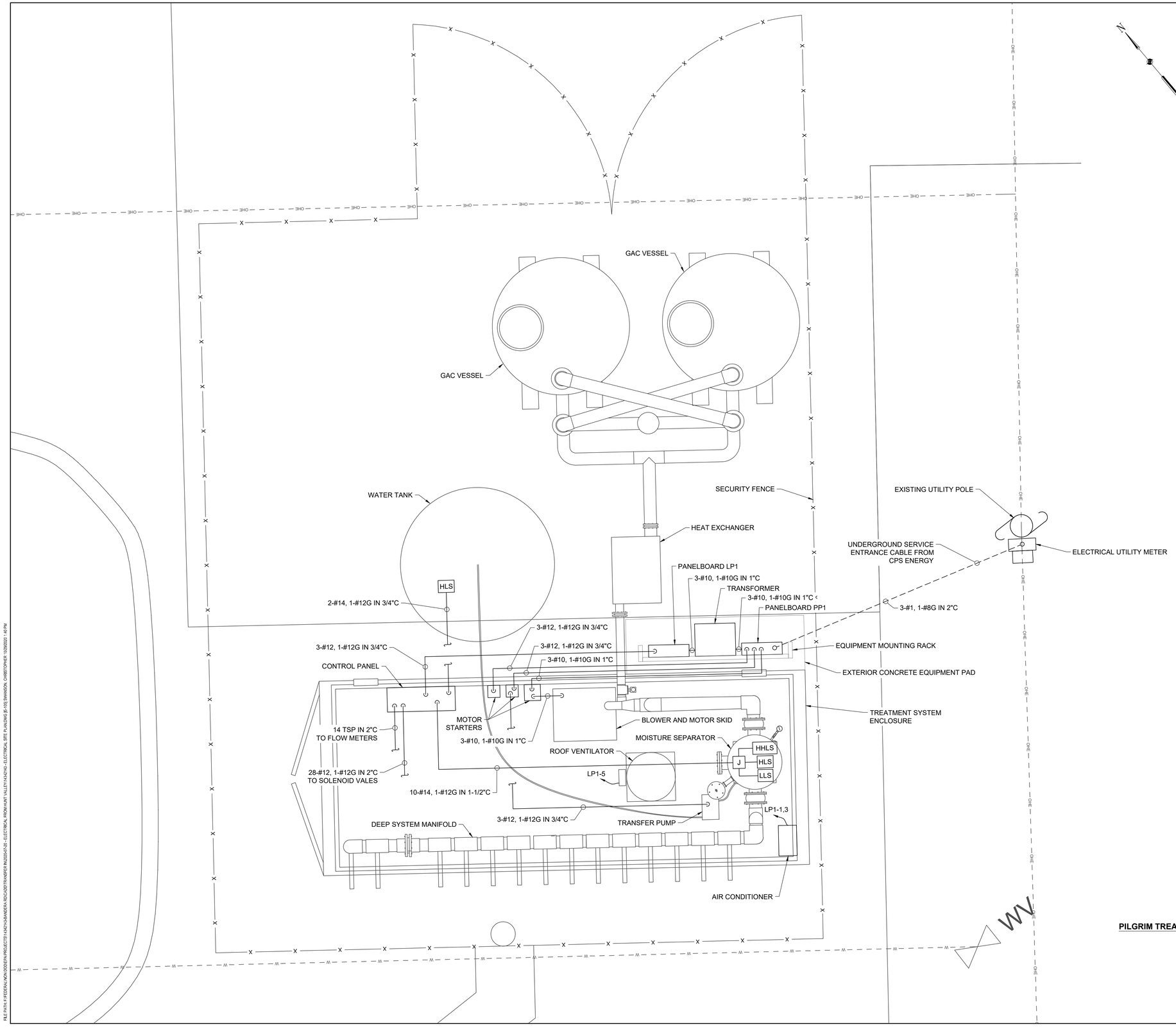
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-104

SHEET: 28 OF 34

FINAL SUBMITTAL



PILGRIM TREATMENT COMPOUND PLAN
SCALE: 1" = 2'

0 1 2 4
GRAPHIC SCALE IN FEET

FILE PATH: P:\FEDERAL\NON-DOD\EPA\PROJECTS\14342143-BANDERA ROAD\ADD\TRANSFER IN\2020-07-20 - ELECTRICAL FROM HART VALLEY\14342143 - ELECTRICAL SITE PLAN.DWG [P-105] SWANSON, CHRISTOPHER - 10/29/2020 - 1:47 PM

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
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CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

PILGRIM TREATMENT COMPOUND PLAN

PREPARED FOR:
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Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

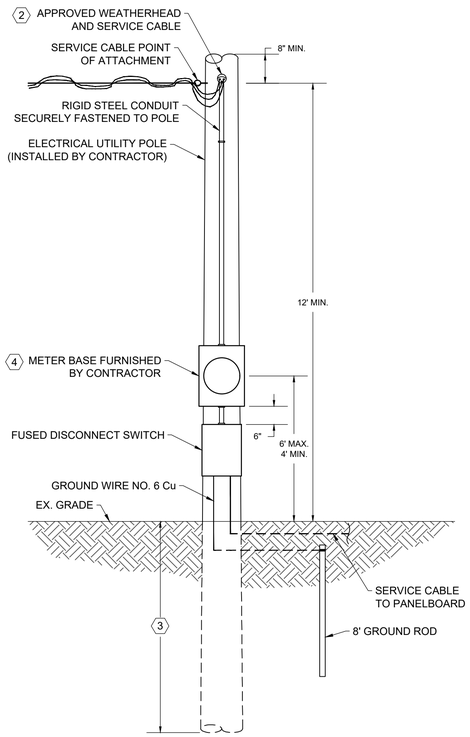
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-105

SHEET: 29 OF 34

FINAL SUBMITTAL



ELECTRICAL SERVICE UTILITY POLE - DETAIL
NOT TO SCALE

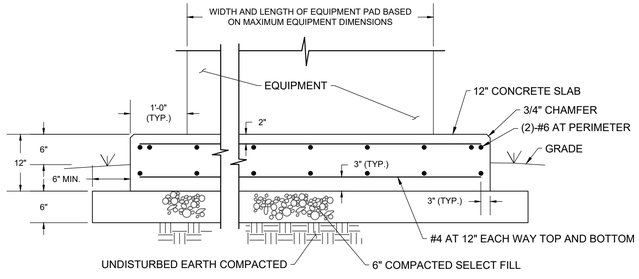
ELECTRICAL SERVICE UTILITY POLE - NOTES:

1. ELECTRICAL UTILITY SUPPLIER TO PROVIDE NEW 480 VAC 3 PHASE SERVICE FOR THE SVE SYSTEM. CONTRACTOR SHALL CONTACT CPS ENERGY AND COORDINATE OBTAINING THIS SERVICE.

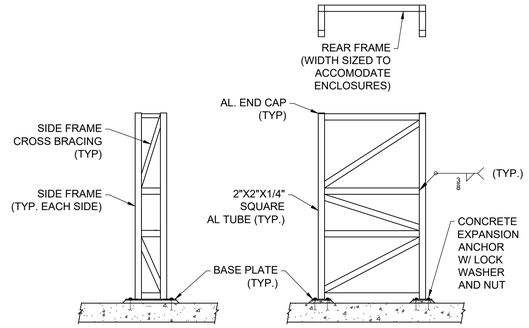
(2) MARK NEUTRAL CONDUCTOR AT THE WEATHER HEAD AND IN THE METER BASE. LEAVE A MINIMUM OF 24" OF WIRE EXPOSED OUT OF WEATHER HEAD FOR CONNECTION OF SERVICE WIRES AND DRIP LOOP.

(3) 5' MINIMUM DEPTH; GREATER DEPTH NECESSARY WHEN POLE EXCEEDS 30'

(4) METER BASE SHALL BE 200 AMP WITH LOCKING JAW BYPASS LEVER AND INCLUDE 600V LIGHTNING ARRESTORS.



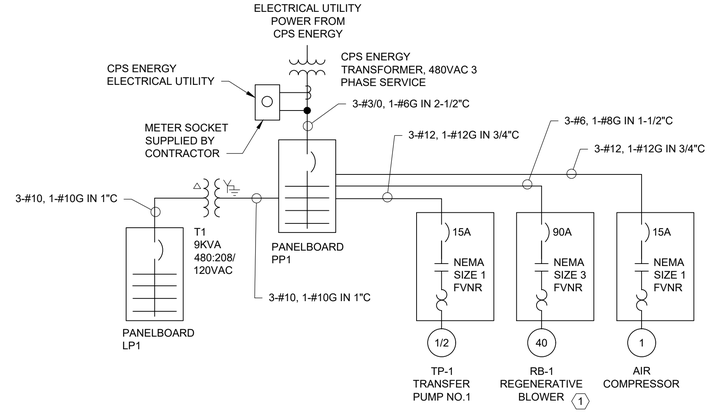
EXTERIOR CONCRETE EQUIPMENT PAD - DETAIL
NOT TO SCALE



EQUIPMENT MOUNTING RACK - DETAIL
NOT TO SCALE

EQUIPMENT MOUNTING RACK DETAIL NOTES

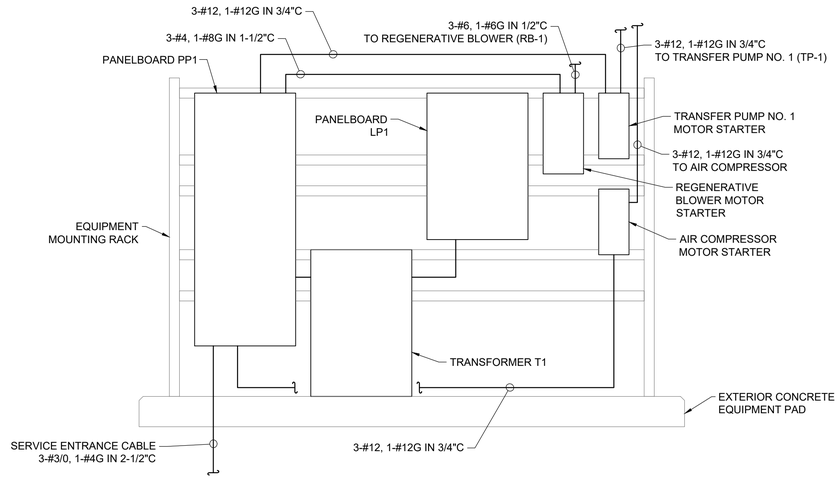
1. SIDE FRAME SHALL BE 10" DEEP MINIMUM. THE SIDE FRAME SHALL BE APPROXIMATELY TWO THIRDS THE SIZE OF THE LARGEST ENCLOSURE DEPTH.
2. CROSS BRACING SHALL BE PROVIDED ON THE REAR FRAME ASSEMBLY FOR EMRs 24" WIDE AND LARGER. CROSS BRACING SHALL BE PROVIDED ON THE SIDE FRAME FOR EMRs 18" DEEP OR LARGER.
3. ENCLOSURES HSALL BE MOUNTED USING STAINLESS STEEL HARDWARE. THE EMR SHALL BE FASTENED TO THE CEP WITH CORROSION RESISTANT EXPANSION ANCHORS.



TREATMENT SYSTEM CONTACTOR CONNECTION DIAGRAM
NOT TO SCALE

TREATMENT SYSTEM CONTACTOR CONNECTION DIAGRAM - NOTES:

(1) REGENERATIVE BLOWER AT SAVINGS SQUARE SHOWN (40HP); REGENERATIVE BLOWER AT PILGRIM IS 15HP (WITH A NEMA SIZE 2 MOTOR STARTER).



EQUIPMENT MOUNTING RACK - ELEVATION
NOT TO SCALE

EQUIPMENT MOUNTING - ELEVATION NOTE

1. NOT ALL CONDUITS SHOWN.

PANEL SCHEDULE

PANELBOARD PP1 LOCATION - INSTALLATION -
RATINGS 200 AMPS, 480/277 VOLTS, 3 PH, 4 WIRE, 60 HZ., GRD BAR -
MAIN LUGS - BKR INTERRUPTING RATING 42,000 RMS. SYMM. AMPS
MAIN CIRCUIT BREAKER 200 AMPS, CONNECTED LOAD - KVA PANEL SIZE -

DESCRIPTION	NOTES	BKR AMPS	CKT	A	B	C	CKT	BKR AMPS	NOTES	DESCRIPTION
SPARE		20A 1P	1				2			
			3				4			
TRANSFER PUMP NO.1 TP-1		20A 3P	5				6			
			7				8			
			9				10			
SPARE		20A 3P	11				12			
			13				14			
REGENERATIVE BLOWER RB-1		90A 3P	15				16			
			17				18			
			19				20			
AIR COMPRESSOR		20A 3P	21				22			
			23				24			
			25				26	20A 1P		TRANSFORMER
			27				28			
			29				30			

PANEL SCHEDULE

PANELBOARD LP1 LOCATION - INSTALLATION -
RATINGS 100 AMPS, 208/120 VOLTS, 3 PH, 4 WIRE, 60 HZ., GRD BAR -
MAIN LUGS - BKR INTERRUPTING RATING - RMS. SYMM. AMPS
MAIN CIRCUIT BREAKER 30 AMPS, CONNECTED LOAD - KVA PANEL SIZE -

DESCRIPTION	NOTES	BKR AMPS	CKT	A	B	C	CKT	BKR AMPS	NOTES	DESCRIPTION
AIR CONDITIONER		20A 2P	1				2	20A 1P		LIGHTS
			3				4	20A 1P		RECEPTACLES
ROOF VENTILATOR		15A 1P	5				6	20A 1P		CONTROL PANEL
			7				8			
			9				10			
			11				12			
			13				14			
			15				16			
			17				18			
			19				20			
			21				22			
			23				24			
			25				26			
			27				28			
			29				30			

NO.	DATE	BY	REVISIONS DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

ONE-LINE DIAGRAM, PANELBOARD SCHEDULES, AND DETAILS

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

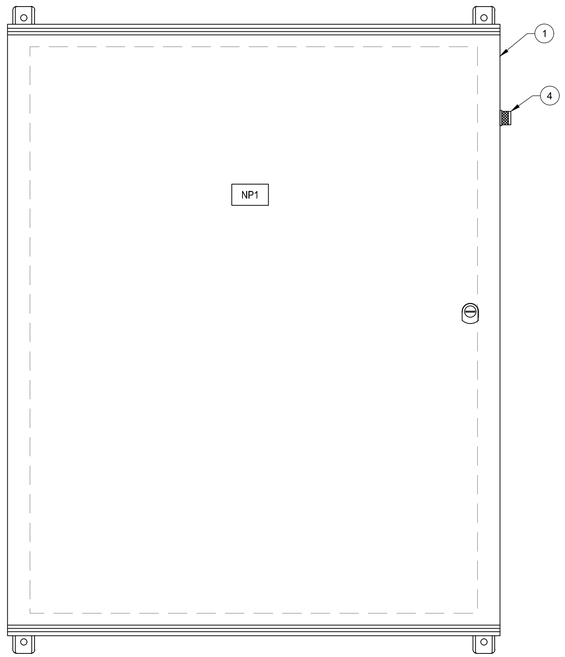
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

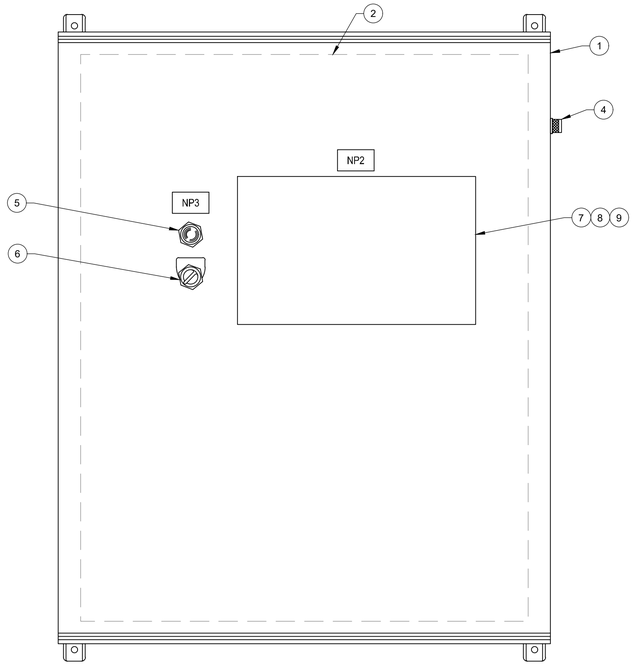
E-501

SHEET: 30 OF 34

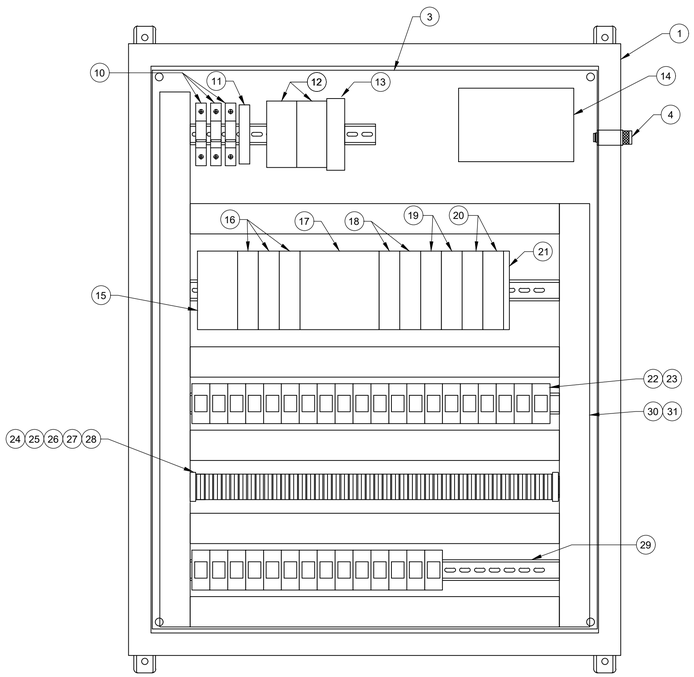
FINAL SUBMITTAL



CONTROL PANEL - ELEVATION
NOT TO SCALE



CONTROL PANEL - INNER-DOOR ELEVATION
NOT TO SCALE



CONTROL PANEL - SUB-PANEL LAYOUT
NOT TO SCALE

CONTROL PANEL PARTS LIST

ITEM #	QUANTITY	MANUFACTURER	PART NUMBER	DESCRIPTION
1	1	HOFFMAN	UU1008030	ULTRX ENCLOSURE, NEMA 4X, 40x32x12 (40.35x32.48x12.64)
2	1	HOFFMAN	UU10080SP	ULTRX SWING-OUT PANEL
3	1	HOFFMAN	A40P30	BACK PLATE, 37 x 29
4	1	POLYPHASER	IS-B50LN-C2	ANTENNA SURGE PROTECTION, 50 kA, 125-1000 MHz
5	1	ALLEN-BRADLEY	800FP-P4PN5R	PILOT LIGHT, RED, 22.5mm
6	1	ALLEN-BRADLEY	800FP-SM32PX41	SELECTOR SWITCH, 3 POS, MAINTAINED, NON-ILLUMINATED
7	1	ALLEN-BRADLEY	27110-B10C4B1	PANELVIEW PLUS 1000 TOUCHSCREEN, 10.4" 640X480 24 BIT COLOR, ETHERNET PORT
8	1	ALLEN-BRADLEY	2711P-RDT12H	HIGH BRIGHT DISPLAY MODULE
9	1	ALLEN-BRADLEY	2711P-RGT12	ANTI-GLARE OVERLAY
10	3	ABB	5201-K15	CIRCUIT BREAKER, 1 POLE, 480Y/277 VAC, UL489 LISTED
11	1	PHOENIX CONTACT	2907918	SURGE PROTECTION, TYPE 2/TYPE 3, 120VAC
12	2	PHOENIX CONTACT	2938730	POWER SUPPLY, 24VDC, 2A, MINI-PS-100-240AC/24DC/2
13	1	PHOENIX CONTACT	2891152	INDUSTRIAL ETHERNET SWITCH, FL SWITCH SFN 5TX 5TP RJ45 PORTS
14	1	GE/MDS	MXNXU91NNNNNNS1FSDUNN	ORBIT MCR-900 WIRELESS ROUTER
15	1	ALLEN-BRADLEY	1769-L35E	MODULAR COMPACTLOGIX CONTROLLER, 1.5MB RAM, 1 ETHERNET/IP PORT, 1 RS-232 PORT (DF1 OR ASCII)
16	3	ALLEN-BRADLEY	1769-IF8	8 CHANNEL ANALOG INPUT MODULE
17	1	ALLEN-BRADLEY	1769-PA2	1769 COMPACT I/O POWER SUPPLY
18	2	ALLEN-BRADLEY	1769-OF8C	8 CHANNEL ANALOG OUTPUT MODULE
19	2	ALLEN-BRADLEY	1769-IA16	16 POINT AC DIGITAL INPUT MODULE, 100/120 VAC
20	2	ALLEN-BRADLEY	1769-OW16	16 POINT DRY CONTACT OUTPUT MODULE, 5-265 VAC
21	1	ALLEN-BRADLEY	1769-ECR	RIGHT END CAP/TERMINATOR
22	34	IDEC	RH2B-UAC120V	RELAY
23	34	IDEC	SH2B-05	RELAY SOCKET
24	AS REQUIRED	PHOENIX CONTACT	3004362	TERMINAL BLOCK, 6.2mm WIDE, 30-10AWG, GRAY, UK 5 N
25	AS REQUIRED	PHOENIX CONTACT	0800886	END BRACKET, 9.5mm WIDE, GRAY, E/NS 35 N
26	AS REQUIRED	PHOENIX CONTACT	3003020	END BARRIER, COVER, 1.8mm WIDE, GRAY, D-UK 4/10
27	AS REQUIRED	PHOENIX CONTACT	3004100	TERMINAL FUSE BLOCK, 8.2mm WIDE, 26-10AWG, UK 5-HESI
28	AS REQUIRED	PHOENIX CONTACT	2775184	GROUND TERMINAL BLOCK, 6.2mm WIDE, GREEN-YELLOW, 24-10 AWG, UDK 4-PE
29	AS REQUIRED	ALLEN-BRADLEY	199-DR1	DIN RAIL
30	AS REQUIRED	THOMAS AND BETTS	T1X2HDG	WIREDUCT, 1" X 2", GRAY
31	AS REQUIRED	THOMAS AND BETTS	T1CG	WIREDUCT COVER, 1", GRAY

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

CONTROL PANEL

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

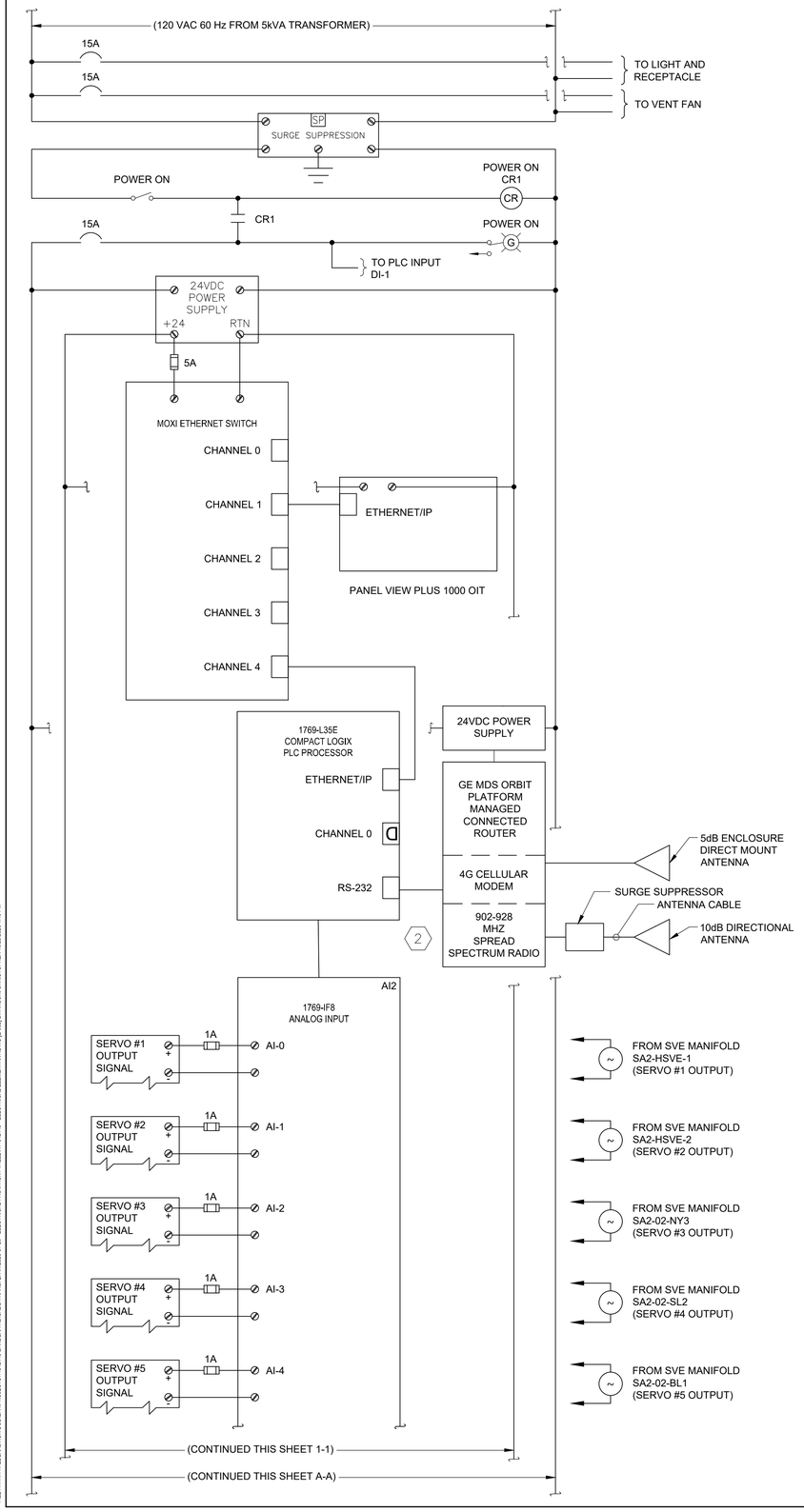
DATE: OCTOBER 2020

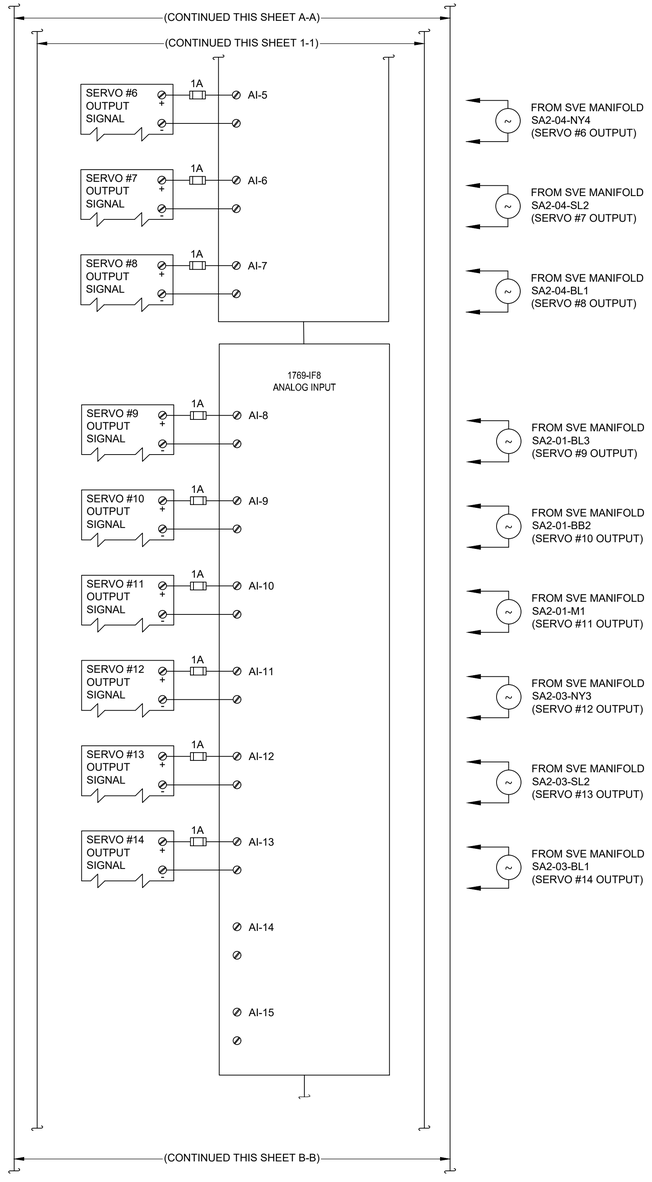
PROJECT NUMBER: 14342143

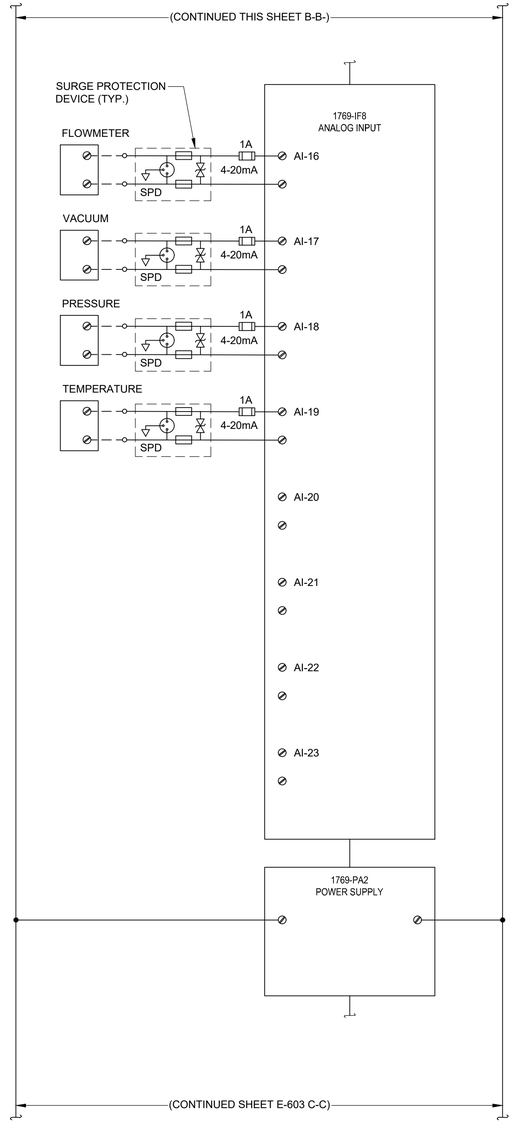
E-601

SHEET: 31 OF 34

FINAL SUBMITTAL







NOTES:

1. ELEMENTARY SHOWN IS FOR BOTH SAVINGS SQUARE AND PILGRIM. CONTROL SYSTEM AT THE TWO SITES ONLY DIFFER BY THE NUMBER OF WELLS; TWELVE AT SAVINGS SQUARE AND FOURTEEN AT PILGRIM.
2. ELEMENTARY SHOWN FOR PILGRIM. ELEMENTARY FOR SAVINGS SQUARE SIMILAR, EXCEPT SUBSTITUTE SA1-HSVE-1FOR SA2-HSVE-1, SA1-HSVE-2 FOR SA2-HSVE-2, SA1-03-NG4 FOR SA2-02-NY3, SA1-03-NY3 FOR SA2-02-SL2, SA1-03-SL2 FOR SA2-04-BL1, SA1-03-BL1 FOR SA2-04-NY3, SA1-02-NG4 FOR SA2-04-SL2, SA1-02-NY3 FOR SA2-04-BL1, SA1-02-SL2 FOR SA2-01-BL3, SA1-02-BL1 FOR SA2-01-BB2, SA1-01-BB2 FOR SA2-01-M1, AND SA1-01-BL1 FOR SA2-03-NY3; AND DELETE SA2-03-SL2 AND SA2-03-BL1.

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

CONTROL PANEL ELEMENTARY - 1

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-602

SHEET: 32 OF 34

FINAL SUBMITTAL

(CONTINUED SHEET E-602 C-C)

1769-0F8C
ANALOG OUTPUT

AO-0	1A	SERVO #1 INPUT SIGNAL
AO-1	1A	SERVO #2 INPUT SIGNAL
AO-2	1A	SERVO #3 INPUT SIGNAL
AO-3	1A	SERVO #4 INPUT SIGNAL
AO-4	1A	SERVO #5 INPUT SIGNAL
AO-5	1A	SERVO #6 INPUT SIGNAL
AO-6	1A	SERVO #7 INPUT SIGNAL
AO-7	1A	SERVO #8 INPUT SIGNAL

TO SVE MANIFOLD SA2-HSVE-1 (SERVO #1 INPUT)
TO SVE MANIFOLD SA2-HSVE-2 (SERVO #2 INPUT)
TO SVE MANIFOLD SA2-02-NY3 (SERVO #3 INPUT)
TO SVE MANIFOLD SA2-02-SL2 (SERVO #4 INPUT)
TO SVE MANIFOLD SA2-02-BL1 (SERVO #5 INPUT)
TO SVE MANIFOLD SA2-04-NY4 (SERVO #6 INPUT)
TO SVE MANIFOLD SA2-04-SL2 (SERVO #7 INPUT)
TO SVE MANIFOLD SA2-04-BL1 (SERVO #8 INPUT)

1769-0F8C
ANALOG OUTPUT

AO-8	1A	SERVO #9 INPUT SIGNAL
AO-9	1A	SERVO #10 INPUT SIGNAL
AO-10	1A	SERVO #11 INPUT SIGNAL
AO-11	1A	SERVO #12 INPUT SIGNAL
AO-12	1A	SERVO #13 INPUT SIGNAL
AO-13	1A	SERVO #14 INPUT SIGNAL
AO-14		
AO-15		

TO SVE MANIFOLD SA2-01-BL3 (SERVO #9 INPUT)
TO SVE MANIFOLD SA2-01-BB2 (SERVO #10 INPUT)
TO SVE MANIFOLD SA2-01-M1 (SERVO #11 INPUT)
TO SVE MANIFOLD SA2-03-NY3 (SERVO #12 INPUT)
TO SVE MANIFOLD SA2-03-SL2 (SERVO #13 INPUT)
TO SVE MANIFOLD SA2-03-BL1 (SERVO #14 INPUT)

(CONTINUED THIS SHEET D-D)

(CONTINUED THIS SHEET D-D)

1769-IA16
DIGITAL INPUT MODULE
DI0

FROM POWER ON SWITCH	0	
MS-1 HHLS	1	FROM MS-1 HHLS (HIGH-HIGH LEVEL)
MS-1 HLS	2	FROM MS-1 HLS (HIGH LEVEL)
MS-1 LLS	3	FROM MS-1 LLS (LOW LEVEL)
SURGE TANK HLS	4	FROM SURGE TANK HLS (HIGH LEVEL)
TP-1 HAND	5	FROM TP-1 CR33-1 (HAND)
TP-1 AUTO	6	FROM TP-1 CR34-1 (AUTO)
TP-1 M	7	FROM TP-1 M (RUNNING)
RB-1 HAND	8	FROM RB-1 CR43-1 (HAND)
RB-1 AUTO	9	FROM RB-1 CR44-1 (AUTO)
RB-1 M	10	FROM RB-1 M (RUNNING)
RB-1 CR42-1	11	FROM RB-1 CR42-1 (HIGH TEMPERATURE)
	12	
	13	
	14	
	15	AC COM

AC COM

(CONTINUED THIS SHEET E-E)

(CONTINUED THIS SHEET E-E)

1769-OW16
DIGITAL OUTPUT MODULE
DO0
120 VAC

0	SSVE-4 CR2	TO TP-1 CR2-1 (RUN TP-1)
1	SSVE-5 CR3	TO RB-1 CR3-1 (RUN RB-1)
2	SSVE-6 CR4	TO SSVE MANIFOLD CR4-1 (SA2-HSVE-1)
3	SSVE-7 CR5	TO SSVE MANIFOLD CR5-1 (SA2-HSVE-2)
4	SSVE-8 CR6	TO SSVE MANIFOLD CR6-1 (SA2-02-NY3)
5	SSVE-9 CR7	TO SSVE MANIFOLD CR7-1 (SA2-02-SL2)
6	SSVE-10 CR8	TO SSVE MANIFOLD CR8-1 (SA2-02-BL1)
7	SSVE-11 CR9	TO SSVE MANIFOLD CR9-1 (SA2-04-NY3)
8	SSVE-12 CR10	TO SSVE MANIFOLD CR10-1 (SA2-04-SL2)
9	SSVE-13 CR11	TO SSVE MANIFOLD CR11-1 (SA2-04-BL1)
10	SSVE-14 CR12	TO SSVE MANIFOLD CR12-1 (SA2-01-BL3)
11	SVE-1 CR13	TO SSVE MANIFOLD CR13-1 (SA2-01-BB2)
12	SVE-2 CR14	TO SSVE MANIFOLD CR14-1 (SA2-01-M1)
13	SVE-3 CR15	TO SSVE MANIFOLD CR15-1 (SA2-03-NY3)
14	SVE-4 CR16	TO SSVE MANIFOLD CR16-1 (SA2-03-SL2)
15	SVE-5 CR17	TO SSVE MANIFOLD CR17-1 (SA2-03-BL1)

(CONTINUED THIS SHEET F-F)

(CONTINUED THIS SHEET F-F)

1769-OW16
DIGITAL OUTPUT MODULE
DO1
120 VAC

0	SPARE
1	SPARE
2	SPARE
3	SPARE
4	SPARE
5	SPARE
6	SPARE
7	SPARE
8	SPARE
9	SPARE
10	SPARE
11	SPARE
12	SPARE
13	SPARE
14	SPARE
15	SPARE

NO.	DATE	BY	DESCRIPTION
			REVISIONS

SEAL

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

CONTROL PANEL ELEMENTARY - 2

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

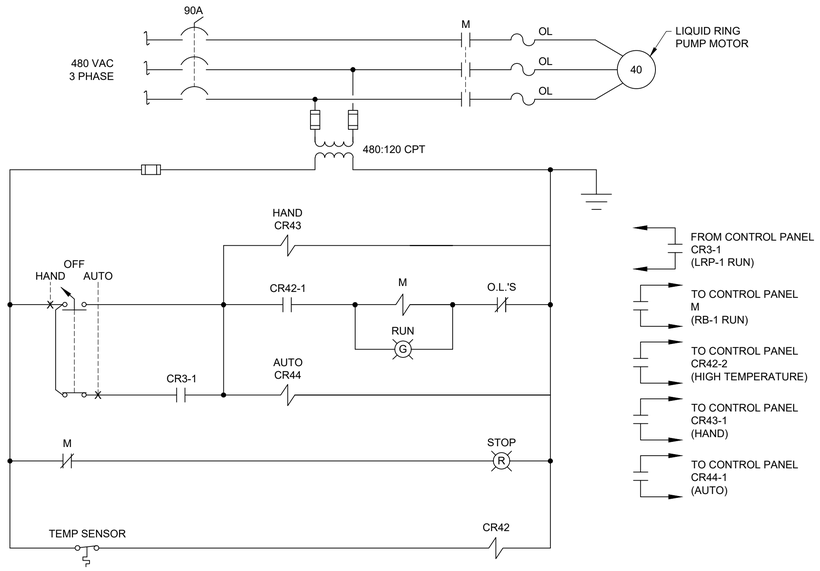
DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-603

SHEET: 33 OF 34

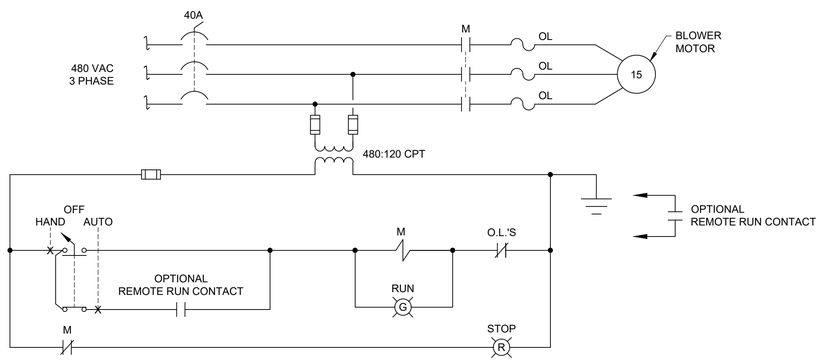
FINAL SUBMITTAL



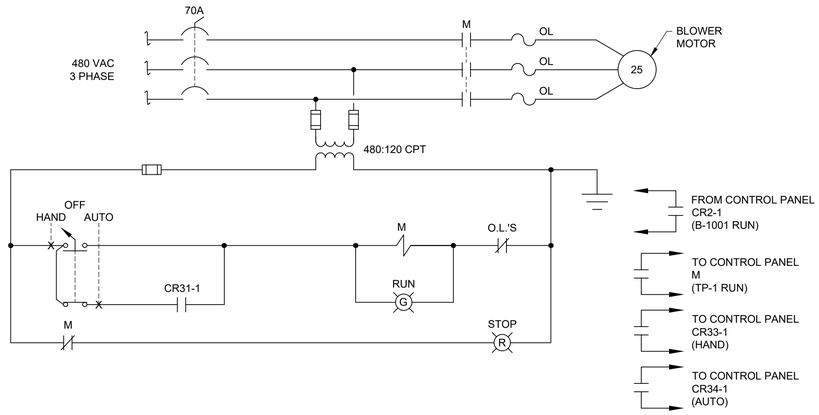
RB-1 REGENERATIVE BLOWER ELEMENTARY
NOT TO SCALE

RB-1 REGENERATIVE BLOWER ELEMENTARY NOTES:

1. ELECTRICAL FOR REGENERATIVE BLOWER RB-1 SIMILAR, EXCEPT SUBSTITUTE 10HP FOR 40HP, 25A CB FOR 90A CB, CR41 AND CR62 FOR CR42.



AIR COMPRESSOR ELEMENTARY
NOT TO SCALE



TP-1 TRANSFER PUMP ELEMENTARY
NOT TO SCALE

TP-1 TRANSFER PUMP ELEMENTARY NOTES:

1. ELECTRICAL FOR TRANSFER PUMP TP-2 SIMILAR, EXCEPT SUBSTITUTE CR61 FOR CR51.

REVISIONS

NO.	DATE	BY	DESCRIPTION

DESIGN INFORMATION
DESIGNED BY: AS/ DY
DRAWN BY: CNS/ JRM
CHECKED BY: AS
PROJECT MANAGER: PA

SEAL

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
REMEDIAL DESIGN
SOIL VAPOR EXTRACTION AND IN-SITU BIOREMEDIATION SYSTEMS
BEXAR COUNTY, TEXAS

ELEMENTARIES

PREPARED FOR:
EPA
REGION 6
DALLAS, TX
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

EA Engineering, Science, and Technology, Inc., PBC
405 State Highway 121 Bypass
Suite C-100
Lewisville, Texas 75067
(972) 315-3922
Texas PE Firm Registration No. F003896

DATE: OCTOBER 2020

PROJECT NUMBER: 14342143

E-604

SHEET: 34 OF 34

FINAL SUBMITTAL

Appendix B

Design Specifications

SOIL VAPOR EXTRACTION AND TREATMENT SYSTEM

BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE
BEXAR COUNTY, TEXAS

TECHNICAL SPECIFICATIONS

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SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contract description.
   2. Other Work at the Site.
   3. Contractor's use of Site.
   4. Specification conventions.

1.2 CONTRACT DESCRIPTION

A. Work of the Project is installation of a soil vapor extraction system. Work under this contract will include, but is not limited to the following:
   1. Site preparation
   2. Prepare Treatment system compound areas
   3. Install horizontal SVE wells
   4. Install SVE conveyance lines
   5. Provide treatment system enclosures (conex boxes)
   6. Install SVE treatment systems
      a. Rotary positive displacement blower
      b. Piping manifold
      c. Gauges, sensors and appurtenances
      d. Interconnection piping
      e. Monitoring and control system
      f. Air compressor
   7. Install vapor-phase granular activated carbon (GAC) treatment vessels
   8. Install 480V electrical service at the compound, including pole, service meter, and power supply enclosure
   9. Install and program monitoring and control system

1.3 CONTRACTOR'S USE OF SITE

A. Limit use of Site to allow Landowners to access their property and Tenants to maintain occupancy. Patron access to private businesses at the Site shall be maintained at all times and the Contractor shall not cause extended disruptions of tenant or patron access outside of the Construction Limits shown in the Drawings. Contractor shall limit use and movements to the areas designated in the Drawings.

B. Construction Operations:
   1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed before 7:00 a.m. or after 8:00 p.m.

C. Time Restrictions for Performing Work: Sunrise to Sunset.

D. Utility Outages and Shutdown:

1. Coordinate and schedule electrical and other utility outages with affected landowners or tenants.
2. Outages shall be allowed only at previously agreed upon times.

1.4 STORMWATER

A. If disturbed area, including material stockpiles, exceeds 1 acre, the Contractor shall comply with the requirements of the State of Texas Pollution Discharge Elimination System (TPDES) General Permit TXR150000 for construction storm water.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description.

B. Submittals.

C. Measurement.

D. Application for Payment

E. Change Procedures

F. Estimated Quantities

G. Defect assessment.

H. Measurement and Payment.

1.2 DESCRIPTION

A. The items listed in the Schedule of Values Form constitute all of the pay items for the completion of the Work. Compensation for all such services and materials shall be included in the prices stipulated for the lump sum and unit price pay items listed in the Schedule of Values Form. Items of Work not specifically included in the Schedule of Values Form for measurement and payment will not be measured for payment, but will be considered subsidiary to the cost of the related work items. Minor items and incidentals necessary to complete the work in a workman-like manner and provide complete, serviceable facilities shall be included in the sum of the work items and furnished even if not specifically called for in the Drawings and Specifications.

1.3 SUBMITTALS

A. The Contractor shall submit to the Engineer a completed Schedule of Values Form including unit prices for each bid item.
   1. Include within each line item overhead, profit, bid bond, and all other expenses that are expected to be incurred.
   2. Bids that deviate from the Schedule of Values format or leave items blank may be considered non-responsive.
   3. This Schedule of Values Form shall be used as the basis for the Contractor's Application for Payments.

1.4 MEASUREMENT

A. Measurement shall be in accordance with the Schedule of Values Form items as described in this Section. The Contractor is responsible for constructing the project to the final lines and grades

shown. Engineer will measure construction units only to ensure that at least minimum quantities have been properly installed. The quantities listed in the Schedule of Values Form shall not be exceeded unless pre-approved by the engineer and supported with detailed documentation.

1. Lump Sum Price Items
   a. Measurement of lump sum priced items will be based on percent complete for the item.
2. Unit Price Items
   a. Measurement of unit price items will be based on percent complete of quantities listed in the Bid Form.

B. Measurement of Quantities:
   1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
   2. Measurement by Volume: Measured by cubic dimension using survey data and a computer-aided design software package.
   3. Measurement by Area: Measured by square dimension using survey data and a computer-aided design software package.
   4. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
   5. Lump Sum: Measured by percent complete of work completed.
   6. Daily or Hourly: Measured by onsite time, of work conducted in accordance with Contract Documents, documented by Contractor and verified by Engineer
   7. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the work.

C. Unit Quantities: Quantities and measurements indicated on Schedule of Values Form are for Contract bidding purposes only. Quantities and measurements supplied or placed in the Work shall determine payment.
   1. When actual Work amounts to greater or lesser quantities than those quantities indicated on the Schedule of Values Form, provide those actual Work amounts at contracted unit prices.
   2. When actual Work quantity is 25 percent more or less than the Schedule of Values Form quantity for a bid item, Engineer or Contractor may claim a Contract Price adjustment and the two parties shall renegotiate the unit price of that bid item.

D. Measurement of Quantities:
   1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year.
   2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
   3. Metering Devices: Inspected, tested, and certified by applicable State department within past year.
   4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
   5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
   6. Measurement by Area: Measured by square dimension using mean length and width or radius.
   7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
   8. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.5 APPLICATION FOR PAYMENT

A. Submit electronic copy of each Application for Payment to the Engineer.

B. Content and Format: Use Schedule of Values for listing items in Application for Payment. Revise schedule to reflect approved Change Orders with each Application for Payment.

C. Submit an updated construction schedule with each Application for Payment.

D. Payment Period: Monthly. The Engineer will provide closing dates.

E. Submit Application for Payment with a transmittal letter as specified in Section 01 33 00 - Submittal Procedures.

F. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Partial release of liens from major Subcontractors and vendors.
   2. Record Documents as specified in Section [01 70 00 - Execution and Closeout Requirements], for review by Engineer, which will be returned to Contractor.
   3. Affidavits attesting to off-site stored products.

G. Payment for Unit Price items will be made at the Contract Unit Price given in the Schedule of Values Form.

H. Payment for Lump Sum items will be made at the Contract Lump Sum Price given in the Schedule of Values Form.

I. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.

J. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit price for Work incorporated in or made necessary by the Work.

K. No payment shall be made for work performed by the Contractor to replace defective work, work which is not required by the Contract Documents, work outside the limits of the contract and additional work necessary due to actions of the Contractor, unless ordered by the Engineer in writing.

L. Items of Work not specifically included in this Section for measurement and payment as described herein will not be measured for payment, but will be considered subsidiary to the cost of the related work items. Minor items and incidentals necessary to complete the work in a workman-like manner and provide complete, serviceable facilities shall be included in the sum of the work items and furnished even if not specifically called for in the Drawings and Specifications.

M. Final payment for work governed by unit prices will be made on basis of actual measurements and quantities accepted by Owner multiplied by unit sum/price for work incorporated in or made necessary by the work.

1.6 CHANGE PROCEDURES

A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.

C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
   1. Submit RFIs through Primavera Contract Manager for requesting interpretations.
   2. Engineer will respond through Primavera Contract Manager.

D. Engineer will advise Contractor of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

E. Engineer may issue Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and Specifications and possibly a change in Contract Time for executing the change.

F. Contractor may propose changes by submitting RFI to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation.

G. Force Account Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

H. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.

I. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

J. Correlation of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Incorporate changes in the next scheduled update of the Progress Schedules to reflect change in Contract Time and revise subschedules to adjust times for other items of Work affected by the change.
   3. Promptly enter changes in Record Documents.

1.7 ESTIMATED QUANTITIES

A. Various estimated quantities are furnished within the Contract Documents to assist the Contractor in reviewing the Project prior to bidding. The estimated quantities are not intended to be used by the Contractor as the sole basis for determining the scope and volume of the work. The Contractor

is responsible for verifying all quantities necessary to submit bids for the construction of a proper and complete project.

1.8 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, at Engineer's discretion, but unit sum/price may be reduced as much as 50 percent, at discretion of Engineer.

D. Defective Work will be partially repaired if the Engineer so directs, and unit sum/price may be reduced as much as 25 percent at discretion of Engineer.

E. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Engineer to assess defects and identify payment adjustments is final.

G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from transporting vehicle.
4. Products placed beyond lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.

1. Promptly enter changes in Record Documents.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance.

B. Product options.

C. Product substitution procedures.

1.2 QUALITY ASSURANCE

A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.

B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.

C. Substitution proposals are permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Engineer.

1.3 PRODUCT OPTIONS

A. See Section 01 60 00 - Product Requirements.

1.4 PRODUCT SUBSTITUTION PROCEDURES

A. Engineer will consider requests for substitutions only within 30 days after Notice to Proceed.

B. Substitutions may also be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
   1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
   2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
   3. Reference to Article and Paragraph numbers in Specification Section.
   4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
   5. Changes required in other Work.
   6. Availability of maintenance service and source of replacement parts as applicable.
   7. Certified test data to show compliance with performance characteristics specified.
   8. Samples when applicable or requested.

9. Other information as necessary to assist Engineer's evaluation.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for substitution as for specified product.
   3. Waives claims for additional costs or time extension that may subsequently become apparent.
   4. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete, with no additional cost to Engineer.
   5. Will reimburse Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.
   6. That material is in compliance with Buy American Act provisions included in the contract by way of contract flow down clauses.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request. The Engineer may choose not to consider substitutions when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit electronic files through Primavera Contract Manager of Request for Substitution. Limit each request to one proposed substitution.
   2. Submit information required in Paragraph 1.4.C, above. Burden of proof is on proposer.
   3. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Pre-Construction meeting

B. Progress meetings

C. Pre-Installation meetings

D. Project Website

1.2 PRE-CONSTRUCTION MEETING

A. The Engineer will schedule and preside over meeting after Notice of Award.

B. Attendance Required: Engineer, Contractor, major Subcontractors.

C. Minimum Agenda:
1. Submission of executed bonds and insurance certificates
2. Distribution of Contract Documents
3. Review permit requirements and conditions
4. Submission of list of Subcontractors, list of products, and schedule
5. Designation of personnel representing Contractor
6. Communication procedures
7. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures
8. Critical work sequencing
9. Scheduling activities of sample collection and analysis
10. Temporary utilities provided by Contractor
11. Security and housekeeping procedures
12. Procedures for maintaining record documents

D. Contractor shall record minutes and distribute draft minutes to participants within four days after meeting.

1.3 PROGRESS MEETINGS

A. Contractor shall schedule and administer meetings throughout progress of the Work at weekly intervals.

B. Contractor shall make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.

C. Minimum Agenda:
1. Review minutes of previous meetings
2. Health and Safety
3. Review of Work progress

4. Review of daily reports
5. Review of quality control actions and issues
6. Field observations, problems, and decisions
7. Identification of problems impeding planned progress
8. Review of submittal schedule and status of submittals
9. Review of off-Site fabrication and delivery schedules
10. Maintenance of Progress Schedule
11. Corrective measures to regain projected schedules
12. Planned progress during succeeding Work period
13. Coordination of projected progress
14. Maintenance of quality and Work standards
15. Effect of proposed changes on Progress Schedule and coordination
16. Other business relating to Work

D. Contractor shall record minutes and distribute them to meeting participants within two days after meeting.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals.

B. Bar chart schedules.

C. Review and evaluation.

D. Updating schedules.

E. Schedule Recovery.

1.2 SUBMITTALS

A. Within 10 days after Notice to Proceed**,** submit proposed construction schedule to the Engineer.

B. Submit updated schedules every 14 days and with each Application for Payment.

C. Schedule Updates:
1. Overall percent complete, projected and actual.
2. Completion progress by listed activity and subactivity, to within five working days prior to submittal.
3. Changes in Work scope and activities modified since previous schedule submittal.
4. Delays in submittals or resubmittals, deliveries, or Work.
5. Adjusted or modified sequences of Work.
6. Other identifiable changes.
7. Revised projections of progress and completion.

1.3 BAR CHART SCHEDULES

A. Format: Bar chart Schedule, to include at least:
1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:

a. Subcontract Work.
b. Major equipment design, fabrication, factory testing, and delivery dates including required lead times.
c. Move-in and other preliminary activities.
d. Equipment and equipment system test and startup activities.
e. Project closeout and cleanup.
f. Work sequences, constraints, and milestones.

2. Listings identified by Specification Section number.
3. Identification of the following:

a. Horizontal time frame by year, month, and week.
b. Duration, early start, and completion for each activity and subactivity.
c. Critical activities and Project float.
d. Subschedules to further define critical portions of Work.

1.4 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of schedules with Engineer at each submittal.

B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.

1.5 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.

C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

D. Upon approval of a Change Order, include the change in the next schedule submittal.

E. Indicate changes required to maintain Date of Substantial Completion.

1.6 SCHEDULE RECOVERY

A. If schedule update projects a completion date for the project later than the approved contract completion date, and if requested by the Engineer, the Contractor shall submit a Time Impact Analysis (TIA) within 7 calendar days. The TIA shall include:
1. Impact schedule
2. A detailed plan outlining efforts needed to complete the project by the approved contract completion date, or
3. An explanation as to why additional time is warranted.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Definitions.

B. Submittal procedures.

C. Construction progress schedules.

D. Proposed product list.

E. Product data.

F. Use of electronic CAD files of Project Drawings.

G. Shop Drawings.

H. Samples.

I. Other submittals.

J. Test reports.

K. Certificates.

L. Manufacturer's instructions.

M. Manufacturer's field reports.

N. Erection Drawings.

O. Construction photographs.

P. Contractor review.

Q. Engineer review.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action.

1.3 SUBMITTAL PROCEDURES

A. Transmit each submittal through secure means to Engineer.

B. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.

C. Contractor shall certify that review, approval, verification of products required, verification of field dimensions, and coordination of information is according to requirements of the Work and Contract Documents.

D. Schedule submittals to expedite Project. Coordinate submission of related items.

E. For each submittal for review, allow 21 calendar days for acceptance.

F. Identify product or system limitations that may be detrimental to successful performance of completed Work.

G. When a submittal is revised for resubmission, identify changes made since previous submission.

H. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

I. Submittals not specified or requested may not be recognized or processed, at Engineer's discretion.

J. Incomplete Submittals: Engineer may opt to not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Comply with Section 01 32 16 - Construction Progress Schedule

1.5 PROPOSED PRODUCT LIST

A. Within 15 calendar days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.6 PRODUCT DATA

A. Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.7 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

1.8 SHOP DRAWINGS

A. Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
1. Include signed and sealed calculations to support design.
2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.9 SAMPLES

A. Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:
   1. Submit to Engineer for aesthetic, color, and finish selection.
   2. Submit Samples of finishes, textures, and patterns for Engineer selection.

C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

D. Include identification on each Sample, with full Project information.

E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.

F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

1.10 OTHER SUBMITTALS

A. Closeout Submittals: Comply with Section 01 70 00 - Execution and Closeout Requirements.

B. Informational Submittal: Submit data for Engineer's knowledge.

C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge.

B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.12 CERTIFICATES

A. Informational Submittal: Submit certification by manufacturer, installation or application Subcontractor, or Contractor to Engineer.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.13 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer.

C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge.

B. Submit report within 5 days of observation to Engineer for information.

C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.15 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge.

B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.

C. Submittals indicating inappropriate or unacceptable Work may be subject to action by Engineer.

1.16 CONSTRUCTION PHOTOGRAPHS

A. Provide photographs of Site and construction throughout progress of Work.

B. Digital Images: Deliver complete set of digital image electronic files on CD-ROM to Engineer with Project record documents. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as sensor, uncropped.
   1. Digital Images: Uncompressed files, produced by digital camera with minimum sensor size of 12.0 megapixels, and image resolution of not less than 4290 x 2800 pixels.
   2. Date and Time: Include date and time in filename for each image.

1.17 CONTRACTOR REVIEW

A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.

B. Contractor shall be responsible for:
   1. Determination and verification of materials including manufacturer's catalog numbers.
   2. Determination and verification of field measurements and field construction criteria.
   3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
   4. Determination of accuracy and completeness of dimensions and quantities.
   5. Confirmation and coordination of dimensions and field conditions at Site.
   6. Construction means, techniques, sequences, and procedures.
   7. Safety precautions.
   8. Coordination and performance of Work of all trades.

C. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.18 ENGINEER REVIEW

A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Contractor.

B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and may not be reviewed or returned with comment.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Contract Modification.

E. Engineer may withhold money due to Contractor to cover additional costs for reviews beyond the second submittal review.

F. Contractor’s submittals will be returned marked with one of the following classifications:
   1. Code A (Approved)-No corrections, no marks.
   2. Code B (Approved as Noted)-A few minor corrections or notes to Contractor. Contractor shall complete work in accordance with corrections or notes. All items may be fabricated as marked without further resubmission.
   3. Code C (Revise and Resubmit)- Minor corrections. Items not noted to be revised and corrected may be fabricated. Resubmit items as per original submissions with corrections noted.
   4. Code X (Not Approved)-Requires correction or is otherwise not in accordance with contract documents. No items shall be fabricated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 35 29.13 – HEALTH, SAFETY, & EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES

PART 1 GENERAL

1.1 The site is part of the Bandera Road Ground Water Plume Superfund Site. The Contractor must develop a site-specific Health and Safety Plan (HSP) that describes health, safety, emergency preparedness, and response requirements for the Contractor (including Subcontractors) performing the Work. The responsibility for the development, implementation, and enforcement of a documented health and safety program lies with the Contractor and the Contractor's health and safety staff. The health and safety program must clearly identify, evaluate, and describe procedures to control health and safety hazards, and describe emergency response procedures for remedial action activities. The Contractor is responsible for ensuring full compliance with all applicable portions of 29 Code of Federal Regulations (CFR) 1910, 29 CFR 1926, and any federal, state, or local health and safety requirements.

1.2 SUBMITTALS

A. At least 20 calendar days prior to any work at the site, the following items must be submitted for review and approval:
   1. Site Specific Health and Safety Plan (HSP)
   2. 40 Hours Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations (HAZWOPER) certificates
   3. 8 Hours Refresher Training certificates
   4. 8 Hours Supervisor Training certificates
   5. First aid and cardiopulmonary resuscitation (CPR) certificate/cards
   6. Physician's certification for each onsite employee

B. Within 24 hours of data receipt, the following records must be submitted to the Engineer:
   1. Personal air monitoring records

1.3 REFERENCES

A. 29 CFR 1910 Occupational Safety and Health Standards

B. 29 CFR 1926 Safety and Health Regulations for Construction

C. NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

D. Interim Standard Operating Safety Guides (EPA, November 1984)

E. Texas Administrative Code (TAC) Title 30, Part 1, Chapter 106, Subchapter X, Rule 106.533

1.4 HEALTH AND SAFETY PLAN REQUIREMENTS

A. The Contractor shall develop and submit a detailed site-specific HSP. Revisions to the HSP may be required during the execution of the project. All revisions to the HSP shall be submitted to the

Engineer. In addition, the Contractor shall make corrections and amendments to the HSP that are mutually agreed upon by the Contractor and the Engineer. The review of the HSP by the Engineer will only be to ascertain that all necessary elements are included. Full responsibility for developing and implementing the health and safety program at the work area is the responsibility of the Contractor. The Engineer will provide the Engineer's HSP to the Contractor for reference.

B. The Contractor must ensure that all personnel, equipment, and procedures are in compliance with the provisions of the HSP during all activities at the work area.

C. At a minimum, the HSP shall address the following topics:
1. Project description
2. Health and safety program responsibilities
3. Medical surveillance
4. Employee training and qualifications
5. Project task hazard analysis
6. Site control measures
7. Personal protection requirements and methods
8. Monitoring requirements
9. Personnel and equipment decontamination
10. Contingency plan

1.5 PROJECT DESCRIPTION

A. The HSP shall include a brief description of this remedial action project. The project description shall include an overview of the property and the general types of health and safety considerations at the work area.

1.6 HEALTH AND SAFETY PROGRAM RESPONSIBILITIES

A. The Contractor shall, at a minimum, designate by name and title personnel with responsibility to carry out the site-specific HSP and continuously implement the Contractor's written health and safety program. The Contractor's designated health and safety responsible persons shall not be changed following the submittal of the HSP without written approval of the Engineer. The Contractor's organizational structure, establishing a chain of command for personnel responsible for implementing the HSP, shall be included with the submittal. The Contractor shall designate personnel with the following responsibilities:
1. Overall preparation, implementation, and enforcement of the HSP
2. Coordination of the medical surveillance program
3. Performance of the task hazard analysis
4. Direction or supervision of the employee training program
5. Coordination of the development of the personnel air monitoring program
6. Day-to-day functional responsibility for the implementation and enforcement of the HSP
7. Periodic onsite supervision and continued evaluation of the effectiveness of the plans and their implementation and enforcement
8. Authority to act on all health and safety measures and establish new controls as needed
9. Authority to suspend work activities, if the health and safety of personnel are endangered, and to temporarily, or permanently, suspend an individual from field activities for infractions of the HSP.

1.7 MEDICAL SURVEILLANCE

A. The HSP must show how the Contractor will comply with the medical surveillance requirements of OSHA (1910.120(f)). Medical Surveillance requirements must be identified in the HSP. The HSP must address how the Contractor will meet these requirements, which include, but are not necessarily limited to, the following:
   1. The Occupational Physician must certify, in writing, that all Contractor personnel required to wear a respirator are medically qualified to do so.
   2. All medical surveillance records of personnel which are required under the HSP must be maintained by the Contractor in compliance with 29 CFR 1910.20, "Access to Employee Exposure and Medical Records."
   3. Any Contractor employee who develops a work-related lost time illness or injury must be evaluated by a physician before the employee can be readmitted to the work area. Any work-related lost time illness or injury must be verbally reported to the Engineer within 24 hours of the occurrence of any such illness or injury. A written description of any work-related lost time illness or injury must be included on an Accident Report Form. A copy of the physicians return to work form must be submitted to the Engineer prior to the employee is allowed to return to work.

1.8 EMPLOYEE TRAINING AND QUALIFICATIONS

A. The HSP must include documentation of Health and Safety training, in accordance with 29 CFR 1910.120(e), to all onsite workers, including supervisory personnel, who may be exposed to onsite hazardous substances, health hazards, or safety hazards. The training must be provided before personnel are permitted to engage in work area operations that could expose them to hazardous substances. At a minimum, the following training will be required:
   1. 40-Hour Training—Contractor personnel requiring 40-hour HAZWOPER worker training include equipment operators, general laborers, and supervisory personnel. These workers are regularly onsite and engaged in work area operations that could expose them to hazardous substances.
   2. Supervisor Training—An individual qualified to supervise the activities of the Contractor's employees must be present in the work area during the remedial action. The Contractor's supervisory personnel and personnel providing health and safety oversight must have an additional 8-hour HAZWOPER supervisor's training.
   3. 24-Hour Training—A minimum of 24 hours of training is required for general site workers regularly onsite who work in areas where:
      a) Exposures will be under permissible or published exposure limits
      b) Respirators will not be necessary
      c) Health hazards are not present
      d) There is no possibility of an emergency developing
      e) Workers onsite occasionally for a specific limited task and who are unlikely to be exposed over permissible exposure limits can also have 24-hour training. Workers receiving this level of training will not be permitted in the exclusion zone
   4. On-the-Job Training—A minimum of 24 hours of on-the-job training must be provided for each employee in conference with the requirements of 29 CFR 1910.120(e). Field experience may be gained during onsite activities under the direct supervision of a qualified supervisor.
   5. Annual 8-Hour Refresher Training—Applicable Contractor personnel must complete an 8-Hour refresher course annually in accordance with 29 CFR 1920.120(e).

6. Excavation Competent Person Training—In accordance with 29 CFR 1926 Subpart P, the Contractor shall have an individual certified in OSHA Excavation Competent Person Training at the work area to supervise excavation activities conducted by the Contractor.
7. Tailgate Safety Training—See Part 3.1.G.
8. Visitor Training—The Contractor must define the extent of training that visitors to the work area will receive prior to gaining access to the work area.

B. Documentation of training shall include:
1. Certification by the training instructor that personnel have successfully completed the necessary training courses
2. Copies of certificates for OSHA 40-hour, 8-hour Refresher, 8-hour Supervisor, Excavation Competent Person, or other site specific training for all Contractor personnel who will enter the exclusion zone
3. Contractor employee training records required by OSHA must be maintained by the Contractor until site closure or until 3 years from the date the employee last worked onsite, whichever occurs first.

C. The Contractor shall retain the following personnel or their equivalent as part of the project health and safety team. Resumes, certifications, and documentation of training for each shall be included in the HSP.
1. A Health and Safety Officer (HSO) with a minimum of 5 years of total industrial hygiene experience, with a minimum of 2 years of pertinent experience in construction with hazards similar to those anticipated on this project. The HSO shall have formal training in occupational safety and health and a broad working knowledge of both Federal and State occupational safety and health regulations. The HSO shall provide guidance to the SSO and approve the HSP and any modifications to the HSP.
2. A Site Safety Officer (SSO) with a minimum of 2 years of experience in construction and a sound working knowledge of both Federal and State occupational safety and health regulations. The SSO or his alternate shall be onsite during all construction activities. The SSO shall be responsible for implementing the HSP, conducting daily Tailgate Safety Meetings, and monitoring Contractor safety.
3. An Alternate Site Safety Officer (Alternate SSO) to fulfill the duties of the SSO when the SSO is not onsite. The Alternate SSO position may be filled by someone who has other project responsibilities, such as a shift supervisor, chief operator, etc.
4. One or more Occupational Physicians for medical surveillance secured by the Contractor. The Occupational Physician(s) must be responsible for performing medical surveillance functions required by the HSP.

1.9 PROJECT TASK HAZARD ANALYSIS

A. The Contractor shall perform a project task hazard analysis to identify any health and safety hazards that may be incurred in performing the work. Hazards shall be identified based on the specific technical approach proposed by the Contractor for performing various elements of the work. Work procedures for mitigating hazards shall be prepared for all tasks for which potential safety hazards are identified and/or for all tasks that involved subsurface-intrusive activities. The HSP shall comply with the latest OSHA confined space entry and lock-out/tag-out procedures.

1.10 SITE CONTROL MEASURES

A. The Contractor must establish a site control program that is to be included in the HSP. The site control program must define the various work zones and categories of personnel who will have access to various work zones.
   1. Dust suppression must be implemented immediately to control visible dust emissions. Dust suppression techniques and procedures to be implemented must be included in the HSP.
   2. Odor suppression must be implemented immediately to control odors detected at the site perimeter. Odor suppression techniques and procedures to be implemented must be included in the HSP.
   3. Work zones must be delineated by the Contractor to control the flow of personnel and equipment and to reduce the potential for the spread of contaminated soil and debris from contaminated areas to clean areas. The establishment of work zones must ensure that personnel are properly protected where they are working, that work activities and contamination are confined to the appropriate areas, and the personnel can be located and evacuated in an emergency.
   4. The HSP must define work zones and have provisions for establishing the boundaries of each work zone. The HSP must include detailed drawings of the Site that identify the boundaries of each work zone. Persons entering each of these zones must comply with the applicable personal protective equipment, medical surveillance, and training requirements described in the HSP. The Contractor must clearly and physically mark and identify each work zone.
   5. The onsite control program must include the use of the "buddy system," communications and mechanism for alerting personnel of emergencies, use of standard operating procedures or safe working practices, and the identification of the nearest medical assistance. Wherever practical, the Contractor may reference other portions of the HSP that satisfy these requirements.

1.11 PERSONAL PROTECTION REQUIREMENTS AND METHODS

A. The HSP must specify levels of personal protection to be required and utilized during remediation activities. The selection of appropriate personal protective equipment (PPE) during activities and within each work zone must be determined by the Contractor and must be in accordance with OSHA regulations (29 CFR Part 1910.120). The HSP must include minimal equipment requirements for personal protection as described in publications such as the Interim Standard Operating Safety Guides (EPA, November 1984) and the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (NIOSH/OSHA/USCG/EPA, October 1985).
   1. The HSP must define minimum PPE requirements that cannot be reduced unless the Contractor's air monitoring or other data support a chance in protection level. A description of levels of protection and the PPE required for each level must be included in the HSP. Methods of monitoring and defining the appropriate levels of the protection must be included in the HSP. The Contractor shall describe in the HSP the coordination between the SSO and the HSO of any PPE downgrades or upgrades. The Contractor must define the appropriate PPE to be used for each work activity at the work area. The Contractor must ensure that appropriate PPE is being used in the exclusion zones(s) and the contamination reduction zone(s).
   2. To ensure that the appropriate PPE is available for use, the Contractor must include a list of PPE available and a description of its proper use in the HSP.
   3. The Contractor must perform all work during the project at the appropriate level of protection for workers defined in the HSP. No claims for extra payment for equipment,

material, or loss of productivity will be allowed because of PPE requirements, other than those considerations defined in Section 01 20 00 – Price and Payment Procedures.

1.12 MONITORING REQUIREMENTS

A. A description of the monitoring techniques and equipment must be included in the HSP. Monitoring must, at a minimum, meet the requirements of 29 CFR 1910.120. Monitoring must be conducted to evaluate the following hazards:
   1. Total suspended particulate
   2. Airborne constituents of concern (COCs)
   3. Volatile organic compounds (VOCs)
   4. Heat Stress
   5. Noise
   6. Other hazards identified in the task hazard analysis described in Section 1.9.

B. The Contractor must design, implement, and oversee an air monitoring program for work areas and for personnel. Data from the air monitoring program will be used to make decisions regarding worker protective measures, routine work procedures, and appropriate responses to emergency events. An air monitoring plan that contains the following elements must be prepared as a component of the HSP:
   1. Personnel air sampling
   2. Air sampling equipment
   3. Air sampling methods and procedures
   4. Action levels and responses
   5. Air sampling equipment calibration procedures and frequencies
   6. Air sampling equipment maintenance procedures and frequencies.

C. Results from the Contractor's air monitoring program must be compared with action levels consistent with OSHA guidance in order to protect worker health and safety at the time of field work. These action levels must be specified in the HSP and the selection of the appropriate level of protection should be based on sustained airborne exposure levels. The HSP must define the actions required if these action levels are exceeded. All air monitoring data records must be maintained by the Contractor. Reports of the area and personnel air monitoring results must be transmitted to the Engineer.

1.13 PERSONNEL AND EQUIPMENT DECONTAMINATION

A. The HSP must describe implementation of the following responsibilities of the Contractor:
   1. Provide and maintain decontamination facilities for personnel and equipment. Personnel decontamination stations must be positioned at each exclusion zone exit.
   2. Provide all respirators required by the Contractor's staff. All respirators must be cleaned and inspected in accordance with manufacturer's recommendations. The HSP must describe procedures for performing daily maintenance in accordance with the appropriate OSHA standards (29CFR 1920.134).
   3. All disposable PPE and other contaminated materials generated by personnel decontamination must be placed in containers for temporary storage in a designated area at the work area. Containers must be labeled to identify their contents and be sealed. All used PPE and containers used for storing PPE must be disposed of offsite. Documentation of storage and disposal of used PPE must be submitted to the Engineer.

4. Personnel decontamination facilities and equipment decontamination facilities must be described in detail and their layout shown in the HSP. Wastewater disposal from the personnel and equipment decontamination facilities must comply with federal, state, and local requirements. Documentation of storage and disposal of decontamination wastewater must be submitted to the Engineer.

1.14 EMERGENCY RESPONSE/CONTINGENCY PLAN

A. The Contractor must develop and implement an emergency response/contingency plan in accordance with the requirements of 29 CFR 1910.120(l) that describes the appropriate actions project personnel in the event of an emergency such as fire, explosion, or spill/release of hazardous constituents. The following requirements shall be included and/or incorporated by reference into the HSP:
   1. Provide appropriate emergency response equipment
   2. Provide a supply list in the works area of onsite emergency equipment and equipment available from local emergency response agencies
   3. Specify the chain of command by name and title
   4. Specify equipment and signals to be used to notify site personnel of an emergency
   5. Specify emergency response actions
   6. Provide descriptions and maps of routes to local hospitals with emergency services or nearest trauma center
   7. Describe plans for coordination with local emergency response agencies
   8. Provide employees emergency response plan training
   9. Specify by name and title the emergency coordinators and alternates, including telephone/pager, numbers for 24-hour/day coverage and the authority of the emergency coordinators to commit resources and direct emergency actions
   10. Identify the physical location of the plan onsite during operations
   11. List local emergency response agencies and telephone numbers
   12. Specify emergency equipment and supply inspection frequency (i.e., good condition, ready to use, and easily accessible)
   13. Accident/incident reporting program

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXECUTION

A. Conduct operations in accordance with the site-specific HSP. The Contractor is solely responsible for the safety of his personnel.
B. Take action to establish and maintain safe working conditions and to safeguard employees, the public, and the environment.
C. If an unforeseen or facility specific, safety related factor, hazard, or condition become evident during the performance of the work, the Contractor shall notify the Engineer immediately.

D. In the event of any safety related incident associated with the remedial action, the Contractor shall (1) take action to remove or otherwise minimize the cause of the incident, (2) alert the Engineer, and (3) institute measures to prevent repetition of the conditions or actions leading to or resulting in the incident.

E. Any Contractor employee who develops a work-related lost time illness or injury shall be evaluated by a physician before the employee can be readmitted to the work area. Any work-related lost time illness or injury shall be verbally reported to the Engineer within 24 hours of the occurrence of any such illness or injury. A written description of any work-related lost time illness or injury shall be included on an Accident Report Form. A copy of the physicians return to work form shall be submitted to the Engineer prior to the employee is allowed to return to work.

F. If the Engineer observes unsafe operations by Contractor's personnel the Engineer may stop the work. This observation does not replace the Contractor's responsibility for the safety of his personnel. Work stopped for safety reasons will not be considered stand-by time.

G. Tailgate safety meetings shall be held daily. These meetings shall inform employees of the day's activities and individual responsibilities, inherent hazards, emergency procedures, and approved changes to the HSP.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control.

B. Tolerances.

C. References.

D. Labeling.

E. Testing and inspection services.

F. Manufacturers' field services.

1.2 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.

B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. Perform Work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.

E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.

C. Obtain copies of standards and maintain on Site when required by product Specification Sections.

D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 TESTING AND INSPECTION SERVICES

A. Employ and pay for services of an independent testing laboratory acceptable to Engineer to perform specified testing if called for in the individual specifications.
   1. Before starting Work, submit testing laboratory name, address, and telephone number, and names of full-time Professional Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities' inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Engineer.
   1. Laboratory: Authorized to operate in State of Texas.
   2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer.

D. Reports shall be submitted by independent firm to Contractor and Engineer indicating observations and results of tests and compliance or noncompliance with Contract Documents.
   1. Submit final report indicating correction of Work previously reported as noncompliant.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and independent firm 24 hours before expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

F. Employment of testing laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.

G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Contractor shall pay for retesting or re-inspection.

H. Testing or Inspection Service (Laboratory) Provider Responsibilities:
   1. Test Samples of mixes submitted by Contractor.
   2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform indicated sampling and testing of products according to specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings if requested by Engineer.

I. Laboratory Reports: After each test, promptly submit report to Engineer and Contractor. When requested by Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and Specification Section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.
   10. Conformance with Contract Documents.

J. Limits on Testing Authority:
   1. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Laboratory may not approve or accept any portion of the Work.

3. Laboratory may not assume duties of Contractor.
4. Laboratory has no authority to stop the Work.

1.7 MANUFACTURER'S FIELD SERVICES

A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment, and commissioning as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 14 days in advance of required observations. Observer is subject to approval of Engineer.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary electricity.

B. Construction water

C. Temporary sanitary facilities.

D. Field offices and material storage.

E. Vehicular access.

F. Parking.

G. Progress cleaning and waste removal.

H. Project identification.

I. Traffic regulation.

J. Fire-prevention facilities.

K. Barriers.

L. Enclosures and fencing.

M. Security.

N. Water control.

O. Dust control.

P. Erosion and sediment control.

Q. Pollution control.

R. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Provide and pay for all electricity required for construction.

1.3 CONSTRUCTION WATER

A. The Contractor shall provide water needed for construction from their own sources. There is no water source available at the project site.

1.4 TEMPORARY SANITARY FACILITIES

A. Provide and maintain portable toilet facilities at site. Portable toilets shall be serviced regularly and kept in good order.

1.5 FIELD OFFICES AND MATERIAL STORAGE

A. Contractor may store material at project site, however, no security will be provided by the Engineer. The Contractor may place shipping containers for material storage and security.

B. Materials must be contained within the boundaries of the Contractor staging area as shown in the Drawings, unless the Engineer gives prior approval to keep materials at other locations.

C. The Contractor may provide a field office at the project site. Temporary utilities will be provided and paid for by the Contractor. The field office will not be used for employee residency.

D. Removal: At completion of Work remove buildings, foundations, utility services, shipping containers, and debris.

1.6 VEHICULAR ACCESS

A. Provide means of removing mud from vehicle and equipment wheels before entering streets. Clean vehicles in the vicinity of the Construction Entrance

B. Limit construction traffic to existing roads, paved areas, and designated construction access pathways as shown in the Drawings.

1.7 PARKING

A. Construction personnel may park in unused areas of the parking lot. Access by tenants and patrons shall not be blocked. Contractor shall coordinate with tenants to ensure that local businesses are not disrupted.

B. Metal tracked vehicles are not allowed on paved areas. Damage caused by Contractor equipment or vehicles shall be repaired at the Contractor's expense.

1.8 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain work areas, areas accessed by tenants and patrons, and parking areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.

B. Broom and vacuum pavement if soiled and eliminate dust in tenant and patron access areas that may be caused by Contractor activities.

C. Collect and remove waste materials, debris, and rubbish from Site weekly and dispose of off-Site.

1.9 PROJECT IDENTIFICATION SIGN

A. Two painted signs, 32-sq ft area each, attached to security fencing. One located at each AOI.

B. Content:
1. Bandera Road Ground Water Plume Superfund Site, EPA ID TXN000606565, and EPA logo, EPA Contact Name and Telephone Number.
2. EA Engineering, Science, and Technology, Inc., PBC
3. Name of Contractor and major Subcontractors.
4. Contractor shall request the contact information listed above from the Engineer before having the sign manufactured.

C. Lettering: Series C of Standard Alphabet for Traffic Control Devices, "Manual on Uniform Traffic Control Devices for Streets and Highways," Federal Highway Administration.

D. Sign Painter: Experienced as professional sign painter.

E. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

F. Submit drawing showing sign content, layout, lettering, and colors. Fabricate only after receiving approval.

G. Sign Materials:
1. Structure and Framing: New wood or metal, structurally adequate.
2. Sign Surfaces: Exterior grade plywood with medium-density overlay, minimum of 3/4 inches thick, standard 4 x 8 foot size to minimize joints.
3. Rough Hardware: Galvanized.
4. Paint and Primers: Exterior quality.
5. Lettering: Exterior quality paint, contrasting colors.

H. Installation:
1. Install Project identification sign within 15 days after Notice to Proceed.
2. Erect at entrance to project area on Barely Lane. Location to be approved by Engineer prior to installation.
3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
4. Install sign surface plumb and level. Anchor securely.
5. Paint exposed surfaces of sign, supports, and framing.

I. Maintenance: Maintain clean signs and supports; repair deterioration and damage.

J. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area. Sign shall become property of the Owner. Support materials shall be disposed of as directed by the Engineer.

1.10 TRAFFIC REGULATION

A. Signs, Signals, and Devices:
   1. Provide warning signs, signals, traffic cones, drums, flares, and lights when working within public road ROWs.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Detours: If necessary, provide an alternate route for vehicular traffic during disruptions to traffic, whether on private property or public roads.

E. Disruptions to public traffic shall be authorized by local authorities.

1.11 FIRE-PREVENTION FACILITIES

A. Prohibit smoking within buildings under construction. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
   1. Provide one fire extinguisher at doorway of each building under construction.
   2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.

1.12 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades required by authorities having jurisdiction for public rights-of-way.

C. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

1.13 CONSTRUCTION FENCING

A. Temporary construction fence: Plastic construction netting, orange.

1.14 SECURITY

A. Entry Control:
   1. Restrict entrance of persons and vehicles to Project Site.
   2. Allow entrance only to authorized persons with proper identification. Do not restrict access by tenants and patrons to areas not within the Construction Limits.

3. Maintain log of workers and visitors and make available to Engineer on request.

1.15 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.

B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

1.16 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.17 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

1.18 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Equipment electrical characteristics and components.

1.2 PRODUCTS

A. At minimum, comply with specified requirements and reference standards.

B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.

C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

D. Product purchases must be in accordance with the Buy American Act (BAA – 41U.S.C. § 10a-10d). Buy American requirements are located in the FAR flow down clauses, which are an integral part of the contract documents.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products according to manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products according to manufacturer's instructions.

B. Store products with seals and labels intact and legible.

C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.

D. For exterior storage of fabricated products, place products on sloped supports aboveground.

E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

PART 2 PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.

B. Cord and Plug: Furnish minimum 6-foot (2-m) long cord and plug including grounding connector for connection to electric wiring system. Cord of longer length may be specified in individual Specification Sections.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Starting of systems.

C. Demonstration and instructions.

D. Project record documents.

E. Operation and maintenance data.

F. Spare parts and maintenance products.

G. Product warranties and product bonds.

H. Examination.

I. Preparation.

J. Execution.

K. Cutting and patching.

L. Protecting installed construction.

M. Final cleaning.

1.2 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
   1. Submit operation and maintenance manuals, record documents, digital images of construction photographs, and other similar final record data in compliance with this Section.
   2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to operating and maintenance personnel as specified in compliance with this Section.
   3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.

4. Obtain and submit releases enabling full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
5. Deliver tools, spare parts, extra stocks of material, and similar physical items.
6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to Engineer.
7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
8. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:
1. When Contractor considers Work to be substantially complete, submit to Engineer:
   a. Written certificate that Work, or designated portion, is substantially complete.
   b. List of items to be completed or corrected (initial punch list).
2. Within seven days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Engineer determine that Work is not substantially complete:
   a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
   b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
   c. Engineer will reinspect Work.
   d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.
4. When Engineer finds that Work is substantially complete, Engineer will:
   a. Prepare Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer (final punch list).
5. After Work is substantially complete, Contractor shall:
   a. Complete Work listed for completion or correction within time period stipulated.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
1. When Contractor considers Work to be complete, submit written certification that:
   a. Contract Documents have been reviewed.
   b. Work has been examined for compliance with Contract Documents.
   c. Work has been completed according to Contract Documents.
   d. Work is completed and ready for final inspection.
2. Submittals:
   a. Final punch list indicating all items have been completed or corrected.
   b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
   d. Accounting statement for final changes to Contract Sum.
   e. Contractor affidavit of release of liens.
3. Perform final cleaning for Contractor-soiled areas according to this Section.

D. Final Completion Inspection:

1. Within seven days after receipt of request for final inspection, Engineer will make inspection to determine whether Work or designated portion is complete.
2. Should Engineer consider Work to be incomplete or defective:
    a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
    b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
    c. Engineer will reinspect Work.
    d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.

1.3 STARTING OF SYSTEMS

A. Individual equipment testing should be completed to confirm compatibility of individual components. Full system startup activities, calibration, and testing will be an optional addition.

B. Coordinate schedule for startup of various equipment and systems. Provide at least seven days' notice to Engineer.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Engineer's personnel prior to date of final inspection.

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

C. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment, at equipment location.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

E. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, product data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates used.
   3. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction as follows:
   1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
   2. Include locations of concealed elements of the Work.
   3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
   4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
   5. Identify and locate existing buried or concealed items encountered during Project.
   6. Measured depths of foundations in relation to finish floor datum.
   7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   9. Field changes of dimension and detail.
   10. Details not on original Drawings.

G. Submit marked-up paper copy documents to Engineer with claim for final Application for Payment.

H. Submit PDF electronic files of marked-up documents to Engineer with claim for final Application for Payment.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit in PDF composite electronic indexed file.

B. Submit data bound in 8-1/2 x 11-inch (A4) text pages, binders with durable covers.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white background, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
      g. Safety precautions to be taken when operating and maintaining or working near equipment.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop Drawings and product data.
      b. Certificates.
      c. Originals of warranties and bonds.

1.7 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

B. Deliver to Project Site and place in location as directed by Engineer.

1.8 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

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

D. Co-execute submittals when required.

E. Include table of contents and assemble in binder with durable cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:
1. Make submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
2. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing Site conditions are acceptable for subsequent Work. Beginning new Work constitutes Contractor acceptance of existing conditions.

B. Verify that existing surface is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual Specification Sections.

D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 EXECUTION

A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.

B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
   1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
   2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
   3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.

E. Allow for expansion of materials and building movement.

F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
   1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
   2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
   1. Refer questionable mounting heights choices to Engineer for final decision.
   2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.

H. Adjust operating products and equipment to ensure smooth and unhindered operation.

I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.3 CUTTING AND PATCHING

A. Employ skilled and experienced installers to perform pavements cutting and restoration.

B. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and nonconforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

C. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

D. Cut masonry and concrete materials using masonry saw or core drill.

E. Restore Work with new products according to requirements of Contract Documents.

F. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

G. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

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

I. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

3.5 FINAL CLEANING

A. Execute final cleaning prior to final Project assessment.
1. Employ experienced personnel or professional cleaning firm.

B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces.

C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean Site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION

SECTION 02 54 19.19 – BIOREMEDIATION USING AMENDMENT INJECTION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. This specification prescribes the injection of emulsified vegetable oil with bioaugmentation for the purpose of creating a permeable reactive barrier to promote enhanced reductive dechlorination (RDC).

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Contractor's Field Reports: Summary reports of all activities performed on site shall be submitted to the Engineer on a daily basis.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Operation Data:
1. The Contractor shall provide injection data to the Engineer. Information shall include mixture quantities, injection quantities, injection rates, and injection pressures.

1.4 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Requirements

B. The Contractor shall arrange and pay for all necessary official inspections and permits and shall install or change work as required by official inspection. All such indicated changes shall be documented by the Contractor and reported to the Engineer to allow for construction options to be exercised.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. The Contractor will be responsible for safe and timely transportation of all necessary equipment and appurtenances to the site. The Contractor's representative on site will inspect for damage and assumes the responsibility for any issues which may arise from equipment transportation.

C. The Contractor will be responsible for providing any equipment required for system unloading and temporary storage.

D. Store and maintain materials in a clean, uncontaminated condition throughout the course of the project.

E. *Dehalococcoides* bacteria should be stored per manufacturer's instructions. The bacteria must be stored in an anaerobic and refrigerated environment.

1.6 PROJECT AND SITE CONDITIONS

A. Access to each well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work, is the responsibility of the Contractor. Furnish a copy of all permits, licenses, and other legal requirements necessary for execution of the work before commencement of the work. Obtaining rights-of-entry is the responsibility of the Government. Visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site.

PART 2 PRODUCTS

2.1 SUBSTRATE

A. Emulsified Vegetable Oil (EVO) shall be food grade quality. Quantities shall be based on equivalent weight in pounds of emulsified vegetable oil. The EVO must be suitable for promoting enhance RDC.

B. Clean Water shall be used for diluting the EVO mixture and as chase water to better distribute the EVO throughout the subsurface. Clean water must be dechlorinated.

C. Sodium ascorbate may be used to create reduced conditions in the EVO prior to bioaugmentation.

D. Sodium bicarbonate shall be used to buffer pH and maintain pH in the suitable range in order to maintain a robust and vigorous *Dehalococcoides* population.

2.2 EQUIPMENT

A. Injection Delivery Pump - Delivery pump capable of delivering product into several wells simultaneously at approximately 10 gallons per minute, with delivery pressures from 5 to 100 psi.

B. Centrifugal Pump – Pump capable of circulating fluids and creating the EVO emulsion.

C. Batch Mixing Tank - Tank capable of holding injection and mixing quantity needed for simultaneous injection into multiple wells.

D. Chase Water Storage Tank - Tank capable of holding chase water quantity needed for simultaneous injection into multiple wells.

E. Injection Manifold for simultaneous injection into multiple wells. Each leg shall have a totalizing flow meter and pressure gauge suitable for metering diluted EVO mixture and chase water equally between wells.

F. Packer and Injection piping (tubing diameter compatible with packer), manifold and appurtenances necessary to simultaneously inject amendment into at a minimum three (3) wells simultaneously. Well packers and associated equipment for application in the well, capable of handling pressures up to 200 psi).

G. Packer Inflatable sliding head style packers similar to Aardvark Packers LLC model 34B, P/N 9249. (Port Orchard, WA). One of these packers is extra. The packers are to be assembled so that they can be used as a single packer. The packers must be able to be used and re-used after many inflations and this usage must be consistent with "normal" and due care operating procedures as described in the manufacturers operating manual. The packers shall be manufactured from aluminum, natural rubber which has a wire mesh wall and a 1.00" I.D. stainless steel center tube with 1" NPT connection threads. The length of this pipe shall be have 1.0" Male NPT threads on each end, and shall be sized for injection into a 20-foot injection length. Contractor shall keep an additional packer available in the event that a packer malfunctions.

H. Nylon Type "H" Tubing Nylon Type "H" tubing will be used as the inflation tubing for the packers and have a burst rating of 2,500 psi. The operator will be required to obtain a reliable and quality regulator to measure the packer inflation and monitor for any changes that might occur downhole. The inflation tubing shall extend a minimum of 10 linear feet from the well head(s). The inflatable packers shall not be left unattended while charged, unless a quick disconnect fitting has been installed on the gas regulator to retain the gas pressure to the packer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. After becoming familiar with the details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancies before performing the work.

3.2 PROTECTION OF EXISTING CONDITIONS

A. Maintain existing survey monuments and wells and protect them from damage from equipment and vehicular traffic. Repair any items damaged during this work.

3.3 PREPARATION

A. Water Source - Water will not be provided to the Contractor. Contractor is responsible for obtaining water from a clean non-chlorinated source.

B. MIXING AND BATCHING - EVO shall be mixed with clean water in accordance with the manufacturer's instructions. Quantities shall be mixed in proportion to and in the quantities specified in the mix design. A culture of Dehalococcoides shall be added to the mixture for bioaugmentation. *Dehalococcoides* shall not be added to any EVO water mixture until dissolved oxygen is 0.0 mg/L and ORP is below 0 mV. Care should be taken to ensure that the *Dehalococcoides* does not come into contact with oxygen. Sodium ascorbate can be added to

the mixture to more rapidly reduce DO and ORP levels. Sodium bicarbonate should be added if the pH drops below 6.5 in order to maintain pH between 6.5 and 7.5.

The Contractor may elect to fill the mixing tanks the night before to allow time for the mixture to reach reducing conditions, dissolved oxygen is 0.0 mg/L and ORP is below 0 mV.

C. The EVO mixture and chase water shall be injected through a valved and metered manifold. Care should be made to evenly distribute the EVO mixture between injection wells. Due to the nature of the formation, this may not be possible.

Inflatable sliding head packers may be used to push the EVO mixture and chase water into the formation more quickly. The injection pressure shall not exceed 100 psi.

D. Immediately following amendment injection, chase water shall be injected. Quantities shall be based on the manufacturer's recommendations.

END OF SECTION

SECTION 02 62 16 - SOIL VAPOR EXTRACTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Soil vapor extraction (SVE) system equipment.
   2. SVE system piping.
   3. SVE system control.

B. Related Sections:
   1. Section 26 00 00 – Electrical General
   2. Section 26 09 00 – Instrumentation
   3. Section 26 09 10 – Control Panels
   4. Section 26 09 16 – Miscellaneous Electrical Controls
   5. Section 26 21 01 – Incoming Services
   6. Section 26 29 13 – Motor Controllers
   7. Section 33 23 16 – Soil Vapor Extraction Well Installation
   8. Section 43 13 13.13 – Vapor-Phase Granulated Activated Carbon Systems

1.2 DESCRIPTION OF WORK

A. This specification prescribes the requirements for the installation of the two (2) SVE systems, one (1) at AOI 1 and one (1) at AOI 2. The Contractor shall provide labor, supervision, materials, equipment, tools, permits, and services that are required to install, startup, and test the SVE system as shown on the Drawings and as covered in this specification.

B. Each SVE system shall connect to a piping manifold through a header pipe. A network of SVE wells will each connect to each manifold through individual conveyance pipes. The SVE manifold will connect the lines to said header pipe as shown in the Drawings.

C. At AOI 1 the SVE system shall extract approximately 490 standard cubic feet per minute (SCFM) of vapor at a vacuum gauge pressure of 146.1 inches of water (in. water) at the SVE manifold. From each of the ten (10) horizontal nested, segmented well (Vertebrae™) screens the SVE system shall extract approximately 17.5 SCFM of vapor at a vacuum gauge pressure of 145 in. water at the SVE manifold. From each of the two (2) deep horizontal well the SVE system shall extract approximately 35 SCFM of vapor at a vacuum gauge pressure of 45 in. water at the SVE manifold. A dilution valve shall extract 245 SCFM from the atmosphere. All extraction wells shall be operated simultaneously, creating a total system flow of 490 SCFM at a total required vacuum of 158.4 in. water.

D. At AOI 2 the SVE system shall extract approximately 230 SCFM of vapor at a vacuum gauge pressure of 70.6 in. water at the SVE manifold. From each of the twelve (12) horizontal nested, segmented well (Vertebrae™) screens the SVE system shall extract approximately 13.0 SCFM of vapor at a vacuum gauge pressure of 70 in. water at the SVE manifold. From each of the two (2) deep horizontal well the SVE system shall extract approximately 35 SCFM of vapor at a vacuum gauge pressure of 45 in. water at the SVE manifold. All extraction wells shall be

operated simultaneously, creating a total system flow of 230 SCFM at a total required vacuum of 116.9 in. water.

E. The SVE System will connect to the vapor-phase granular activated carbon vessels described in Section 43 13 13.13

F. The Contractor shall install the pipe and fittings connecting all the listed components as presented in the Drawings and specified in this section. The Contractor shall install all the wiring, instrumentation, and control components associated with the listed components as presented in the Drawings and specified in this section and related sections.

1.3 REFERENCES

A. American Society of Testing and Material International (ASTM)
   1. ASTM A-36 – Standard Specification for Carbon Structural Steel.
   2. ASTM C795 – Standard Specification for Mineral Fiber Pipe Insulation
   3. ASTM D1785 – Standard Specification for PVC Plastic Pipe, Schedules 40, 80, and 120.

B. National Electrical Code (NEC)
   1. National Electrical Code 2014.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. The Contractor shall submit the SVE unit design to the Engineer for review, within 21 days after the date of notice of award. The Contractor shall provide information, including equipment weights, power requirements, residual production rates, and the other pertinent data in the design submittal. The design submittal must be approved by the Engineer before the installation of the system can commence.

C. Contractor’s Field Reports: Summary reports of all activities performed on site shall be submitted to the Engineer on a daily basis.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Shop Drawings:
   1. Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

C. Operation and Maintenance Data:
   1. Operating instructions outlining the step-by-step procedures required for system startup, operation, and shutdown. Include in the instructions layout, wiring, and control diagrams of the system as installed. Also the manufacturer's name, model number, service manual, parts list, brief description of all equipment and their basic operational features, and operating instructions for each piece of equipment and bulletins, cut sheets and descriptive data.

2. Maintenance instructions listing routine preventative maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides
3. The Contractor shall provide any data requested by the Engineer. Proprietary information or data shall be made available based on a non-disclosure agreement, if necessary.

1.6 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Requirements

B. The Contractor shall arrange and pay for all necessary official inspections and permits and shall install or change work as required by official inspection. All such indicated changes shall be documented by the Contractor and reported to the Engineer to allow for construction options to be exercised.

1.7 QUALIFICATIONS

A. Manufacturers of the required equipment shall be companies specializing in manufacturing products specified in this section with a minimum of 10 years of experience in the manufacture of soil vapor extraction equipment.

B. Installer: Company specializing in performing Work of this Section, with minimum five years documented experience, shall be authorized for installation of the supplied equipment and shall have all required licenses and certifications for the Work performed on site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. The Contractor will be responsible for safe and timely transportation of all necessary equipment and appurtenances to the site. The Contractor's representative on site will inspect for damage and assumes the responsibility for any issues which may arise from equipment transportation.

C. The Contractor will be responsible for providing any equipment required for system unloading and temporary storage.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

A. Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

B. Major equipment items such as the vacuum pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.2 SVE SYSTEM at AOI 1

A. SVE System Manifold
1. Substitutions: Section 01 25 00 – Substitution Procedures
2. 6” x 2” Sch 80 PVC manifold with 12 legs
   a. All 12 Well Legs
      1) 1/2' in. brass sample ports with hose barb and valves
      2) 2” PVC Full-Port Sliding Gate Valves
      3) 2” Full-Port Brass Ball Valves
      4) 1/2 in. quick-connect air compressor fitting
      5) 2” Butterfly Valves
         a) Valwork Series 5671 Electric Actuated Butterfly Valves
         b) Wafer Style
         c) Epoxy Coated
         d) Stainless Steel Disc
         e) Double Acting Actuator
         f) NBR (Buna -N) seals
      6) Unions
      7) PVC to HDPE adaptor
   b. USA Industries, Inc. Orifice Plate
      1) 6 in. paddle-type with raised face orifice flanges and holding blocks
      2) 304 stainless steel
      3) ¼ to 1/8 in. thick
      4) Machined to provide 98.3 in. W.C. vacuum at 70 SCFM
   c. 2 Deep Horizontal Well Legs Only
      1) PRM, Inc. Model FMDFG40 Rotometers with a 2-25 SCFM scale
   d. 10 Shallow Horizontal Nested, Segmented Well Legs Only
      1) PRM, Inc. Model FMDFG4050 Rotometers with a 5-50 SCFM scale
3. 6” x 6” Sch 80 PVC dilution leg
   a. USA Industries, Inc. Orifice Plate
      1) 6 in. paddle-type with raised face orifice flanges and holding blocks
      2) 304 stainless steel
      3) ¼ to 1/8 in. thick
      4) Machined to provide 146.1 in. W.C. vacuum at 245 SCFM
   b. Solberg Inlet air filter and silencer assembly
      1) 2-micron, 99%+ removal efficiency
      2) Powder coated carbon steel construction
      3) 1,100 scfm flow rating
      4) 6 in. MPT inlet and outlet
      5) Model FS-275P-600 Compact Filter Silencer
      6) Model 275P Polyester Filter

B. Moisture Separator
1. Manufacturers:
   a. Gasho, Inc.
   b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Model GX-125DL moisture separator
   a. 6 in. flex union couplings on inlet and outlet and flanged connections

b. Centrifugal inlet design with bolt down lid and 6 in. cleanout
c. 2 in. PVC sight tube
d. Three float switch system
e. Stainless steel demister
f. Automatic pump down system

3. 2 in. Dilution Valve Assembly
   a. Vacuum relief valve – 2 in. Tuthill Model 1362-F
      1) Stainless steel
      2) Set at 180 in. Hg
   b. Vacuum gauge
      1) ¼ in. NPT
      2) 2.5 in. diameter gauge
      3) Gauge isolation valve
      4) Liquid filled
      5) Measurement displayed as 0-12 in. Hg and 0-160 in. WC
      6) Vent plug
   c. Apollo 77F-100 Full-port threaded brass ball valve
   d. Solberg Inlet Filter assembly
      1) 135 scfm flow rating
      2) 2 in. MPT inlet and outlet
      3) Model F-231P-200 Compact Filter
      4) Model 231P Polyester Filter
   e. ½ HP Centrifugal Transfer Pump
      1) Orberdorfer Pump Co. Model N994HJ96
      2) Oberdorfer Pump Co. Frame 56C
      3) ½ HP motor
      4) 1,150 RPM
      5) Bronze construction with 303 stainless steel shafts
      6) Connected to moisture separator drain and double walled liquid storage tank with 1.5 in. HDPE tubing

C. SVE Blower Package
   1. Manufacturer/model:
      a. Tuthill Pneu-Pak 33-60-A-7011 CP Series Regenerative Blower Package
         1) Tuthill 7011 Rotary Positive Displacement Blower
         2) Weg 324/6T -IP55 Motor Frame
      b. Substitutions: Section 01 25 00 – Substitution Procedures
   2. Product Description: Regenerative industrial/chemical processing blower.
      a. 40 HP, 230/460 VAC, 3-phase, totally enclosed, fan cooled (TEFC) Induction Motor
      b. 2-Lobe
      c. 490 scfm at 158.4 in. WC
      d. Includes flex connectors
      e. Intake silencer
      f. Discharge silencer with ½ in. Female NPT drain
      g. 6 in. flanged input and output connections

D. Heat Exchanger
   1. Manufacturer/Model:

a. Xchanger, Inc./ AA-1000
b. Substitutions: Section 01 25 00 – Substitution Procedures

2. Product Description: Heat Exchanger
   a. Total heat exchanged: 87,610 BTU/hr
   b. At 490 SCFM, capable of reducing heat from 250°F to 84.5°F at 80°F ambient air temperature
   c. Maximum 3.5 in. W.C. pressure drop
   d. 2.0 HP TEFC motor
   e. 6 in. ANSI pattern FFF 3/8" thick inlet and outlet flanges.

E. Vapor Phase Carbon

1. Manufacturer/Model:
   a. Tigg Corporation N-5000-PDB-1001 Carbon vessels
   b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Vapor Phase Carbon Vessels
   a. Epoxy lined
   b. 20 in. hinged manway
   c. 1 in. NPT HDPE drain plug
   d. Stainless steel plenum
   e. ¼ in. nominal wall thickness
   f. Skid mounted
   g. Anchors for lifting
   h. Valved liquid drain port
3. Product Description: Vapor Phase Carbon
   a. Minimum Carbon Tetrachloride number 60
   b. Minimum Iodine Number 1,150 mg/g
   c. Maximum moisture, 3% by weight
   d. Approximate density 26 lbs/ft^3
   e. Virgin vapor phase activated carbon from coconut shells
   f. 7,400 lbs of carbon per vessel
4. Product Description: Valved Duct Rack
   a. 6" flanged PVC inlet
   b. Pressure relief valve
   c. Inlet and outlet sample ports to allow sampling before and after each vessel regardless of lead/lag vessel configuration
   d. Interconnected piping as shown on drawings
   e. Discharge stack to atmosphere with rain cap
   f. Valves to allow switching lead/lag configuration
   g. Inlet and outlet pressure gauges for each vessel, 0-10 psig gauge

F. Surge Tank

1. Manufacturer/Model:
   a. Snyder Industries, Inc./550 gallon Captor Containment System
   b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Surge Tank
   a. Double-walled
   b. HDPE
   c. 18" polyethylene threaded manway
   d. High level sensor and transmitter

2.3 SVE SYSTEM at AOI 2

A. SVE System Manifold
1. Substitutions: Section 01 25 00 – Substitution Procedures
2. 6” x 2” Sch 80 PVC manifold with 14 legs
   a. All 14 Well Legs
      1) 1/2' in. brass sample ports with hose barb and valves
      2) 2” PVC Full-Port Sliding Gate Valves
      3) 2” Full-Port Brass Ball Valves
      4) 1/2 in. quick-connect air compressor fitting
      5) 2” Butterfly Valves
         a) Valwork Series 5671 Electric Actuated Butterfly Valves
         b) Wafer Style
         c) Epoxy Coated
         d) Stainless Steel Disc
         e) Double Acting Actuator
         f) NBR (Buna -N) seals
      6) Unions
      7) PVC to HDPE adaptor
   b. USA Industries, Inc. Orifice Plate
      1) 6 in. paddle-type with raised face orifice flanges and holding blocks
      2) 304 stainless steel
      3) ¼ to 1/8 in. thick
      4) Machined to provide 18.2 in. W.C. vacuum at 70 SCFM
   c. 2 Deep Horizontal Well Legs Only
      1) PRM, Inc. Model FMDFG40 Rotometers with a 2-25 SCFM scale
   d. 12 Shallow Horizontal Nested, Segmented Well Legs Only
      1) PRM, Inc. Model FMDFG4050 Rotometers with a 5-50 SCFM scale

B. Moisture Separator
1. Manufacturers:
   a. Gasho, Inc.
   b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Model GX-100DL moisture separator
   a. 4 in. flex union couplings on inlet and outlet and flanged connections
   b. Centrifugal inlet design with bolt down lid and 6 in. cleanout
   c. 2 in. PVC sight tube
   d. Three float switch system
   e. Stainless steel demister
   f. Automatic pump down system
3. 2 in. Dilution Valve Assembly
   a. Vacuum relief valve – 2 in. Tuthill Model 1362-F
      1) Stainless steel
      2) Set at 180 in. Hg
   b. Vacuum gauge

1) ¼ in. NPT
2) 2.5 in. diameter gauge
3) Gauge isolation valve
4) Liquid filled
5) Measurement displayed as 0-12 in. Hg and 0-160 in. WC
6) Vent plug

c. Apollo 77F-100 Full-port threaded brass ball valve
d. Solberg Inlet Filter assembly
1) 135 scfm flow rating
2) 2 in. MPT inlet and outlet
3) Model F-231P-200 Compact Filter
4) Model 231P Polyester Filter
e. ½ HP Centrifugal Transfer Pump
1) Orberdorfer Pump Co. Model N994HJ96
2) Oberdorfer Pump Co. Frame 56C
3) ½ HP motor
4) 1,150 RPM
5) Bronze construction with 303 stainless steel shafts
6) Connected to moisture separator drain and double walled liquid storage tank with 1.5 in. HDPE tubing

C. SVE Blower Package
1. Manufacturer/model:
a. Tuthill Pneu-Pak 33-30-A-4007 CP Series Regenerative Blower Package
1) Tuthill 4007 Rotary Positive Displacement Blower
2) Weg 254/6T -IP55 Motor Frame
b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Regenerative industrial/chemical processing blower.
a. 15 HP, 230/460 VAC, 3-phase, totally enclosed, fan cooled (TEFC) Induction Motor
b. 2-Lobe
c. 230 scfm at 116.9 in. WC
d. Includes flex connectors
e. Intake silencer
f. Discharge silencer with ½ in. Female NPT drain
g. 3 in. flanged input and output connections

D. Heat Exchanger
1. Manufacturer/Model:
a. Xchanger, Inc./ AA-250
b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Heat Exchanger
a. Total heat exchanged: 14,987 BTU/hr
b. At 230 SCFM, capable of reducing heat from 150°F to 89.6°F at 80°F ambient air temperature
c. Maximum 4.2 in. W.C. pressure drop
d. 1.0 HP TEFC motor
e. 4 in. ANSI pattern FFF 3/8” thick inlet and outlet flanges.

E. Vapor Phase Carbon
   1. Manufacturer/Model:
      a. Tigg Corporation N-2500-PDB-1001 Carbon vessels
      b. Substitutions: Section 01 25 00 – Substitution Procedures
   2. Product Description: Vapor Phase Carbon Vessels
      a. Epoxy lined
      b. 20 in. hinged manway
      c. 1 in. NPT HDPE drain plug
      d. Stainless steel plenum
      e. ¼ in. nominal wall thickness
      f. Skid mounted
      g. Anchors for lifting
      h. Valved liquid drain port
   3. Product Description: Vapor Phase Carbon
      a. Minimum Carbon Tetrachloride number 60
      b. Minimum Iodine Number 1,150 mg/g
      c. Maximum moisture, 3% by weight
      d. Approximate density 26 lbs/ft^3
      e. Virgin vapor phase activated carbon from coconut shells
      f. 2,300 lbs of carbon per vessel
   4. Product Description: Valved Duct Rack
      a. 4” flanged PVC inlet
      b. Pressure relief valve
      c. Inlet and outlet sample ports to allow sampling before and after each vessel regardless of lead/lag vessel configuration
      d. Interconnected piping as shown on drawings
      e. Discharge stack to atmosphere with rain cap
      f. Valves to allow switching lead/lag configuration
      g. Inlet and outlet pressure gauges for each vessel, 0-10 psig gauge

F. Surge Tank
   1. Manufacturer/Model:
      a. Snyder Industries, Inc./550 gallon Captor Containment System
      b. Substitutions: Section 01 25 00 – Substitution Procedures
   2. Product Description: Surge Tank
      a. Double-walled
      b. HDPE
      c. 18” polyethylene threaded manway
      d. High level sensor and transmitter

2.4 SYSTEM ENCLOSURE

A. Product Description: Steel General Purpose Sea Box Shipping Container (one trip unit)
   1. Outside Dimensions: 8’ wide x 20’ long x 8.5’ high
   2. Inside Dimensions: 7.75’ wide 19.33’ long x 7.83’ high
   3. Corrosion resistant white steel exterior corrugated walls
   4. Corrosion resistant white steel exterior roof
   5. Corrosion resistant steel floor

6. 2 in. thick Sonic-Shield sonic fiber black faced sound absorber attached with 2.5 in. fiber anchoring stick pins and locking washers per manufacturer's installation instructions on all sides except floor, excluding vent and fan openings.
7. Steel skid(s) appropriate for mounting of all equipment inside the enclosure
8. Barn-style rear double doors with passive vents
9. Stationary intake louver with bird screen per SVE system – Dayton® Model 4F421
    a. Substitutions: Section 01 25 00 – Substitution Procedures
10. Automatic Power Attic Roof Ventilator Dayton® Model 10N201
    a. Substitutions: Section 01 25 00 – Substitution Procedures
11. One additional passive vent adjacent to the double doors
12. Provide industrial room air conditioner (Friedrich Kuhl 35000 BTU 9.1 EER) to provide cooling. Provide additional insulation to bring insulation value to R13.
13. Interior
    a. Fluorescent lights spaced at 4' maximum with one (1) wall switch near doorway
    b. (4) 120V power receptacles evenly spaced in accessible locations not blocked by proposed equipment
    c. All electrical components and wiring shall be per NEC for a class 1, division 2 area inside of enclosure.
14. Interior: all electrical components and wiring shall be per NEC for a class 1, division 2 area inside of enclosure.
15. Exterior: NEMA 4-door in door control panel.
16. Exterior: Main disconnect.

2.5 PIPE

A. Vapor inlet piping through the enclosure wall and all piping within the enclosure up to the moisture separator shall be either polyvinyl chloride (PVC) approved equivalent, with appropriate pressure and vacuum strength for the application.

B. Vapor discharge piping from the discharge end of the vacuum pump shall be ductile iron pipe or black steel and extend a minimum of 3 feet after it exits the heat exchanger. The pipe shall be insulated until it exits the enclosure, with insulation that conforms to ASTM C795 standards and has an operating temperature range of 0 to 600 degrees F. The black steel discharge pipe must contain a cautionary label outside the enclosure stating the pipe may be hot.

C. Vapor discharge piping beyond the black steel pipe or ductile iron pipe shall be schedule 80 PVC.

2.6 VALVES AND SAMPLE PORTS

A. The valve ends and size shall be compatible with adjacent piping.

B. All sample ports shall be ½ in brass hose barb with brass ball valve.

2.7 INSTRUMENTATION

A. Pressure Gauge
    1. Dial type with bottom connection

2. 3 ½-inch diameter dial
3. 0 to 40 psi reporting range
4. -4 degrees F to 350 degrees F operational range
5. Within 2% accuracy
6. Type 304 stainless steel case material
7. Valved stem for isolation

B. Vacuum Gauge - Vacuum Application
1. Dial type with bottom connection
2. 3 ½ - 4-inch diameter dial
3. -200 to 0 inches of water reporting range
4. For use with -4 degrees F to 150 degrees F operational range
5. Within 2% accuracy
6. Type 304 stainless steel case material
7. Valved stem for isolation

C. Temperature Gauge
1. Dial type with bottom connection
2. 3 ½ - 4-inch diameter dial
3. 0 to 200°C reporting range
4. Within 3% accuracy
5. stainless steel case material
6. Polycarbonate front panel
7. Valved stem for isolation

D. Vacuum Indicator and Transmitter
1. Manufacturer:
   a. Dwyer 626 Industrial Pressure Transmitter/Transducer
   b. Substitutions: Section 01 25 00
2. Product Description
   a. Type 316 L stainless steel
   b. For use in 0 to 200°F range
   c. 4-20 mA signal
   d. NEMA 4x enclosure
   e. For gases and liquids
   f. 0-160 in W.C. vacuum reporting range
   g. LED display

E. Pressure Gauge and Transmitter
1. Manufacturer:
   a. Dwyer Mercoid Series EDA Electronic Pressure Controller
   b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description
   a. 316L stainless steel
   b. NEMA 4X enclosure rating
   c. 4 digit back lit LCD display
   d. 4-20mA output signal

F. Air Flow Indicator

1. Manufacturer:
    a. PRM; models FDMFG40 and FMDFG4050
    b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description
    a. In-line
    b. 1.5” MNPT end connections
    c. Gradations: 20-25 SCFM Air and 5-50 SFM Air
    d. Removable for cleaning
    e. Factory calibrated for design vacuum

G. Differential Pressure Transmitter (For Air flow Measurement)
1. Manufacturers:
    a. Dwyer Series MS2 Magnesense® II Differential Pressure Transmitter
    b. Substitutions: Section 01 25 00 – Substitution Procedures
2. Product Description: Pressure and Air Velocity Transmitter
    a. Pressure Limits: 1 psi
    b. Temperature limits: 0 – 150 degrees Fahrenheit
    c. Accuracy: 5 in. WC within 1% accuracy
    d. Outputs: Positive only, 4-20 mA

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. After becoming familiar with the details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancies before performing the work.

3.2 INSTALLATION

A. Install equipment as shown and in accordance with written instructions from the manufacturer. Provide anchor brackets, anchor rods or straps to secure the equipment and process pipe to the system enclosure.

B. Connect piping to the adjacent equipment in accordance with the Drawings.

3.3 POSTED FRAMED INSTRUCTIONS

A. Post installation instructions, sequences, and precautions, including tolerances for level, horizontal, and vertical alignment as specified. Submit for approval prior to posting: grouting requirements, including grout spaces and materials; wiring and control diagrams; system layouts and isometrics; instructions and other sheets; operating instructions explaining preventive maintenance procedures; and checks to assure the system is operating normally and safely. Methods of checking the system for normal safe operation; procedures for operating the system; and procedures for safely starting and stopping the system shall be prepared in typed form, framed and posted beside the diagrams. Catalog cuts are not acceptable

3.4 FIELD QUALITY CONTROL

A. After installation of the SVE system is complete, operating tests shall be carried out to ensure that the units installed operates properly. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of all equipment; all operating mechanisms shall be tested to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Tests shall assure that there is no abnormal vibration, or noise from any parts. If deficiencies are revealed during tests, such deficiencies shall be corrected and the tests shall be re-conducted at the Contractor's expense. Results of the tests shall be used in determining the capacity and performance of the SVE system.

END OF SECTION

SECTION 26 00 00 - ELECTRICAL GENERAL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes general requirements for all electrical work. The Contractor shall furnish and install all materials, equipment, and appurtenances necessary for a complete and satisfactory installation of the electrical systems. The Contractor shall coordinate all electrical work required for the project. The Contractor shall provide the correct electrical service to each piece of electrical equipment whether or not shown on the drawings and check and coordinate electrical service and controls required with equipment provided under other specification sections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers

B. National Fire Protection Association (NFPA)

C. Underwriters Laboratories, Inc. (UL)

D. National Electrical Manufacturers Association (NEMA)

E. American Society of Testing Materials (ASTM)

F. Association of Illuminating companies (AEIC)

G. Insulated Cable Engineers Association (ICEA)

1.3 SUBMITTALS

A. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model number, complete part number, nameplate data, size, layout dimensions, capacity, project specification, and paragraph reference.

B. Shop Drawings: Submit shop drawings in accordance with the General Conditions, the Supplementary Conditions, and Section 01 33 00 Submittals. Organize similar items into a single submittal to include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Shop drawings shall be specific for this project. Shop drawings which provide only generic information or are of a generic nature are not sufficient. Information within the shop drawings shall be clearly marked to identify components applicable for this project. Non-applicable information shall be noted, or neatly crossed out.

C. Manufacturer's Catalog Data: Shop drawings shall include manufacturer's catalog data for each manufactured item. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data as a minimum.

D. Materials List: The Contractor shall submit, along with Shop Drawings, a materials list which shall include full information, including manufacturer's complete part number, regarding all components of the equipment. Materials of construction shall be presented in the listing by ASTM reference and grade.

E. Nameplate Information. Submit complete nameplate information for all industrial machinery. The nameplate shall include the following information:
   1. Supply voltage, number of phases, frequency, and full-load current.
   2. Maximum ampere rating of the short-circuit and ground-fault protective device
   3. Ampere rating of largest motor, from the motor nameplate, or load
   4. Short-circuit current rating of the machine industrial control panel. Short-circuit current rating shall be based on the short-circuit current rating of a listed and labeled machine control enclosure or assembly. Or the short-circuit current rating shall be as established utilizing an approved method.
   5. Electrical diagram number, or the number of the index to the manufacturer's electrical drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual. Prepare electronic and hard copy of operation and maintenance manuals. Include one copy of the following:
   1. Copy of all relevant, and previously reviewed shop drawings, with all comments addressed.
   2. Record (as-built) drawings, incorporating all field changes and Engineer's comments.
   3. Wiring diagrams incorporating all field changes and Engineer's comments.
   4. Manufacturer's instructions on care , operation, and maintenance of equipment.
   5. Narrative describing the procedures for equipment startup and operating.
   6. Warranty certificates.
   7. Spare parts list
   8. Complete type written operating instructions, covering all systems descriptions and operation, emergency operating instructions, and precautions.
   9. Copies and originals of all applicable software certificates showing proof of ownership by the Engineer.
   10. Name, address, and telephone number of supplier or representative of manufacturer for each item of equipment in Contract.

B. Bind all items (all unused, clean and legible) in common folder or heavy notebook covers and submit to Engineer before request for final acceptance.

C. Affidavit of Compliance. The manufacturer shall provide an affidavit stating compliance of their equipment with all applicable provisions of this specification.

D. Software. Submit two electronic copies of all final application software developed. Electronic copy shall be on flash drives, or other method mutually agreed upon between Engineer and

Contractor. In addition to electronic copies, submit hard copy of all application software developed. For software applications of a graphical nature (such as Operator Interface Terminals or Human Machine Interfaces), hard copy submittal shall include copies of all screens.

E. Setup Parameters. Submit printed copy of all setup parameters used for all equipment in this project. This includes, but is not limited to, all setup parameters used for the programmable controller, the operator interface terminal, the radio, the variable frequency drive, and the softstart. Include the factory default value of each parameter in this list of setup parameters.

1.5 QUALITY ASSURANCE

A. Experience: All equipment furnished under Division 26 shall be furnished by manufacturers who have at least three years experience in the design, production, assembly, and field service of equipment of like type and size. Products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the two-year period. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturer's factory or laboratory tests, is furnished.

B. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

C. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with NEMA, IEEE, or other applicable technical standards and shall have a neat and finished appearance.

D. Installation: Erect equipment in a neat and workmanlike manner; align, level, and adjust for satisfactory operation. Install equipment so that parts are easily accessible for inspection, operation, maintenance, and repair. Minor deviations from the indicated arrangements may be made, but only after obtaining approval from the Engineer.

E. Electrical work shall meet or exceed the latest revisions for the following standards and codes except where more stringent requirements have been specified:
1. Local Building Codes
2. National Fire Protection Associations – NFPA
3. National Electrical Code – NEC
4. National Electrical Safety Code - NESC
5. Underwriters Laboratories, Inc. – UL
6. National Electrical Manufacturers Association – NEMA
7. Institute of Electrical and Electronic Engineers – IEEE
8. American Society of Testing Materials – ASTM
9. Insulated Power Cable Engineers Association – IPCEA
10. Association of Edison Illuminating Companies – AEIC
11. American National Standard Institute - ANSI

F. In general, all electrical equipment furnished shall be listed and labeled by Underwriters Laboratories, Inc. (UL) or another acceptable organization to the County and the Engineer. Submit name of organization that will label equipment if other than Underwriters Laboratories. Organization shall certify that the equipment meets applicable UL, ANSI, and NEMA standards.

1.6 INSPECTIONS

A. The Contractor shall have all electrical work inspected by the following agency and this work shall pass such inspection: Independent electrical inspection agency approved by the Engineer.

B. The Contractor shall furnish to the Engineer a certificate of compliance stating that the completed installation complies with the requirements of the National Electrical Code. This certificate shall be completed by the approved independent electrical inspection agency.

1.7 CONTRACT DRAWINGS

A. Locations Approximate. The locations of equipment shown on the Contract Drawings are approximate only. The Contractor shall determine the exact locations of the equipment, box-outs, sleeves, and of similar items required for the coordination of electrical work with the mechanical and other work.

B. Plan Drawings Diagrammatic. Power and Control Plans, and Lighting, Receptacle Circuit & Grounding Plans shown are diagrammatic and functional only and are not intended to show exact conduit layouts, number of fittings, or other installation details. The final determination as to routing, location, and termination shall be governed by structural conditions, obstructions, job conditions, and best industry practices. This shall not be construed to mean that the design of the system may be changed without written approval. The Contractor shall obtain shop drawings affecting all conduit locations before installation. The Contractor shall consult all drawings and specifications which may affect location of any outlet, piece of equipment, or conduit run to avoid interference with other trades. The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power, control, and other electrical systems shown.

C. Elementary Circuit Drawings and Control Panel Drawings Diagrammatic. Circuit diagrams and elementaries shown are diagrammatic and functional only and are not intended to show exact wiring, circuitry, or to be considered a substitute for wiring diagrams. Control Panel drawings, including sub-panel layout drawings, are diagrammatic and functional only and are not intended to show exact parts and locations, or to be considered a substitute for assembly drawings. The Contractor shall submit shop drawings detailing exact part selection, placement, and wiring connections.

D. Parts lists and part numbers are included to convey design intent using actual manufactured parts. Every attempt has been made to provide a part number that may be used to order and purchase parts; but the Contractor shall be responsible for checking all part numbers to verify that all parts will perform the intended function correctly as part of an integrated system, and fit in the designated space.

1.8 INSTRUCTION OF ENGINEER'S REPRESENTATIVES

A. Before request for final acceptance of Work, furnish necessary skilled personnel to operate all systems. Instruct designated Engineer's representative in proper operation and care of systems and equipment. Repeat instructions as required.

1.9 PROTECTED WORK

A. Dry Locations. Dry locations are not normally subject to dampness or wetness. An area classified as dry may be temporarily subject to dampness or wetness.

B. Wet Locations. Wet locations are areas outside, underground, in concrete slabs or masonry in direct contact with the earth, and areas subject to saturation with water or other liquids, such as a vehicle washing area and unprotected areas exposed to weather.

C. Hazardous locations. In areas designated as hazardous locations and where explosion-proof equipment and work is shown or specified, all work shall meet the requirements of the National Electrical Code for Class1, Group D, Division 1 or Division 2 locations as applicable and indicated, unless otherwise noted.

D. Corrosive Areas. Corrosive areas are areas where the potential exists for corrosive gases or liquids to come in contact and corrode equipment and materials. Corrosive Areas shall include rooms housing chemical storage tanks or chemical feed equipment or pumps.

1.10 GROUNDING

A. Equipment and systems shall be bonded and grounded in accordance with Article 250 of the National Electrical Code, applicable local codes, the electrical utility provider, and the manufacturer's recommendations.

B. Ground raceways and noncurrent carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding. Grounding through the conduit system shall be in excess of any ground conductors shown on the Contract Drawings.

C. Circuits in nonmetallic conduit shall carry one ground conductor for equipment grounding.

PART 2 PRODUCTS

2.1 CONCRETE EQUIPMENT PADS (CEP)

A. Provide concrete equipment pads where shown on the Contract Drawings for setting motor control centers, VFD control panels, transformers, control panels, and other floor and ground mounted equipment. Concrete shall be 3000 PSI, 28 day minimum. Refer to details on electrical drawings for outdoor and indoor concrete equipment pads.

2.2 EQUIPMENT MOUNTING RACKS (EMR)

A. Equipment mounting racks shall be provided as required to mount and support equipment and where specifically shown on the Contract Drawing details.

B. The details shown on the Contract Drawings provide minimum requirements for the equipment mounting racks. Equipment mounting racks shall be designed to support the required equipment. Equipment mounting racks shall be constructed to maintain a rigid installation minimizing movement and racking.

C. Materials
   1. Tubing: 2" x 2" x ¼" Aluminum Alloy (6063-T52)
   2. Backplate: ¼" thick aluminum plate (up to 24" x 24" maximum); 3/8" thick aluminum plate (for sizes larger than 24"x 24")
   3. Bottom Plate: 6" x 6" x ½" Aluminum Alloy
   4. Hardware: 3/8" stainless steel locknuts, bolts, and washers.

D. Assembly
   1. Corners and angles shall be ground smooth and shall be free of burrs.
   2. Equipment mounting racks shall be constructed as required to accommodate field conditions such as handrails, mounting against walls, or other structures.
   3. Equipment mounting racks installed in grass areas shall be provided with a concrete equipment pad. The concrete equipment pad shall extend a minimum of 6" around the perimeter of the equipment and an additional 30" (minimum) in front of the equipment to provide an area for operators to stand.
   4. Equipment mounting racks shall be sized to facilitate access to the equipment controls. Controls shall be accessible in an area between 42" and 60" above finished grade.
   5. Utilize 3/8" full welds as appropriate for the connection of the components.

E. Equipment Mounting Racks installed in rooms or areas designated as "Corrosive Areas" shall be constructed of non-metallic components. Hardware shall also be non-metallic, and resistive to corrosion.

2.3 PADLOCKS

A. Padlocks shall be suitable for outdoor, severe weather use and shall be provided with the following features:
   1. Boron alloy-steel shackles which repel saws and bolt cutters.
   2. Dual locking shackles shall resist forcing or prying.
   3. Pick resistant spool pins.
   4. Durable thermo-plastic cover to protect lock body and key cylinder from dirt, dust, and other contaminants
   5. Special drain channels to move water through the lock body.
   6. 2-1/8 inch wide steel case and five pin W6000 removable cylinder.

B. Padlocks shall be "keyed alike" for similar equipment, such that all locks can be opened via the same key number. Keys shall be punched with letters as specified. Pad locks shall be provided for the following areas:
   1. Each Pad Mounted Transformer (Punched: "XMFR")

2. Each Substation Area man-gate and vehicle gate. (Punched: “SUBST”)
3. 10 Spare Padlock & keys.

C. Manufacturers
1. Master – Pro-Series 6121
2. Equal

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

A. Factory Applied. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

B. Field Applied. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2 NAMEPLATE MOUNTING

A. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two stainless steel rivets.

3.3 COORDINATION

A. The Contractor shall coordinate all electrical work involving existing circuits and operations with the Engineer for required shutdowns, conversions, and tie-ins.

END OF SECTION

SECTION 26 05 01 - CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes wires, cables, and accessories as shown, specified, or required for the complete power, lighting, control, and other systems in the Contract.

B. This Section includes fiber optic cables and accessories as shown, specified, or required for the process control system.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

B. NFPA 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

C. Insulated Cable Engineers Association (ICEA)

D. Underwriters Laboratories, Inc. (UL)

E. National Electrical Manufacturers Association (NEMA)

F. American Society of Testing Materials (ASTM)

G. Association of Edison Illuminating Companies (AEIC)

1.3 SYSTEM DESCRIPTION

A. Product Requirements. Provide products as follows:
   1. Conductors for feeders and branch circuits 10 AWG and smaller shall be stranded.
   2. Control circuits shall utilize stranded conductors.
   3. Conductors for power and lighting circuits shall not be smaller than 12 AWG.
   4. Conductors for control circuits shall not be less than 14 AWG.
   5. Increase wire size in branch circuits to limit voltage drop to a maximum of 2.5%.

B. Wiring Methods. Provide the flowing wiring methods:
   1. Wet or Damp Interior Locations: Use only building wire, type THHN/THWN, or XHHW insulation using raceway (PVC coated rigid metal conduit or rigid metal conduit), direct burial cable, armored cable, or metal clad cable.
   2. Exterior Locations: Use only building wire, type THHN/THWN, or XHHW insulation using raceway (PVC coated rigid metal conduit or rigid metal conduit), direct burial cable, service-entrance cable, armored cable, or metal clad cable.

3. Underground Locations: Use only building wire, type THHN/THWN, or XHHW insulation using raceway (PVC coated rigid metal conduit or rigid metal conduit), direct burial cable, armored cable, or metal clad cable.

1.4 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of Section 01 33 00 Submittals.

B. Submittals shall contain a material list with manufacturer data describing the material and showing its compliance with the specification, associated standards, and test requirements.

C. Other Submittals
1. Samples of any material shall be submitted upon the Engineer's request.
2. A list of all test equipment shall be submitted to the Engineer for review.
3. Cable testing results.

1.5 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
1. National Electrical Code (NEC)
2. Insulated Cable Engineers Association (ICEA)
3. Underwriters Laboratories, Inc. (UL)
4. National Electrical Manufacturers Association (NEMA)
5. American Society of Testing Materials (ASTM)
6. Association of Edison Illuminating Companies (AEIC)

B. Conductor Manufacturers. All wires and cables of like type shall be the product of one manufacturer.

C. Manufacturer Test Requirements. Certified test reports showing compliance with applicable ICEA and UL Standards for each type of conductor shall be provided upon request.

D. In general, all electrical equipment furnished shall be listed and labeled by Underwriters Laboratories, Inc. (UL) or another acceptable organization to the County and the Engineer. Submit name of organization that will label equipment if other than Underwriters Laboratories. Organization shall certify that the equipment meets applicable UL, ANSI, and NEMA standards.

E. Verify that field measurements are as indicated on the drawings.

F. Coordination. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 PRODUCT

2.1 GENERAL

A. Unless otherwise shown or specified, all conductors shall be stranded copper.

B. Material construction of copper conductor strands shall be coated or uncoated soft drawn or annealed copper.

2.2 MEDIUM VOLTAGE CABLES

A. Medium voltage cable for 2 kV service and above shall consist of a single annealed copper, compact strand conductor with an extruded semi-conducting strand shield, ethylene propylene insulation, insulation shield, and overall jacket. The insulation shield shall consist of zinc or coated copper tape, or copper drain wires with semi-conducting shield. The jacket shall be abrasion resistant and suitable for general-purpose applications in wet and dry locations. The cable shall be UL listed as Type MV-105, sunlight resistant, suitable for cable tray use.

B. The cables shall meet all applicable ICEA and AEIC Standards, and shall be as manufactured by Kerite, Okonite, Rome, General Cable/BICC, or approved equal.

2.3 LOW VOLTAGE CONDUCTORS

A. Low voltage conductors for 600 VAC service and below shall be rated a minimum of 600 volts. Conductors shall be constructed of uncoated Class B copper concentric-lay- stranded wires, rated for 90 degrees C (dry), 75 degrees C (wet), machine tool wire with thermoplastic (PVC) insulation and nylon jacket. Conductors shall be oil and gasoline resistant II. Conductors stranded in other than Class B may be used provided that all terminals, lugs, and connectors are listed and marked for use with that conductor stranding.

B. Conductors shall be of the following type, temperature rating, insulation, and/or jacket:
   1. THHN/THWN/MTW: 600 Volt, 90ºC (dry), 75ºC (wet)
   2. MTW/AWM: 600 Volt, 90ºC (dry) with PVC insulation

C. Control conductors shall be type MTW/ATM, 14 AWG. Control conductors for AC circuits within MCC or control panels shall be red. Control conductors energized from a source external to the control panel source shall be yellow.
   1. Control conductors may be 16 AWG copper provided all of the following conditions are met:
      a. Continuous load does not exceed 8 amperes.
      b. Overcurrent protection is provided by one of the following:
         i) Branch-circuit-rated circuit breakers listed and marked for use with 16 AWG copper wire
         ii) Branch-circuit-rated fuses listed and marked for use with 16 AWG copper wire.
         iii) Class CC, Class J, or Class T fuses.

   2. Control conductors may be 18 AWG copper provided all of the following conditions are met:

a. Continuous load does not exceed 5.6 amperes.
b. Overcurrent protection is provided by one of the following:
   i) Branch-circuit-rated circuit breakers listed and marked for use with 18 AWG copper wire
   ii) Branch-circuit-rated fuses listed and marked for use with 18 AWG copper wire.
   iii) Class CC, Class J, or Class T fuses.

D. Acceptable manufacturers: Royal, Deceron, Rome, GE, General Cable/BIC, Essex, or equal.

2.4 Submersible Cables

A. Submersible pump cable or submersible pump conductors shall be of the extra heavy usage type and be constructed of Class K or H tinned, copper bunch-stranded wires. Insulation shall be EPD with a single pass of CP for Size No. 8 and larger. Cable shall be suitable for use in municipal sewage.

B. Acceptable manufacturers: Royal, equal.

2.5 INSTRUMENTATION CABLES

A. Multi-conductor control cable shall consist of 600 volt, individual conductors, each constructed of a minimum of seven strands of No. 14 AWG (or as shown on the Contract Drawings) uncoated Class B copper concentric-lay-stranded wires. Each conductor shall have HMW-PE insulation and color coded PVC outer jacket. Additional overall PVC jacket shall be provided around individual conductors. Cables shall be Type 20-10 as manufactured by Anaconda, Type CT-B manufactured by Rome Cable Co. or equal.

B. Twisted Shielded Pair (TSP) Instrumentation conductors shall consist of two twisted strands of No. 16 AWG (or as shown on the Contract Drawings) tinned coated Class C copper concentric-lay-stranded wires with a braid or foil shield. Each conductor shall have polyethylene insulation and color coded (black/white) PVC outer jacket. With multi-conductor twisted pair assemblies, each pair shall include individual shield and an overall shield shall be applied over the cable assembly with an additional overall PVC jacket around the conductors.

C. Acceptable manufacturers: Rome, Deceron, Belden, or equal.

2.6 GROUNDING SYSTEM CONDUCTORS

A. Grounding grid system conductors shall be constructed of tin coated copper concentrically lay-stranded wires in accordance Section 26 05 26 - Electrical Grounding.

2.7 NETWORKING CABLES

A. Category 5 Cables
   1. The cable and patch cords shall consist of four (4) unshielded twisted pair of 24 AWG solid bare copper conductors and shall be FEP Teflon insulated. The conductor shall be color coded and the cable plenum jacketed.
   2. The Unshielded Twisted Pair (UTP) wiring shall be able to accommodate data transmission speeds up to 100 MPS fast Ethernet.

3. Manufacturer: Belden or equal.

B. Category 6 Cables

1. The cable and patch cords shall consist of four (4) unshielded twisted pair of 24 AWG solid bare copper conductors and shall be FEP Teflon insulated. The conductor shall be color coded and the cable plenum jacketed.
2. The Unshielded Twisted Pair (UTP) wiring shall be able to accommodate data transmission speeds up to 10 gigabits at 250 MHz.
3. Manufacturer: Belden or equal.

C. Coaxial Cable
1. Cable shall be #20 AWG tinned stranded copper with tinned copper braid shielding, and a foam FEP Teflon insulation. Cable shall be rated for 120V, 75ºC. Cable shall support Ethernet and shall be plenum jacketed.
2. Video Cable (RG6)
   a. The conductor shall be #18AWG, 0.037" diameter solid bare copper. The insulation shall be made of foam polyethylene and the core shall have a nominal outside diameter of 0.180 inches.
   b. There shall be two (2) bare copper braids 98% shield coverage and the cable jacket shall be made of black PVC.
3. Manufacturer: Belden or equal.

2.8 TELEPHONE CABLES

A. Telephone cable shall be twisted shielded pairs, #24 AWG, and shall be solid copper. Cable shall consist of 4 pairs or 25 pairs as shown on the Contract Drawings. Cable shall be suitable for installation in cable tray, conduit, access floors, and above suspended ceilings.

B. The cable shall be provided with a FEP Teflon insulation and shall be plenum jacketed.

C. Manufacturer: Belden or equal.

2.9 FLEXIBLE CORD

A. Flexible cord for conductors 600 VAC and below shall be rated a minimum of 600 volts. Conductors shall be constructed of Class K flexible stranded conductors for sizes 18 AWG through 10 AWG, and sot-drawn rope lay conductors for sizes 8 AWG through 2 AWG, and heat and moisture resistant thermoplastic-elastomer (TPE) insulation, type SEOW.

2.10 COLOR CODING OF CONDUCTORS

A. Power conductors on systems 600 volts and less shall be color coded in accordance with the following:
1. 480/277 VAC, three phase, 4 wire, 60 Hz.

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	White

Ground	Green

2. 240/120 VAC, single phase, 3 wire, 60 Hz.

Conductor 1	Black
Conductor 2	Red
Neutral	White
Ground	Green

3. 208/120 VAC, three phase, 4 wire, 60 Hz.

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

B. For conductors larger than No. 6 AWG, colored tape may be used to color code the conductors at all terminations, splices or other places where they are visible.

C. Multi-conductor Instrumentation cables shall be color-coded according to ICEA/NEMA, latest edition, Method 1.

2.11 CONNECTORS AND TERMINALS

A. Connectors (for #10 AWG and smaller)
1. Solderless pressure connectors (wirenuts) for pigtail splicing all power conductors and cables #10 AWG and smaller shall be "Wing-nut" type made by Ideal.

Model No.	Wire Size
451	2 #18 min.; 3 #12 max.
452	2 #14 min.; 4 #12 max.
453	1 #10, and 1 #12 min.; 2 #8 and 1 #16 max.
455	3 #12 min.; 4 #10 max.

2. Connectors for (straight) splicing signal and control wires #10 AWG and smaller shall be solderless and compression type. Connectors shall be Burndy Hydent, Thomas and Betts Stakon, or equal.

B. Connectors (for #8 AWG and larger)
1. Connections of conductors to terminal posts or other conductors shall be made with UL approved compression type connectors. Wire nuts shall not be permitted.
2. Connections shall insure a thorough connection without damaging the conductor.
3. Connections shall be suitable for the conductor size used.
4. Typical compression type fittings shall be as specified below:

a. Two way splices for large conductors size 1/0 and larger shall be uninsulated indenture type similar to Burndy "Hy-Link", Thomas and Betts Sta-kon, Burndy, or equal.
b. Two way splices for small conductors, size l AWG and smaller shall be uninsulated indenture type similar to Burndy "Hy-Dent", Thomas and Betts "Sta-Kon" or equal.
c. Fixture connections shall be two piece indenture type similar to Thomas and Betts "Sta-Kon" Series PT-66M, Ideal - Crimp Connector Sleeve No. 410 with wire cap insulated or equal.

C. Terminals
1. Terminals shall be 600 volt, indenture type, two or one hole lugs similar to Thomas and Betts "Sta-Kon", Burndy "Hylug" or equal.
2. Spade terminals shall be locking, vinyl self insulated similar to Thomas and Betts "Sta-Kon", Burndy or equal.
3. All accessories that use special tools for proper application as recommended by the manufacturer shall be installed only with those tools and in accordance with the established practices and recommendations of the manufacturers.

D. Terminal Blocks
1. Terminal blocks shall be suitable for a continuous rating of 600 VAC shall be manufactured in accordance with UL and NEMA standards for clearance between adjacent terminals.
2. Terminal blocks shall be sectional units of molded thermoplastic polyester and suitable for channel mounting.
a. Sections shall have built in marking areas
b. Center post in each section shall prevent over insertion of wires.
c. Sections shall not be interlocked so that one section may be removed without disturbing the remainder of the assembly.
d. Terminals shall be tin plated, box lugs, having hardware recessed into the molding, or flat terminal connectors.

E. Power Distribution Terminal Blocks
1. Power distribution blocks shall be constructed of copper. Blocks shall have a minimum of two line connections and one load connection per pole with lug wire range suitable for conductor size as indicated on the Contract Drawings.
2. Power terminal blocks shall be furnished with removable clear lexan cover plates to prevent accidental contact with live parts.
3. Power distribution blocks shall be as manufactured by Allen-Bradley, Gould-Shawmut, or equal.

2.12 MISCELLANEOUS ACCESSORIES

A. Wire pulling lubricant shall be non-toxic and contain no solvents that degrades wire insulation, plastic tape, or conduits. Lubricant shall not leave residual material in conduit, shall be rust inhibited, and be non-combustible. Lubricant shall be as manufactured by Ideal, Tomic Electric, or equal.

B. Cable and wire supports shall be Kellem grips or cable supports wedges as manufactured by O. Z. Gedney, or equal.

C. Cable tags for coding of individual conductors shall be in accordance with Section 26 05 53 - Identification for Electrical Systems.

D. Plastic tape shall be all weather vinyl electrical tape having a high dielectric strength and resistant to sun, water, oil, acids and corrosive chemicals. Tape shall be 3M Type 88 or similar item as manufactured by Bishop Electric, General Electric, Okonite, or equal.

E. Electrical insulation putty shall be rubber based elastic putty in tape form. Putty shall be 3M Scotchfill, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Unless otherwise shown or specified, all power, lighting, and control circuits shall be enclosed in conduit wireways.

B. All individual conductors shall be identified at all termination and splice points. Wire numbers or letter coding shall be by means of printed plastic tape, and shall be as scheduled on the Contract Drawings.

C. Each conductor's insulation shall be a single color throughout its entire length.

D. Splices and connections shall be made with solderless pressure type connectors, and shall be taped and covered to provide an insulating value of the connection equal to the adjacent wire insulation.

E. Conductors installed in wireways shall be grouped and bundled as they exit each conduit run. In open areas, such as wireways, manholes, or other similar areas, wires and cables shall be tied every twelve (12) inches.

F. All conductors shall be carefully handled to avoid kinks or damage to its insulation.
   1. Lubricant may be used to assist in pulling conductors through conduits.
   2. Pulling strain shall not exceed the value recommended by the cable manufacturer.

G. Spare conductors shall be of sufficient length for future connections where spare terminals are provided; proper terminals shall be installed and connected.

H. Conductors shall be installed in junction boxes and pull boxes that are sized to meet the requirements of the National Electrical Code for wire bending and minimum radius.

3.2 SPLICES AND JOINTING

A. Cables and conductors installed in the underground distribution system and duct banks shall be routed continuously from termination point to termination point. No splices shall be made in underground manholes or handholes without written approval by the Engineer. Where underground or outdoor splices of 600 volt conductors are approved by the Engineer, they shall

be installed utilizing an epoxy based cast splice kit. Splice kit shall be as manufactured by 3M or equal.

B. Splices shall be made in junction boxes and shall be taped to an insulating value at least equal to the insulating value of the conductors.

C. Application of taped joints shall be as follows:
   1. For 480/277 VAC power circuits, connection shall be wrapped with plastic tape.
   2. For lighting circuits, splice connections shall be wrapped with plastic electrical tape.
   3. For motor circuit terminations, splice connections shall be wrapped with 3M Scotchfill tape and finished with plastic tape.

D. Copper to aluminum connections shall be made with UL approved aluminum-to-copper connectors and compound.

E. Solder joints, hinged connectors, and bolted terminal lugs will not be permitted. The exception of multi-bolted directed compression connectors in large wire and cable sizes will be permitted, if compression type fittings are not available.

F. Splices, taps, or terminations shall not be made when conductor ends have missing strands or when the ends are mutilated in any way.

G. Pump power and control cables shall be connected to conductors using power terminal blocks which shall be mounted inside local junction boxes as shown on the Contract Drawings. Terminal blocks shall be provided with insulation barriers so that there are no exposed live parts inside the junction box.

3.3 MEDIUM VOLTAGE CABLE

A. All bends in medium voltage cables shall have a minimum centerline radius equal to the values recommended by the Engineer.

B. Splicing and terminating shall be as recommended by the cable manufacturer and reviewed by the Engineer.
   1. All splices and terminations shall be in accordance with the instructions of the cable manufacturer and as reviewed by the Engineer.
   2. Methods for splicing and terminating shall be completely described and submitted to the Engineer prior to any splicing.

3.4 MULTI-CONDUCTOR CONTROL CABLE

A. Multi-conductor cable shall be provided where shown on the Contract Drawings. Multi-conductor control cable may be used where separate control circuits having a number of conductors greater than three are shown on the Contract Drawings. The Contractor shall be responsible for sizing the conduit required at no cost to the Owner.

B. Termination of cable shall be as specified.

3.5 LOW VOLTAGE AND CONTROL CONDUCTORS

A. All power, control, and lighting conductors shall be type THHN-90C, THWN-75C/MTW unless otherwise noted.

3.6 CONNECTIONS TO EQUIPMENT

A. Connections and interconnections shall be made to all equipment in accordance with the Contract Drawings, and wiring diagrams furnished by manufacturers, and as specified by the Engineer.

B. The Contractor shall be responsible for the accuracy of the connected work made under this contract. Any damage resulting from erroneous connections shall be corrected by the Contractor at his own expense.

3.7 TESTING

A. General
   1. When all wires and cables are in place but before the final connections have been made, they shall be tested.
   2. Manufacturer's data on testing resistance shall be submitted with tabulated test results.
   3. Contractor shall furnish all necessary test equipment instruments.
   4. All tests shall be performed in the presence of the Engineer, unless waived by the Engineer.
   5. Contractor shall notify the Engineer three (3) working days in advance of any testing.
   6. If damage is indicated during testing or upon review of the tabulated data, Contractor shall replace defective wires and cables and retest at no cost to the Owner.

B. Direct Current High Potential Test
   1. A direct current high potential test (Hi Pot Test) shall be performed as described below for the following conductors:
      a. All conductors operating over 600 volts.
      b. Any conductor, not otherwise required to be tested, but in the opinion of the Engineer has been subjected to possible damage.
   2. The direct current high potential test shall be recorded at one minute intervals over a ten minute period for each conductor, and between each conductor and ground.
   3. The ten minute period shall commence when the charging/leakage current stabilizes.
   4. If leakage current stabilizes and decreases with time, the conductor being tested is acceptable.
   5. Voltage levels for high potential test shall be as scheduled below.

Rated cable voltage	D.C. high potential test voltage
600	2000
Up to 5 kV	25 kV
Up to 8 kV	35 kV
Up to 15 kV	55 kV

Up to 25 kV	80 kV
Up to 28 kV	85 kV
Up to 35 kV	100 kV

6. The data recorded during high potential testing shall be tabulated by the Contractor and submitted to the Engineer in the typewritten form as indicated below:

High Potential Test Data

Circuit No.	**Minute**	**Test Voltage**		
		MF – 1/25 kV	**P – 1/2 kV**	**P – 3/2 kV**
PH A, B, C to Grd.	Init.			
	1			
	2			
	…			
	10			
PH A to B, C	Init.			
	1			
	2			
	…			
	10			
PH C to A, B	Init.			
	1			
	2			
	…			
	10			

C. Megaohm Test
   1. For all wires and cable #8 AWG and larger, a 1500 volt insulation resistance (Megohm) test shall be performed.
   2. The Megohm test shall be performed on the following combination of conductors:
      a. Between all conductors in the same enclosure
      b. Between each conductor and ground.
      c. The resistance test shall be recorded at the end of one minute of sustained voltage.

D. Acceptance. After all final connections have been made, the equipment and controls shall be tested, by operation, to demonstrate performance.

END OF SECTION

SECTION 26 05 26 - ELECTRICAL GROUNDING

PART 1 GENERAL

1.1 SUMMARY

A. This section includes rod electrodes, active electrodes, equipment grounding conductors, grounding well components, mechanical connectors, exothermic connections, the grounding system, and the grounding grid where shown on the Contract Drawings.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers
   1. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
   2. IEEE 1100 – Recommended Practice for Powering and Grounding Electronic Equipment

B. International Electrical Testing Association
   1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

C. National Fire Protection Association
   1. NFPA 70 – National Electrical Code

1.3 SYSTEM DESCRIPTION

A. The Grounding systems shall use the following elements as grounding electrodes:
   1. Existing or new metal underground water pipe
   2. Concrete-encased electrode
   3. Ground ring
   4. Rod electrode
   5. Plate electrode

B. All of these metal underground systems and structures shall be bonded together to form the grounding electrode system. Piping systems and underground tanks shall be included when present.

1.4 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted including but not limited to:
   1. Ground Grid Conductors
   2. Grid Connecting Conductors
   3. Grid Compression Connectors (each type)
   4. Compression Tools
   5. Grounding Electrodes

6. Ground Bushings
7. Water Pipe Ground Connectors

B. Test Reports: Indicate overall resistance to ground and the resistance to ground at each electrode.

C. Submittals shall conform to the requirements of Section 01 33 00 - Submittals.

D. Submittals shall contain a material list with manufacturer data describing the material and showing its compliance with specifications, associated standards, and test requirements.

E. Prior to installation of any material, a detailed plan layout of the entire grounding system, including location and quantity of electrodes, connections, and cables shall be submitted to the Engineer for review.

F. Samples of any material shall be submitted upon Engineer's request.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.6 QUALITY ASSURANCE

A. Materials and installation shall be in accordance with latest revisions of the following codes, standard, and specifications, except where more stringent requirements have been specified herein:
1. National Electrical Code (NEC)
2. Underwriters Laboratories, Inc. (UL)

B. These Specifications require that all grounding and grounding circuitry equal or exceed the requirements of the National Electrical Code Article 250, and in the event of a conflict or discrepancy between these Specifications, the Contract Documents, and NEC Article 250, the more stringent requirements shall apply.

PART 2 PRODUCT

2.1 GROUNDING ELECTRODES

A. Rods shall be 5/8 inch in diameter, minimum 8 feet long unless otherwise shown, steel core with copper molten welded or electrolytically bonded to exterior. Two section ground rods are acceptable. Rods shall be manufactured by Copperweld Steel Co., Thompson Lightning Protection, Inc. or equal.

B. Grounding plates shall be 24 inch by 24 inch, ¼ inch thick solid copper.

2.2 EQUIPMENT GROUND CONDUCTORS

A. Equipment ground conductors shall be in accordance with Section 26 05 19 – Conductors and Cables.

1. Ground conductor #8 and smaller shall be green in color.
2. For #6 and larger ground conductors, black wire may be used and identified where exposed in all junction boxes, disconnect switches, panels, etc. with green tape wrapped over its entire exposed length.

B. All exposed grounding conductors such as bars, straps, cables, flexible jumpers, braids, shunts, etc., shall be bare copper.

C. All submersible pump installations shall be in accordance with NEC Article 250-112 (l and m). Submersible pumps shall include either a grounding conductor integral with the pump power cable or a separate grounding conductor sized in accordance with the National Electrical Code. A connection shall also be made between this grounding conductor and the metallic well casing (if any). This grounding conductor shall terminate at the branch circuit.

PART 3 EXECUTION

3.1 GENERAL

A. All grounding and bonding of electrical installations shall be in accordance with, or shall exceed the requirements of Article 250 of the National Electrical Code. In the event of a conflict or a discrepancy between these Specifications, the Contract Document Drawings, and the National Electrical Code, the more stringent requirement shall apply.

3.2 INSTALLATION

A. Install in accordance with IEEE 142.

B. Install grounding rod electrodes at locations as indicated on the drawings. Install additional rod electrodes to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Euipment Grounding Conductor. Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

E. Permanently ground entire power system in accordance with the National Electrical Code, including service equipment, distribution panels,, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, ground terminals, and ground bus at service panel.

F. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

G. Bare copper bars, cables, fittings, etc. shall not be installed in cinder fill nor shall be covered with soil containing cinders or other corrosive material.

H. Cables shall be installed with enough slack to prevent breaking stresses.

I. All grounding conductors subject to mechanical damage shall be protected by rigid steel conduit or other suitable guards and in all cases where so protected shall be permanently and effectively grounded to said enclosure at each end of its lengths with approved grounding connector and conduit fittings.

J. Where grounding conductors pass through floor slabs, walls, etc., and are not encased in metal conduit, they shall be sleeved in transite, fiber, or approved nonmetallic conduit.

K. All equipment ground bus, ground pads, frames, enclosures, etc., shall have all surfaces at the point of connection thoroughly cleaned and brightened, to remove paint or non-conducting material, just prior to actually making the connection. Touch-up damaged pointed surfaces to match existing conditions.

L. Splices in wire or cable grounding conductors are prohibited.

3.3 GROUNDING SYSTEM CONNECTIONS

A. Exposed connections shall be made with pressure clamps. Connections between different metals shall be protected against corrosion and moisture with an insulating epoxy resin.

B. Buried connections shall be made with exothermic weld type connections. Exothermic welding equipment shall be selected and used in accordance with the equipment manufacturer's instructions. Equipment and molds shall be used to accommodate the wire size, the metallic structure's shape, the wire position of attachment, vertical or horizontal, and other criteria that may be specified. Before a mold is used, remove and clean slag, dirt, and other foreign matter from the mold. Use cartridge and charge size based on the manufacturer's recommendations for the specific application. Different charges are required for steel and ductile iron pipe.

1. Surface preparation
    a. Surfaces with little or no coating shall be cleaned to bare metal by grinding or filing an area approximately three inches square to produce a bright metal surface. Weld area shall be free of coating, dirt, mill scale, oxide, grease, moisture, and other foreign matter.
    b. Surfaces with a thick coating shall have a four inch square window cut through the coating and three inches square of surface cleaned to bright metal. Avoid damaging the surrounding coating.
2. Prior to welding, remove the wire insulation as required to fit the mold. Avoid damaging the exposed copper wire. If the wire is cut or nicked over half way through its diameter, cut off and strip a new end. If the manufacturer requires the use of a copper sleeve, the sleeve shall be crimped securely to the wire and excess wire protruding from the end of the sleeve removed.
3. After the charge is set, remove the mold and slag from the weld area with a welder's hammer. Strike the top and sides of the weld with the hammer to test the secureness of the connection. If the weld does not hold, remove the scrap weld material clean and begin the weld process again.
4. After the weld is completed and prior to coating the clean and weld area, the Engineer may test the joint bond wire for electrical continuity.
5. Weld Caps
    a. After the weld passes the test for soundness, and electrical continuity, repair coating in the weld area with a cold-applied bituminous or coal-tar mastic and a weld cap placed over the weld. Mastic shall be applied to fill the weld cap and cove the exposed metal of

the structure and the wire to a minimum thickness of 1/4 inch. Damage to the coating around the weld area shall be repaired according to the coating manufacturer's recommendations.

b. If weld cap will not fit due to physical space limitations, coat bare metal and wire in weld area with a minimum 1/4 inch thickness of bituminous mastic.

C. In fixtures, enclosures, equipment, etc., ground terminals or lugs shall be provided.

1. Ground clips may be installed within device or switchboxes where terminals are not provided or are impracticable if used with solid ground wire.
2. Each panel, switchboard, or motor control center shall be provided with a ground bar of sufficient size for all ground conductors to be connected.

3.4 CONDUIT SYSTEM

A. Ground Conductor

1. All power and 120-volt control system conduits (feeders, branch circuits, lighting circuits, etc.) shall have an internal grounding conductor, which shall be sized in accordance with the requirements of the National Electrical Code. This grounding conductor shall be installed although it may not be shown or scheduled on the Contract Drawings.
2. The internal grounding conductor shall be bonded to each device box, pull-box, junction box, or wiring trough it passes through.
3. All conduits one inch and larger shall be provided with grounding bushings on each end and at all cabinets and pull, junction, or outlet boxes.
4. The Contractor shall exercise care to ensure good ground continuity, in particular, between the conduit system and equipment frames and enclosures.

3.5 SECONDARY ELECTRICAL SYSTEM

A. The neutral conductor of all low-voltage, single and/or polyphase distribution systems shall be solidly connected at one point only. This connection shall be as follows:

1. For Separately Derived System
   a. Ground neutral at transformer neutral bushing. Connect to system ground and transformer enclosure in accordance with NEC Article 250. In addition, Transformer secondary neutral bushings are also to be bonded to nearest metallic water pipe, building steel, or ground rod.
   b. Control power transformers must have their secondary (neutral) leg grounded at the transformer.
2. For Subfed Secondary Systems: Neutral shall be grounded only at one point of origin of secondary systems. Do not ground subfed panel neutral bars. Ground connection shall be in accordance with NEC Article 250.
3. For Service Supplied Systems
   a. The electric service shall be grounded at an accessible point in the main service disconnect in accordance with NEC Article 250.
   b. The grounding conductor shall be sized in accordance with NEC, Table 250-66 unless otherwise shown or specified.

3.6 TESTING

A. Acceptance

1. Unless otherwise specified, the installed grounding grid shall have a resistance to ground of 5 ohms or less.
2. The Contractor shall test all grounding conductors and grounding systems for continuity. Where continuity does not exist, jumpers shall be installed at no cost to the Owner and the system retested.
3. All testing shall be performed in the presence of the Engineer.

B. Grounding Resistance
1. Grounding resistance of the existing facility ground grid shall be tested using the ratio method, or other similar method that is acceptable to the Engineer. Contractor shall submit test procedure and equipment to be used in the testing. If the grounding resistance of the existing facility ground grid is in excess of 5 ohms, additional grounding shall be provided. After instillation of additional grounding, ground resistance shall be retested to verify that the value does not exceed 5 ohms.

END OF SECTION

SECTION 26 05 33 - CONDUITS AND RACEWAY SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes the conduit system required, specified, or shown on Contract Drawings including conduits, fittings, boxes, hangers, and accessories.

1.2 REFERENCES

A. American National Standards Institute
   1. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.
   2. ANSI C80.3 – Specification for Electrical Metallic Tubing, Zinc Coated.
   3. ANSI C80.5 – Aluminum Rigid Conduit – (ARC).

B. National Electrical Manufacturers Association
   1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FN 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   3. NEMA OS 1 – Sheet Steel Outlet Boxes, Device Boxes, covers, and Box Supports.
   4. NEMA OS 2- Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   6. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   7. NEMA TC 3 – PVC fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceways and boxes located as indicated on the drawings, and other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. In or Under Slab or Grade: Provide rigid metal conduit or PVC coated rigid metal conduit. Provide cast metal or nonmetallic boxes.

C. Outdoor Locations, Above Grade: Provide rigid metal conduit or PVC coated rigid metal conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.

D. In Slab Above Grade: Provide rigid metal conduit or PVC coated rigid metal conduit. Provide cast metal boxes.

E. Wet and Damp Locations: Provide rigid metal conduit or PVC coated rigid metal conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounted outlet boxes in finished areas.

1.4 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of section 01 33 00 - Submittals.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications and associated standards.

C. Samples of any material shall be submitted upon Engineer's request.

D. Prior to installation of any material in a specific area, a detailed plan layout of the conduit system, including the routing of conduits, support systems, junction boxes, conduit fittings and condulets, and coordination of other work, shall be submitted to the Engineer for review. Existing conduits and enclosures to be reused shall be shown and indicated on the submittal.

1.5 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. American National Standard Institute (ANSI)
   2. National Electrical Code (NEC)
   3. National Electrical Manufacturers Association (NEMA)
   4. Underwriters Laboratories (UL)

B. Equipment furnished under this section shall be furnished by manufacturers who meet the industry standards for quality, workmanship, and experience.

PART 2 PRODUCT

2.1 CONDUIT

A. Rigid Metal Conduit (Type RMC)
   1. Rigid metal conduit shall be galvanized steel, hot-dipped with zinc over the entire length, both exterior and interior including threads. Conduits shall have a coat of lacquer for sealing.
   2. Each conduit shall have a coupling on one end and a thread protector on the other.
   3. Conduit shall meet ANSI Standards C80.1 and C80.4 latest revisions. The conduit shall be manufactured by Allies Tube & Conduit Corporation, Pittsburgh Standard Conduit Company, Triangle PWC Co., or equal.

B. Intermediate Metal Conduit (IMC)

1. IMC shall be galvanized steel, hot-dip galvanized over entire length including threads. In addition, the exterior shall have a chromate coating applied and the interior shall be coated with a silicone lubricant. Conduits shall have a coat of lacquer for sealing.
2. The conduit shall be supplied with threads cut one thread short on each to assure a good ground return path. A standard rigid steel coupling shall be supplied on one end and a color-coded thread protector on the other.
3. Swivel type retractable couplings will not be permitted.
4. IMC shall be manufactured to meet the latest revisions of Federal Specification WW-C-581E. IMC shall be manufactured by Allied Tube and Conduit Corporation, or equal.

C. Electrical Metallic Tubing (EMT)
1. EMT shall be galvanized steel, hot-dipped with zinc over the entire length, both exterior and interior.
2. EMT shall be in accordance with ANSI Standards C80.3 galvanized tubing, latest revisions.
3. Fittings and conduit bodies shall be in accordance with NEMA FB1, steel or malleable iron; compression, set screw, or indenter type.
4. EMT shall be manufactured by Pittsburgh Standard Conduit Co., Allied Tube & Conduit Corporation, Triangle PWC Co., or equal.

D. PVC Coated Rigid Metal Conduit
1. PVC coated rigid metal conduit and fittings shall consist of a rigid metal conduit having a PVC coating not less than 40 mils thick. Rigid metal conduit shall be as specified above. PVC coating shall be bonded to the conduit and fittings such that the bonding shall be stronger than the tensile strength of the PVC.
2. PVC coated rigid metal conduit shall be in accordance with NEMA Standard RN-1, latest revision, for Type A-40 PVC coated conduit and fittings. PVC coated conduit and fittings must comply to ASTM D870, D1151, D3359 and D1308.
3. The PVC coated conduit and general purpose fittings must be UL Listed for the PVC as supplying the primary corrosion protection.
4. Fittings and conduit bodies shall be accordance with NEMA FB1, steel fittings with external PVC coating to match conduit.
5. The conduit threads must be hot galvanized, not hot dipped, and have an additional coat of clear Urethane.
6. PVC coated rigid steel conduit, all conduit bodies, fittings, and female threads shall include a minimum of 2 mils urethane internal coating. Product shall be Robroy Plasti-Bond Red, Perma-Cote or engineered approved equal.

E. Non-Metallic Conduits (PVC)
1. Non-Metallic conduits and fittings shall be Schedule 40 or schedule 80, polyvinyl chloride. Materials shall be corrosion and fire retardant, and sunlight resistant.
2. Conduit and fittings shall be in accordance with the NEMA Standard TC-2 and TC-3, latest revisions, and UL-651 Schedule 40 and 80 PVC Conduit.
3. The conduit and fittings shall be manufactured by Carlon Electric Conduit Co., Triangle PWC Co., or equal.

F. Flexible Conduit
1. Flexible metallic conduit (Greenfield). Shall be hot dipped galvanized flexible steel or aluminum and shall comply with UL Standard No. 1, latest revisions. Conduit shall be

manufactured by Anaconda Metal Hose Company, Triangle PWC Co., or equal. Fittings shall be PVC coated at each end of the liquid-tight conduit.

2. Liquid-tight flexible metal conduit (Seal-tight). Shall be constructed of flexible corrosion resistant zinc galvanized steel conduit with an extruded plastic jacket and built-in continuous copper ground strap under the jacket. Conduit shall be type UA manufactured by Anaconda Metal Hose Company, Type LA manufactured by Electri-Flex Co., or equal. Fittings shall be PVC coated at each end of the liquid tight conduit.
3. Liquid-tight Flexible Non-metallic Conduit. Shall be constructed of corrugated flexible PVC. Fittings shall be identified for use with flexible non-metallic conduit. Flexible non-metallic conduit shall be Carflex as manufactured by Carlon, or equal.
4. Hazardous Area Flexible Metal Conduits. Flexible metal conduits installed in areas classified as Hazardous shall be Crouse-Hinds Series EC, Killark Series EK, or equal.

2.2 JUNCTION, DEVICE AND PULL BOXES

A. Junction Boxes.

1. Junction boxes and pull-boxes shall be sized as required for the quantity and size of conductors to be installed within the box. Sizes shall comply with the requirements of the National Electrical Code for wire bending space radius. Stamped Steel Junction Boxes installed in areas approved for use with EMT conduit may be constructed of code-gage galvanized steel.
2. Cast Junction Boxes. Junction boxes for use with RMC or IMC shall be constructed of hot-dipped galvanized cast iron or copper free aluminum and shall be sized per NEC requirements. Boxes shall be manufactured by Crouse-Hinds Co., Killark Co., or equal.
3. PVC coated Junction Boxes. Junction boxes used with PVC coated rigid metal conduit shall be hot-dipped galvanized cast iron or copper free aluminum with a minimum of 40 mil factory applied PVC coating and a minimum of 2 mil of factory applied urethane interior coating. Thin or non-coated areas of the interior coating will be cause for rejection. Cover screws or bolts shall be stainless steel. Junction boxes and fittings are to be of the same manufacturer as the PVC coated conduit and must be UL listed with the PVC as a primary corrosion protection. Junction boxes installed in wet locations shall be suitable for such use.
4. Hazardous Area Junction Boxes. Junction boxes in areas classified as Hazardous shall be Series EJB or GU manufactured by Crouse-Hinds Co., Series XB or GR as manufactured by Killark Co., or equal.

B. Device Boxes for Outlets and Switches

1. Stamped Steel Device Boxes. In areas approved for use with EMT Conduit, device boxes may be constructed by code-gage galvanized steel with required knockouts. Boxes shall be manufactured by Steel City Co., or equal.
2. Cast Device Boxes. Cast device boxes shall be constructed of hot-dipped galvanized cast iron or copper free aluminum and sized in accordance with the requirements of the National Electrical Code. Boxes shall be Series FD manufactured by Crouse-Hinds Co., Series FD manufactured by Killark Co., or equal.
3. Flush Device Boxes. Device boxes installed within concrete masonry units shall be constructed of code-gage galvanized steel and shall be of the type specifically approved for masonry use. Boxes shall be installed flush with finished surface and the mounting height shall be adjusted for masonry joints.
4. Hazardous Area Device Boxes. In areas classified as Hazardous, device boxes shall be Series ED manufactured by Crouse-Hinds, series SWB manufactured by Killark Co., or equal.

5. PVC Coated Device Boxes. Device boxes used with PVC coated rigid steel conduit shall be hot-dipped galvanized cast iron or copper free aluminum with a minimum of 40 mil factory applied PVC coating and a minimum of 2 mil urethane interior coating. Thin or non-coated areas in the interior will be cause for rejection. Cover screws shall be stainless steel. PVC coated device boxes and fittings are to be of the same manufacture as the PVC coated conduit and must be UL listed and the PVC coating shall provide the primary corrosion protection.

C. Pull Boxes:

1. Pull boxes shall be used in dry locations only for pulling. No splicing of conductors shall be allowed. The boxes shall be constructed of galvanized steel, 12-gauge sheet metal, angle and frame members with welded joints. The pull box cover shall be gasketed and attached with stainless steel screws. A ground lug shall be provided, sized in accordance with the National Electrical Code.

2.3 CONDUIT OUTLET BODIES, FITTINGS, COUPLINGS, EXPANSION COUPLINGS, CONDUIT SLEEVES, AND SUPPORTS

A. Conduit Outlet Bodies

1. Conduit outlet bodies shall be used where required to permit ready fishing and withdrawing of wires. Conduit bodies not located in areas classified as Hazardous shall be gasketed. Bodies shall be of cast iron or copper-free aluminum type. Bodies shall be Condulet series manufactured by Crouse-Hinds Co., Electrolet series manufactured by Killark Co., or equal.
2. Conduit bodies used with PVC coated rigid metal conduit shall be of the cast type as specified above with a factory applied 40-mil PVC coating. The conduit bodies, fittings, and couplings shall be provided with extruded PVC sleeves as required by NEMA Standards. Conduit bodies, for general service, (½" – 2") shall be equipped with a V-Seal gasket. All general-purpose fittings must be UL Listed for the PVC coating as supplying the primary corrosion protection, in accordance with the National Electrical Code. All screws shall be stainless steel with the screw heads encapsulated with PVC. Product shall be Robroy "Plasti-Bond Red", Perma-Cote, or engineer approved equal.
3. Conduit outlet bodies used with rigid PVC conduit shall be of the same material and schedule as rigid PVC conduit.

B. Fittings and Couplings

1. IMC - Standard Rigid Steel conduit fittings shall be installed with IMC conduit.
2. EMT- All couplings and connectors for EMT shall be of the Rain-tight cadmium plated, malleable iron gland compression type manufactured by O.Z. Gedney Co., Steel City Company, or equal.
3. PVC Coated Rigid Metal Conduit - All couplings and fittings for PVC coated rigid metal conduits shall have factory coating similar to above PVC coated conduit bodies.
4. PVC - All couplings and fittings for PVC rigid conduit shall be of the same material and schedule as PVC rigid conduit.
5. Hazardous Areas - Seal off fittings in areas classified as Hazardous or Corrosive shall be Series EYS manufactured by Crouse-Hinds Co., Series E manufactured by Killark Co., or equal. Sealing compound shall be Chico manufactured by Crouse-Hinds or Series SC manufactured by Killark, or equal. Damming material shall be of the ceramic fiber type.

C. Expansion Couplings

1. Expansion couplings shall be a watertight, corrosion retardant coupling with flexible neoprene outer jacket, stainless steel jacket clamp, flexible copper ground strap, and internal hub bushing.
2. Coupling shall compensate for the following movements:
   a. Axial expansion or contraction
   b. Angular misalignment
   c. Parallel misalignment
3. Coupling shall be Type XD as manufactured by Crouse-Hinds Company, Type DX as manufactured by O.Z. Gedney Co., or equal.

D. Conduit Sleeves
1. Where conduits pass through the walls or floors of structures, they shall be installed in suitable sleeves. Sleeves, installed in the outside walls of structures or elsewhere where watertightness is required, shall be cast iron and shall be equal to thru-wall and floor seal manufactured by O.Z. Gedney Manufacturing Company, Inc. Types No. FSK, WSK, FSC, or WSC as required, or Link-Seal as manufactured by Thunderline Corp. When Link-Seal is used, a wall sleeve, with water-stop, shall be installed. All other sleeves shall be galvanized steel pipe.

E. Conduit Hangers and Supports
1. Hangers and supports for conduits shall be adequate to support conduit systems with a minimum safety factor of 10.
2. All steel parts of the conduit support systems shall be galvanized, cadmium plated or PVC coated.
3. Perforated strap hangars shall not be used.
4. Conduit supports shall be as manufactured by Steel Coty Co. (Kindorf), Unistrut Corp., Allied Tube & Conduit Corporation (Power-Strut) or equal.
5. One hole, malleable iron pipe clamps shall be hot-dipped galvanized. Pipe spacers shall be of malleable iron and have a hot-dip galvanized finish.
6. Hanger rods shall be continuous thread and galvanized not less than 3/8” inch in diameter.
7. All fasteners shall be stainless or silicon bronze.
8. All expansion anchors shall be self-drilling type.

F. Cable Terminator Fitting
1. Cable terminating fittings shall be provided complete with gland nut and neoprene bushing properly sized to provide a tight seal.
2. Cable terminator fittings shall be CGB or CGF series as manufactured by Crouse-Hinds, or equal.

2.4 MISCELLANEOUS ACCESSORIES

A. Warning Tape
1. Tape shall be red and have imprinted a minimum of 1-inch high letters “CAUTION BURIED ELECTRIC LINE BELOW” or appropriate warning approved by the Engineer.
2. Tape shall be 6 inches wide, 4.5 mils thick, and made of low-density polyethylene.
3. Warning tape shall be as manufactured by Allen Systems (Houston, Texas), Panduit, or equal.

B. Duct-bank Conduit Spacers

1. Underground Duct-bank conduit spacers shall provide stability and consistent separation on duct-banks. Spacers shall be sized for the conduits with which they are used. They shall provide both vertical and horizontal spacing with interlocking intermediate and base spacers.
2. Duct-bank conduit spacers shall be as manufactured by Carlon, or equal

PART 3 EXECUTION

3.1 INSTALLATION

A. General
1. Minimum size shall be ¾ inch unless specifically shown otherwise.
2. Conduit shall be installed with a minimum number of joints. Conduits shall be continuous and shall be secured in such a manner that each system shall be electrically continuous. Terminations of conduits shall be furnished with locknuts at each fabricated panel using watertight conduit hubs. (Use PVC coated hubs in corrosive or chemical environments).
3. Terminations of metallic conduits shall be furnished with grounding bushings in accordance with Section 26 05 26 - Electrical Grounding.
4. All conduit fittings, connectors and couplings shall be properly tightened in such a manner so as not to be easily "backed off" in order that proper ground continuity is established.
5. The use of lubricating materials to aid in the installation of conductors is allowed. Where necessary, a powdered soapstone and "Y-ER-EAS" are acceptable.
6. Support outlets, pull-boxes, and junction boxes separately from building construction, not from conduit.
7. Where exposed conduit is permitted, install conduit parallel to or at right angles with lines of building in neat and organized configurations.
8. Coordinate all conduit installations with other trades in advance of installation.
9. Ream conduit ends before installation
10. Plug conduit openings until wires are installed.
11. Where spare conduits are shown to be installed, the conduit shall be capped at each end as provided with a nylon fish-wire.
12. Expansion couplings shall be installed in conduits crossing building expansion joints.
13. Plug conduit openings until wires are installed
14. Do not install conduit or boxes in structural columns unless detailed on Contract Documents.
15. Do not install adjacent to or on hot surfaces.
16. Do not install conduit in water or in areas saturated with moisture.
17. All conduit threads shall be given a coat of zinc dust in oil or other approved compound and shall be made watertight.
18. All conduits routed next to walls, columns, or ceilings shall have minimum ¼" separation between conduit and walls or ceiling.
19. Conduit reducers shall not be allowed unless otherwise specified, or approved by the Engineer.
20. Conduits entering enclosures shall be provided with Myers hubs.

B. PVC Coated Rigid Metal Conduit Requirements
1. PVC coated rigid metal conduits shall be installed using proper tools for threading and tightening conduit fittings.
2. Cutting back of coating for threading will not be allowed.

3. Minor touch up of coating shall be with manufacturer's recommended touch-up compound of applicable color.
4. Contractor must be trained and certified by the factory before installation of PVC coated products can begin.
5. Any coating and conduit considered by the Engineer damaged excessively shall be replaced at Contractor's expense.
6. Conduits shall be installed with a minimum number of joints. Conduits shall be continuous and shall be secured in such a manner that each system shall be electrically continuous. Terminations of conduits shall be furnished with locknuts at each fabricated panel or pull box using PVC coated hubs. Hubs shall be as manufactured by Myers.
7. Conduits entering enclosures shall be provided with PVC coated Myers hubs.

C. PVC Rigid Conduit Requirements
1. PVC rigid conduit shall be installed per manufacturer's recommendations.
2. Use proper tools for installing PVC conduits.
3. Fittings, boxes, and other accessories shall be PVC of the same schedule with all joints being the solvent cement type.

D. Conduit Supports and Hangers
1. Conduit supports shall be spaced at intervals of 8 feet or less as required to obtain rigid construction.
2. Single conduits shall be supported by pipe clamps with clamp backs to raise conduits at least 1 inch from the surface.
3. Multiple runs of conduits shall be supported on trapeze hangers with steel horizontal members and threaded hanger rods. Trapeze hangers shall be crossed braced to prevent spreading.
4. Conduit hangers shall be attached to structural steel by means of beam or channel clamps.
5. Supports located in corrosive areas and/or where shown shall be PVC coated.

E. Conduit Routing
1. The number of bends, offsets and crossovers shall be kept to a minimum.
2. The Contractor shall exercise the necessary precautions to prevent the lodging of dirt, plaster, or foreign matter, in conduits, boxes and fittings during instillations.
3. Runs shall be parallel to walls, beams, columns and horizontal planes and shall be neatly aligned.
    a. For bends made in the field, an approved conduit bending machine shall be used.
    b. Field bends shall be symmetrical and carefully made so as to prevent damage or deformation of conduit.
4. Conduit runs shall be slightly pitched to facilitate draining condensation or shall be otherwise installed to prevent trapping of condensation.

F. Underground Conduits
1. Conduits shall be buried to a minimum of 24 inches unless otherwise shown or specified.
2. All buried metallic conduits shall be individually tied to plant grounding grid at each electric manhole or handhole.
3. All buried conduits or groups on conduits 2 feet in width or less shall have an identifying tape buried 12 inches under finish grade and located directly over the centerline of the conduits. Groups of conduits over 2 feet wide shall have additional identifying tape per 2

feet or less of additional width. Where shown on the Contract Drawings, additional tapes shall be provided for duct banks wider than thirty inches.

4. Underground conduit not encased in concrete shall be PVC coated rigid steel
5. Underground conduit exiting and entering structures shall have expansion couplings as specified.
6. Where conduit is buried below structures, footing, slabs, etc., the electrical Subcontractor shall excavate, install, backfill, and compact buried conduit prior to final compaction by General Contractor.
7. Any Earthwork shall be in accordance with Section 31 23 16 – Excavation and Section 31 23 23 - Fill.
8. The transition from the underground conduit system to the building interior conduit system shall occur at the first junction box, device, or equipment enclosure within the building. Conduit seals shall be provided at this location. Such seals shall minimize the circulation of air between the underground conduit system and the indoor enclosures. Seals shall be composed of Duct Seal sealing compound or similar non-hardening removable sealant.
9. Conduit bends in underground conduits shall have a minimum centerline radius as follows:

Conduit Size	Radius (inches)
3 inch	36
4 inch	42
5 inch	48

10. Conduits terminating at manholes shall have endbells or insulated bushings.
11. Conduit spacers shall be used when installing two or more underground conduits. Conduit spacers shall be located at intervals of 8 ft or less.

G. Conduits in Concrete

1. All electrical conduit placed in concrete slabs shall be installed after and above the bottom reinforcing bars, but before and under the top reinforcing bars.
   a. Where conduit crossovers are necessary, they shall be located so that the reinforcing bars are not displaced from their positions.
   b. The minimum clearance between conduits shall be 2 times the diameter of the conduit.
   c. No conduit greater than t/4 in diameter, where "t" is the thickness of the concrete slab, shall be placed in any structural slab.
   d. If these conditions cannot be satisfied, the conduit shall be placed below the slabs.
2. Where electrical conduits in slabs cross a building expansion joint, an expansion coupling for each conduit shall be installed at the joint.
3. Conduits encased in concrete shall be type 40 heavy - wall polyvinyl chloride per NEMA standards and UL listed.
4. Where concrete encased conduits enter manholes, #4 dowels shall be installed between the duct bank and manhole, on 8 inch centers around the perimeter of the duct bank, to minimize the potential for conduit shearing at the ductbank/manhole interface.
5. Concrete encased conduits (underground ductbanks) where shown or scheduled shall be schedule 40 PVC. Where these conduits enter buildings or equipment, concrete encasement shall stop approximately 5 ft from the building or equipment. There shall be a transition from schedule 40 PVC to RMC or IMC approximately 10 ft. from the building or equipment, so that the transition occurs within the concrete encasement.

3.2 CONDUIT TYPES

A. Conduit types shall be in accordance with the following schedule unless specifically noted otherwise on the Contract Documents:

Area/Use Description	RMC	IMC	PVC coated RMC	PVC	Reference Notes:
Underground Ductbanks	x	x			
Conduit Encased in Concrete	x	x			
Exposed Conduit	x	x			
Concealed conduit above Ceilings, in walls,etc.					(Branch circuits, fire alarm, telephone service, security, PA only
All conduits in “Corrosive” Areas			x		

B. Only rigid metal conduit (RMC) or Intermediate metal conduit (IMC), shall be provided, unless specifically noted otherwise on the Contract Drawings.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes the requirements for providing the underground distribution systems of raceways, duct banks, handholes, and all necessary construction materials and appurtenances as indicated.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electric Code (NEC)
   2. National Electrical Safety Code (NESC)
   3. American Society for Testing of Materials (ASTM)
   4. Underwriters Laboratories (UL)

B. Equipment furnished under this section shall be furnished by manufacturers who meet the industry standards for quality, workmanship, and experience.

1.3 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of Section 01 33 00 - Submittal Procedures.

B. Shop drawings shall show fabrication and installation details for underground ducts and utility structures. Shop drawings shall include catalog information and fabrication drawings for conduits, duct banks, handholes, and all associated accessories. Associated accessories include, but are not limited to, handhole hardware, duct bank spacers, warning tape, and miscellaneous components. Include schedules indicating type, size, number, and identification of all materials and components.

C. Submit scaled layout drawings for the underground distribution system. Drawings shall include the following information:
   1. Underground Distribution Plan, showing manhole and handhole locations, and interconnecting concrete and sand encased duct banks. Scale shall be 1" = 20' maximum.
   2. Duct bank sections, showing scaled cross-sections and labels and sizes of ducts.
   3. Duct bank profile, showing mounting elevations, duct bank penetrations to manholes, handholes, and buildings. Scale shall be 1" = 20' maximum. Other underground utilities in the affected area shall be shown.

D. Submit fabrication and installation details for underground ducts and utility structures.
   1. For handholes, shop drawings shall show the following information:
      a. construction details of individual segments

b. joint details
c. design calculations

2. Submit catalog data for manufactured components in handholes.
   a. Submit product certificates for concrete and steel used in underground precast manholes, in accordance with ASTM C 858.
   b. Submit product test report indicating compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all labor, materials, equipment, and services necessary for a complete installation.

B. Fasteners, supports, and hardware shall be stainless steel.

2.2 UNDERGROUND DUCT BANKS (CONCRETE ENCASED)

A. Underground duct banks shall be arrangements of single bore, PVC conduits (except where otherwise specified herein to be PVC coated rigid steel conduits) concrete encased with steel reinforcing bars. The number and size of conduits shall be as indicated on the Contract Drawings.

B. PVC schedule 40 conduit shall be in accordance with the requirements of Section 26 05 33 - Conduits and Raceways Systems.

C. Concrete for duct banks shall be 3,000 psi test in 28 days (with pea gravel aggregate) and shall be in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

D. Reinforcing steel (rebar) shall conform to ASTM A615 – Grade 40 or Grade 60, minimum ½" and shall be in accordance with the requirements of Section 03 30 00 Cast-in-Place Concrete.

E. Conduit spacers shall be rigid plastic and shall maintain conduit spacing during concrete pour.

F. Joint sealant shall be watertight as recommended by conduit manufacturer.

G. Thruwall and Floor Seals shall be OZ type "FSK" or "WSK", or equal.

2.3 UNDERGROUND DUCT BANKS (DIRECT BURIED)

A. Underground duct banks shall be arrangements of PVC coated rigid galvanized steel (RGS) conduits encased in sand, unless otherwise specified. Conduit shall be provided as specified in the Section 26 05 33 - Conduits and Raceways Systems. Direct buried conduits shall only be installed where specifically indicated in the Contract Documents.

2.4 HANDHOLES

A. Precast handholes shall be reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of handhole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading in non-road or pavement areas and ASSHTO H20 loading in road or pavement areas.

B. Cover shall be labeled to identify the handhole as "ELECTRIC" or "SIGNAL".

2.5 CONSTRUCTION MATERIALS

A. Mortar. Mortar shall be in accordance with ASTM C 270, Type M, except for quantities less than 2 cubic feet (60 l). If quantity is less than 2 cubic feet, packaged mix complying with ASTM C 387, Type M may be used.

B. Concrete. Concrete shall be 3000 psi (20.7 MPa) minimum, 28 day compressive strength and 3/8 inch (10mm) maximum aggregate size. Concrete and reinforcement shall be as specified in Section 03000 Concrete.

2.6 ACCESSORIES

A. Warning Tape
1. Tape shall be red and have imprinted a minimum of 1-inch high letters "CAUTION BURIED ELECTRIC LINE BELOW" or appropriate warning approved by the Engineer.
2. Tape shall be 6 inches wide, 4.5 mils thick, and made of low-density polyethylene.
3. Warning tape shall be as manufactured by Allen Systems (Houston, Texas), Panduit, or equal.

B. Duct-bank Conduit Spacers
1. Underground Duct-bank conduit spacers shall provide stability and consistent separation on duct-banks. Spacers shall be sized for the conduits with which they are used. They shall provide both vertical and horizontal spacing with interlocking intermediate and base spacers.
2. Duct-bank conduit spacers shall be as manufactured by Carlon, or equal

C. Duct-Sealing Compound shall be non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C), and capable of withstanding temperatures of 300 deg F (150 deg C) without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 EXECUTION

3.1 GENERAL

A. Perform all site preparation, excavation, trenching, and backfilling necessary to install underground duct banks, handholes, transformers pads, and vaults. Excavation and backfill shall

be performed in accordance with the requirements of the Section 31 23 16 – Excavation and Section 31 23 23 – Fill.

B. Grounding and bonding shall be in accordance with the requirements of the section entitled "Electrical Grounding".

C. Cleaning
1. Keep conduits and handholes free from concrete, dirt, debris, and other substances during the construction.
2. After the duct lines have been completed, pull a standard flexible mandrel not less than 12 inches long, having a diameter approximately ¼ inch less than the inside diameter of the conduit, through each conduit; then pull a brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the conduit. This requirement shall not be applicable for PVC coated rigid steel conduit.
3. Replace conduits that do not allow passage of the mandrel at no additional cost to the Engineer.
4. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full lengths of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

D. Install a 3/8" nylon or polypropylene pull line in all spare conduits. Plug and seal spare conduits after cleaning.

E. Identify all conductors and cables within handholes and manholes with permanently indented or engraved tags. Identifying information shall include circuit origin, circuit number, and load served.

3.2 CONDUIT AND DUCT INSTALLATION

A. Adhere to lines, grades, elevations, and dimensions as indicated. Resolve interferences with other underground conduits, piping, or equipment, either new or existing, with the Engineer. Match components suitable for proper installation.

B. Prior to trenching, locate underground piping and conduits above and up to 12-inches below the new conduit duct banks by hand digging.

C. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 12 feet, except when manufactured bends are used at or near ends of short runs of 100 feet or less. Long sweep bends shall be made up of one or more curved or straight sections. Install manufactured bends with a minimum radius of 48 inches at risers and where larger radius cannot be used.

D. Curves and Bends. Use manufactured galvanized rigid steel elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5m), both horizontally and vertically, at other locations.

E. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

F. Slope of conduits. Pitch duct lines with a minimum slope of four inches per 100 feet and slope towards manholes and handholes and away from buildings and structures.

G. Building Entrances. Make a transition from underground duct to conduit at least 10 feet (3 m) outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below.
   1. Concrete Encased Ducts. Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building.
   2. Direct Buried, Non-encased Ducts at Non-waterproofed Wall Penetrations. Install a Schedule 40, galvanized steel pipe sleeve for each duct. Caulk space between conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.
   3. Waterproofed Wall and Floor Penetrations. Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

H. Concrete Encased, Nonmetallic Ducts. Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:
   1. Separator Installation. Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
   2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 19-mm (3/4-inch) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
   3. Reinforcement. Reinforce duct banks where they cross disturbed earth and where indicated.
   4. Forms. Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
   5. Minimum Clearances between Ducts. 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
   6. Depth. Install top of duct bank at least 24 inches (600 mm) below finished grade in nontraffic areas and at least 30 inches (750 mm) below finished grade in vehicular traffic areas, unless otherwise indicated

I. Direct Buried Ducts. Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:
   1. Separator Installation. Space separators close enough to prevent sagging and deforming of ducts.
   2. Install expansion fittings as shown on Shop Drawings.

3. Trench Bottom. Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earthwork" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Backfill: Install backfill as specified in Division 31 Section "Earthwork." After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum Clearances between Ducts. 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
6. Depth. Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.

J. Warning Tape. Install non-biodegradable, red plastic marker tape above every duct bank. Warning tape shall be in accordance with Section 26 00 00 - Electrical General. Bury warning tape approximately 12 inches (300 mm) above all concrete encased duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank.

K. Stub-ups. Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet (1.5 m) from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.

L. Sealing. Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psig (1.03-MPa) hydrostatic pressure.

M. Pull Cord. Install 100 lbf (445 N) test nylon cord in ducts, including spares.

3.3 GROUNDING

A. Provide grounding at each handhole as follows:
1. Drive a single ¾" diameter by 10 foot long, copper-clad steel ground rod through a hole in the bottom of each manhole and handhole. Leave 6 inches above floor and seal penetration with grout and sealant.
2. Ground rods shall be properly bonded to equipment grounding conductors, metallic cable sheaths, cable racks, manhole cover frame, and ladders. Ground rods shall also be connected to grounding grids located at the nearest adjacent buildings. Ground connections shall be exothermic weld type as specified in the Section 26 05 26 - Electrical Grounding. Ground cables shall be neatly and firmly attached to interior walls, and the amount of exposed bare wire held to a minimum. Bonding wires for racks and ladders shall be #4/0 stranded soft drawn bare copper.
3. Terminate steel conduit entering manholes and handholes using grounding bushings. Ground all steel conduits entering manholes to the ground rod inside the manhole.`

B. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes materials, procedures, practices, and requirements that shall be provided for identification of raceways, conductors, instruments, equipment, and devices.

1.2 QUALITY ASSURANCE

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)
   2. Underwriters Laboratories, Inc. (UL)

1.3 SUBMITTALS

A. Prior to obtaining any materials in conjunction with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures.

B. Submittals include:
   1. Complete list of all engraved nameplates. Failure to indicate all nameplates on this list shall not relieve the contractor of the requirement for their installation.
   2. Sample of engraved nameplate, punch type label, marking tags, laminated instrument tags.
   3. Catalog data sheets for engraved nameplates, marking tags, or other item used to identify equipment.
   4. Duplicate set of all engraved nameplates.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Nameplates shall be engraved lamicoid.

B. All lettering shall be uppercase (condensed block type), unless otherwise noted.

C. Nameplate colors shall be black with white letters unless otherwise shown.

D. Nameplate numbering system, lettering style, and letter size shall be as shown on Contract Drawings, schedules, etc.

E. Plaques for building disconnecting means shall be provided on disconnecting means enclosures for each disconnecting means. For building with multiple power sources, each power source disconnecting means shall be provided with a plaque identifying it as a building disconnecting

means, and the total quantity of building disconnecting means within the building. Plaques shall be of the same construction as the service entrance plaques specified in Section 26 21 01 – Incoming Services.

2.2 MARKING TAGS (WIRE AND CABLE IDENTIFICATION)

A. Marking Tags shall be means of preprinted plastic tape. Manufacturer: Brady, O.Z. Gedney, equal.

2.3 INSTRUMENT TAGS

A. Instrument tags shall be laminated vinyl tape, minimum 3 inches by 5 inches with preprinted insert and "write on" type laminate to provide calibration and servicing information. Each tag shall include a pre-punched hole for fastening to instrument with ty-raps.

B. Tags shall be Panduit No. PST-2 or equal with a preprinted (not handwritten) insert.

C. Each instrument tag shall include the following as appropriate:

SIDE1

FIT – 5021(*instrument tag number)*
FLOW INDICATIONG TRANSMITTER *(instrument type)*

Manufacturer: xxxxx
Model No.: xxxxx
Serial No.: xxxxx
Calibrated Range: xxxxx
Power: 0-24 VDC *(if applicable)*
Installed by: xxxxx, Inc.
Any town, Any state, USA

SIDE 2 *(write-on laminate side)*

FIT – 5021 *(instrument tag number)*
FLOW INDICATING TRANSMITTER *(instrument type)*

Calibrated Range: xxxx-xxxx GPM
Output: 4-20 mA
Alarms Set @ High: xxxxx
Low: xxxxx
Recommended Service Interval: xxx months
Last Serviced on: xxxxx
Last Serviced by: xxxxx

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow the numbering systems specified, scheduled and/or shown on the Contract Documents.

B. Provide identification noted on panel schedules, one-line diagrams, etc. for all instruments, panelboards, contactors, transformers, disconnect switches, bus-ways, motor starters, devices, controllers, motor control centers, unit substation, fire alarm systems, sound systems, and all other electrical devices and enclosures. Indicate with engraved lamicoid nameplate, on cover of equipment and label with numbers and letters as shown.

3.2 FASTENING

A. Nameplates: Clean equipment surface and securely fasten each label with silicone adhesive.

B. Instrument Tags: Laminated instrument tags shall be fastened to instruments with cable ties.

3.3 DEVICES (RECEPTACLES AND LIGHT SWITCHES)

A. Label all receptacles and light switches on faceplate with 3/4-inch clear punched (Dymo) tape.

B. Provide the following information:
1. Panel Designations (per panelboard schedules)
2. Branch Breaker Number

3.4 WIRE CABLES

A. Tag all feeders, sub-feeders, special system wiring, and control wiring in each panelboard, pull-box and gutter space, denoting points of origin and termination of the wires.

B. Provide the following information:
1. Panel or source where the conductors originate
2. Circuit Number
3. Circuit Designation

3.5 EMERGENCY LIGHTING

A. All lighting fixtures powered from an emergency source of power shall be identified by 1/2-inch diameter red dots.

3.6 SPECIAL PANELBOARD REQUIREMENTS

A. Nameplates: Identify in accordance with Panel Schedule

B. Directory:
1. Provide complete type written directory for each panel, with all room numbers, functions, etc., clearly identified for each individual branch circuit.

2. Handwritten directory shall be provided until all circuits are connected and balanced. Then, install permanent directory. Do not mark circuit identification on the front of enclosure of panels or on other electrical equipment.
3. Lighting panel locations shall be identified in the panel directory according to location.
4. Electrical sub-feed circuits from panels shall also be identified in the panel directories.
5. When branch circuits are relocated, the panel directory shall be updated to indicate new functions, and locations.
6. When branch circuits are removed, the panel directory shall be updated to indicate a spare.

END OF SECTION

SECTION 26 09 00 - INSTRUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes requirements for the complete instrumentation system for this project as shown, specified and as scheduled. Detailed specifications for instrumentation equipment are included herein, on the Contract Drawings, and where specifically referenced elsewhere in the specifications. Unless otherwise noted, this section shall apply to all instrumentation furnished under this project, regardless of whether it is specifically identified in this section.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revision of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)
   2. National Electrical Manufacturers Association (NEMA)
   3. Underwriters Laboratories (UL)
   4. American National Standards Institute (ANSI)
   5. The American Society of Mechanical Engineers (ASME)
   6. The American Society for Testing Materials (ASTM)
   7. Instrument Society of America (ISA)

B. Qualifications of manufacturer. Provide materials and equipment that are the products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer.

C. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

D. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ISA, ANSI, ASME, ASTM, and other applicable technical standards and shall have neat and finished appearance.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General. In addition, submittals shall include the manufacturer's name, trade name, place of manufacturer, catalog model or number,

nameplate data, size, layout dimensions, capacity, project specification, and technical paragraph reference.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications, associated standards and test requirements.

C. Submittals for individual pieces of equipment such as indicators, flow meters, level meters, etc. shall include manufacturer's data describing the equipment and showing its compliance with their associated specification.

D. The Contractor, his supplier, system builder, or subcontractor shall prepare and submit a set of system coordination drawings which shall show all instrument connections and interconnections as well as the functional and connection relationship of the instrumentation equipment to the related equipment and devices.

E. Prior to obtaining any material in connection with this section, catalog data and detailed wiring connection diagrams shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Drawings shall include elementary and interconnection diagrams showing connections to internal components, and indicate field termination points for power and control interface. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted.

F. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly and section views, and all necessary details pertaining to coordinating the work of the Contract, lists of materials and finishes, parts list and the descriptions thereof, lists of spare parts and tools where such parts or tools are required, and any other information that is required to demonstrate compliance with the Contract Documents. Drawings for electrical equipment shall include elementary and interconnection diagrams showing connections to internal components, and indicating field termination points for power and control interface.

G. Submit factory calibration sheets for all instrumentation, and field calibration sheets for calibration under actual use conditions.

H. Manufacturer's standard wiring diagrams and specific modifications to the wiring of the equipment shall be submitted. All terminal points for field, and interconnecting wiring shall be identified.

I. Samples of any material shall be submitted upon Engineer's request.

1.4 CLOSEOUT SUBMITTALS

A. Prepare four instruction and maintenance portfolios as specified hereinafter. Each shall include:
   1. Index and tabbed section dividers
   2. Reviewed submittals
   3. Wiring diagrams
   4. System coordination drawings

5. Field adjustable settings (e.g. setpoints, ranges, spans current alarm trips)
6. Manufacturer's instructions on care and operation of equipment.
7. Spare parts list
8. Complete typewritten operating instructions, covering all systems descriptions and operation, emergency operating instructions and precautions.
9. Name, address and telephone number of supplier and representative of manufacturer for each item of equipment in Contract.

B. Bind above items (all unused, clean, and legible) in three ring binders and submit to Engineer for review. Provide before request for final acceptance.

C. Provide project record documents which record actual locations of components and circuits.

D. Provide project record documents which record actual setup and calibration of each instrument.

PART 2 PRODUCT

2.1 GENERAL

A. Unless otherwise specified, each measurement system shall be accurate within one percent of full-scale reading over the specified range. This accuracy requirement shall apply to each overall system including any transmitters, retransmitters, receivers, etc. that are shown or required.

B. All instrumentation equipment and components shall be supplied by one contractor, subcontractor, supplier or other single entity who shall coordinate the equipment and its arrangements in the shop drawing, installation and start up stages of the work.

2.2 SIGNAL CARRIERS

A. Signal Carriers for instrumentation shall include the electric wires, cables and conduits as shown, specified and required for a complete transmission of signals between transmitters and receivers.

B. Electronic instrument signals (4-20mA) shall be carried over shielded twisted pairs of wires in accordance with Section 26 05 19 - Wires and Cables. All electric interconnections and terminations shall be in accordance with the requirements for control wiring specified. Signal conductors shall be separated from power and control conductors and routed in separate conduits, regardless of whether they are specifically scheduled or shown.

C. Shielded, coaxial, or special cables, where specified or required by the manufacturer, shall be supplied by the contractor regardless of whether they are specifically scheduled or shown.

D. Current isolators shall be provided and installed where required for proper operation of the equipment.

E. All 4-20 mA analog control loops containing field mounted (i.e. remote from control panel) transmitters shall include surge/lightning transient protectors at the transmitter. Transient protectors shall be Joslyn Model 1669-02, Rosemont Model 470, or equal.

2.3 MISCELLANEOUS EQUIPMENT

A. Enclosures for instruments shall be suitable for the location where mounted and or specified in Section 26 27 16 – Electrical Cabinets and Enclosures.

B. Isolators. Current to Current (I/I) or Current to Voltage (I/E) isolators shall be one of the following:
   1. 4 wire type - Rochester Instrument System (RIS) Series 1300 AC, AGM Series PTA 4000, or equal with options as required for application.
   2. 2 wire type - Rochester Instrument System (RIS) Series 2300, AGM series HPM, or equal with options as required for application.
   3. Rack mounted type - Rochester Instrument System (RIS) Series SC-8300, AGM Series REA 4000, or equal with options as required for application.

C. Power Supplies. DC power supplies shall be of sufficient size to power all connected equipment with an additional 50% reserve. DC power supplies shall be one of the following: Power Mate, Condor Inc., Power One, or equal.

D. Power Disconnection and Overcurrent Protection. Panel mounted instruments shall have integral or external fuse protection.

E. Digital Line Powered Meter
   1. Provide a Digital Line Powered Meter for any and all instruments that require power from a 24 VDC source. The purpose of the digital Line Powered Meter is to provide a locally mounted power supply for the Level Indicating Transmitter, Pressure Indicating Transmitter, or temperature sensor.
   2. Features
      a. NEMA 4X enclosure
      b. Powered using 115/230 VAC (Universal 85-265 VAC input power)
      c. 4-20mA retransmitted signal from instrument
      d. 2 (or 4) programmable relay outputs
      e. User configurable display
      f. Display: 6 digits 1”
      g. Provide mounting kit for Digital Line Powered Meter
   3. Manufacturer/Model
      a. Precision Digital Model PD650, 655, or 656 (655-45)
      b. Precision Digital Model PD6000
      c. Magnetrol Model 009
      d. equal

2.4 FLOAT LEVEL SWITCH

A. Float level switches shall be designed for applications requiring accurate liquid level control. Float switch shall be capable of accurately signaling specific water levels, or for direct alarm actuation.

B. Float level switch shall be designed for horizontal mounting in a tank or process vessel.

C. The float switch shall achieving switching action through use of a magnet attached to the float assembly.

D. Ratings.

Liquid temperature: minimum 32ºF (0ºC), maximum 300ºF (149ºC)
Specific gravity as low as 0.40
Degree of Protection: IP68, 20m (65ft)
Contact ratings: AC resistive load, 250 volts 10 amperes
AC inductive load, 250 volts 3 amperes
DC load, 30 volts 5 amperes

E. Switch Variations

1. Normally Open (N/O). Contacts are open in the hanging position. As the float rises (1" or 5º) above the horizontal position, the contacts shall close.
2. Normally Closed (N/C). Contacts are closed in the hanging position. As the float rises (1" or 5º) above the horizontal position, the contacts shall open.
3. Single Pole, double Throw (SPDT). Both normally open and normally closed contact (but not necessarily both) available.

F. Manufacturer

1. Magnetrol Model TK1
2. equal

2.5 DISPLACER TYPE LIQUID LEVEL SWITCHES

A. Displacer type liquid level switches shall consist suspension cable and displacer elements. Displacer elements and cable shall be 316 stainless steel.

B. Displacer elements shall operate based on buoyancy, whereby a spring is loaded with weighted displacers which are heavier than the liquid. Immersion of the displacers in the liquid shall result in buoyancy force change which shall move the spring upward.

C. All elements of the displacer switch shall be compatible with the liquid being monitored.

D. Displacer elements shall be adjustable along the cable.

E. Displacer elements shall be suitable for operation that indicates liquid levels indicated on the contract drawings.

1. Level switches for Tank T-2R shall be capable of indicating Low, High, and High-High.
2. Level switches for Tank T-6R shall be capable of indicating Low-Low, Low, High, and High-High.

F. Other Ratings

1. Temperature 32ºF (0ºC) through 300ºF (149ºC)
2. Switch contacts shall be rated for 120 VAC, 10 amperes minimum.
3. Switch assembly shall be rated for installation in a Class I Division 1 or Class I Division 2 hazardous location.

G. Displacer Type Liquid Level Switches shall be as manufactured by Magnetrol.

2.6 PRESSURE INDICATING TRANSMITTER

A. The pressure indicating transmitter shall be capable of translating pressure to a 4-20mA signal, proportional to pressure.

B. Pressure sensor shall be capable of measuring the pressure at the discharge of the regenerative blower as indicated on the drawings.

C. Performance Requirements
1. Measurement Range 0-200psi
2. Accuracy +/-0.2% of calibrated span (up to 10:1 turndown)
3. Turn down (minimum span) 10:1
4. Elevation/Suppression -100% to +100%
5. Sensor temperature limit -40º to +212º F (-40º to +100º C)
6. Electronics temperature limit -40º to +185º F (-40º to +85º
7. Wetted parts 316 stainless steel
8. Output signal 4-20mA
9. Enclosure NEMA 6/6P or 4X
10. Power supply 11-45VDC 0 (provide locally mounted Digital Line Powered Meter so unit may be powered using 115VAC)

D. Manufacturer/model
1. Barton Model FCX
2. Endress & Hauser PMP51
3. Mercoid Series EDA
4. equal

2.7 VACUUM SENSOR

A. The vacuum sensor shall be capable of measuring the vacuum level within the process piping at the input to the blower and shall be capable of translating vacuum to a 4-20mA signal, proportional to vacuum.

B. Ratings

1. Wetted Materials	Type 316 stainless steel
2. Signal output	4-20 mA
3. Span	6 to 240 inches
4. Resolution	Analog 0.01 mA, display 0.1 inch
5. Accuracy	1% full scale
6. Power	11-28 VDC

(provide locally mounted Digital Line Powered Meter so unit may be powered using 115 VAC)

C. Manufacturers
1. Dwyer Series 626 or 628
2. SMC ZSE80
3. equal

2.8 TEMPERATURE SENSOR

A. Temperature sensor shall sense process temperature and transmit a 4-20 mA analog signal proportional to measured temperature.

B. Temperature probe shall consist of a 100 ohm RTD temperature sensor housed in a 0.25" diameter, 4" long stainless steel housing.

C. Probe case shall be stainless steel and the thermowell shall be 316 stainless steel.

D. Provide integrated transmitter.

E. Enclosure shall be NEMA 4X.

F. Performance Requirements.
1. Analog Output 4-20 mA proportional to temperature
2. Temperature Measurement Range -50ºC to 260ºC (-58ºF to 500ºF)
3. Power Source 8-30 VDC. Provide digital line powered meter to display temperature and to provide DC power.

G. Manufacturer/Model
1. Minco AS5140 (probe) and TT508 (transmitter)
2. Equal

2.9 DISCRETE LEVEL SWITCH

A. The discrete level switch shall be an ultrasonic level switch which shall be used to detect moisture at the appropriate tank level, and providing a signal to indicate liquid level in the moisture separator.

C. Enclosure shall be NEMA 6.

D. Performance Requirements
1. Accuracy +/- 1mm in water
2. Repeatability +/1- 0.5mm in water
3. Supply Voltage 12-36 VDC. (Provide Digital Line Power Meter to supply power for the until)
4. Consumption 25mA maximum
5. Contact type (1) SPST relay
6. Contact output selectable NO/NC
7. Process Temperature -40ºF to 176ºF (-40ºC to 80ºC)
8. Pressure 150 psi (10 bar) @ 25ºC

9.	Process mount	¾" NPT
10.	Mounting gasket	Viton
11.	Classification	Intrinsically safe
12.	Approvals	Class I, Groups A, B, C, D; Class II, Groups E, F, G

E. Manufacturer/Model
1. Flowline LU10-1305
2. McMaster-Carr 46515K81
3. Equal

2.10 LEVEL INDICATING TRANSMITTER

A. Transmitter

1.	Signal output	4-20 mA
2.	Span	6 to 240 inches
3.	Resolution	Analog 0.01 mA, display 0.1 inch
4.	Power	11-28 VDC

(provide locally mounted Digital Line Powered Meter so unit may be powered using 115 VAC)

B. Performance Requirements

1.	Linearity	<0.1% of probe length
2.	Measured error	+/-0.1% probe length or 0.1 inch (3mm)
3.	Resolution	+/-0.1 inch (3mm)
4.	Repeatability	<0.1 inch (3mm)
5.	Response time	<1 second
6.	Operating temperature range	-40° to +175° F (-40° to +80° C)
7.	Process dielectric effect	<0.3 inch (8mm) of selected range
8.	Humidity	0-99%, non-condensing

C. Manufacturer/Model
1. Magnetrol Model 705 Transmitter and Magnetrol Model 7EB probe
2. equal

D. Schedule

Tag Number	Service	Notes
1) LIT-1	Influent Tank Level	1,2
2) LIT-2	Equalization Tank Level	1,2
3) LIT-3	Effluent Tank Level	1,2

Application Notes:
1. Calibration range shall be equal to tank maximum usable depth
2. Provide surge protection

PART 3 EXECUTION

3.1 INSTALLATION

A. All electronic instruments and systems shall operate on the universal 4-20mA signal system unless otherwise noted and shall be installed in the instrument loop so that the failure or removal of any instrument from the loop, other than primary element or power supply, will not affect the remaining instruments on the loop or the overall integrity of the loop. This shall be accomplished through the use of bias resistors at each receiver.

B. All instruments shall be installed as shown, specified, directed and recommended by the manufacturers.

C. The instrument enclosures shall be solidly grounded with a ground conductor as specified in Section 26 05 26 - Electrical Grounding.

D. Instruments shall be factory calibrated to minimize field adjustments and insure proper operation.

E. Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation; install so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made, but only after obtaining approval from Engineer. All power and signal (4-20 mA / 1-5 VDC / other) cables shall be kept isolated and installed in separate conduit systems.

3.2 MISCELLANEOUS INSTRUMENTATION

A. The following items of materials and installation shall also be provided under this Section.
1. Instrument panels complete with all accessories and appurtenances as shown, specified and scheduled.
2. Furnish and install all mounting stands, supports structures, brackets and accessories as required or detailed for the installation of the instruments furnished. Unless otherwise specified or required, supports shall be galvanized steel. All mounting hardware shall be stainless steel. Equipment mounted on walls in contact with ground or water shall be mounted offset from the wall a minimum of ¼-inch.
3. Temporary storage of all instrumentation equipment shall be in a humidity-controlled environment heated to a minimum of 55°F, maximum of 85°F.
4. Isolation of each device on 4-20 mA loops as required to prevent ground loops, with current-to-current isolators.
5. Current to current isolators as required to provide rated outputs into total impedance of each loop.
6. Identification of instrumentation equipment by means of metal tags or durable printed symbols with information regarding manufacturer, serial number, catalog number and model number.
7. Cutting and drilling of existing panels for new instrumentation as shown, specified, or required, including repair and touch up painting of panel after installation.

3.3 STARTUP

A. Field Tests

1. After installation, instrumentation equipment shall be checked and the required adjustments shall be made by the representatives of the manufacturers.
2. Equipment shall be field tested in the presence of the Engineer and shall be demonstrated to operate satisfactorily over the specified ranges.
3. The Contractor shall provide the necessary test equipment and qualified test personnel.
4. In the event of failure of the field test, the Contractor shall perform the necessary corrections and retest, at his own cost and expense, the equipment as directed by the Engineer.

END OF SECTION

SECTION 26 09 10 - CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes requirements for the Control Panel. This Control Panel shall provide remote control of the major components of the system and provide running logs and display of all electronic sensor readings.

B. Equipment furnished under this Contract shall be installed in an industrial type environment and powered from an electrical source that may include harmonic distortion, surges, sags, and other electrical noise under normal operating conditions. The Contractor and his suppliers shall verify that all equipment furnished shall function correctly in this noisy electrical environment. If the equipment is found to be unable to operate in this environment, the Contractor and/or his suppliers shall furnish any replacement equipment, surge protection, power line conditioners, UPS, or other equipment required to correct this problem at no additional cost to the owner.

C. This section also contains Power Line Surge Protectors as shown on the drawings, specified herein, and otherwise required for appropriate equipment including but not limited to control panels, instrument cabinets, instruments, processors, and other equipment susceptible to damage.

1.2 QUALITY ASSURANCE

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
1. National Electrical Code (NEC)
2. Underwriters Laboratories, Inc. (UL)
3. National Electrical Manufacturers Association (NEMA)
4. JIC Standard EGP-1

1.3 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedure.

B. Submittals shall include:
1. Bill of materials for all components in the panel
2. Catalog data sheets for all components
3. Elevation/layout of panel (front view)
4. Interior sub-panel layout drawings
5. Elementary wiring diagrams (including wire numbers and field connection points)
6. Nameplate list
7. Conduit penetrations
8. Installation and support details

C. Submittal shall contain the NEMA type designation and manufacturer's data describing the enclosure and showing its compliance with specifications and associated standards.

D. Submit diagrams detailing the type, speed, setup parameters, and purpose of all communication ports on each piece of equipment in the control panel. Include a diagram detailing the cabling connections between equipment in the control panel and their ultimate destination or source.

E. Samples of any material shall be submitted upon Engineer's request.

F. Submittal shall contain a narrative describing the Control Strategy that will be used as the basis of the PLC program at each control panel.

G. Contractor shall furnish two copies of all development programming software packages that will be used to program the PLCs and OITs. One copy of the software shall be submitted within 14 days after the shop drawings are approved. The second copy shall be submitted within 60 days of project closeout.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual software and equipment configuration.

PART 2 PRODUCT

2.1 GENERAL

A. A programmable logic controller (PLC) based control system shall be provided to control equipment, generate alarms, collect, and transmit data throughout the site, and provide remote monitoring and control capabilities.

B. The Contractor shall provide a coordinated system. The Contractor shall provide hardware, software, programming, cables, connectors, line drivers, interposing relays, fuses, terminal blocks, power supplies, surge arresters, printed circuit board and graphics drivers, and special controls required to integrate and implement a functional system as specified and shown on the Contract Drawings.

C. The Control Panel shall be furnished to house a programmable controller and all other related items to form a complete control system. The Control Panel shall include a programmable controller that shall serve as the local controller at the SVE compound. The PLC shall also be capable of serving as a remote terminal unit of the SCADA system. The Control Panel shall also include any control relays, timers, power supplies, signal conditioners, surge suppressors, control operators, pilot lights, operator interface terminals, displays, or other equipment necessary to form a complete control system capable of interfacing with the instruments in the well house.

D. Type 1 Surge Protection Device. Type 1 surge protection shall be provided for each power feed to each control panel. The device shall provide the following Surge Protection Performance Requirements:

1. Ambient Conditions:

Degree of protection	IP22
Ambient temperature	-40ºC to 80ºC (-40ºF to 176ºF)
Altitude	<2000 m
Permissible humidity	5% through 95%
Shock (operation)	30g (half-sine / 11 ms / 3x +/-X, +/-Y, +/-Z)
Vibration (operation)	7.5g (10 – 500 Hz / 2.5 h / X, Y, Z)

2. General:

IEC test classification	test class II
EN type	T2
IEC Power Supply System	TN-S separate protective earth (PE) and neutral (N)
Mode of protection	L-N, L-PE, N-PE
Mounting type	DIN rail; 33 mm

3. Protective circuit:

Nominal voltage U_N	240/415 VAC
Nominal frequency f_N	50 Hz / 60 Hz
Maximum continuous operating voltage U_c (L-PE)	385 VAC
Maximum continuous voltage U_c (N-PE)	358 VAC
Residual current I_{PE}	< 600 uA
Nominal discharge current I_n (8/20) us	40 kA
Maximum discharge current I_{max} (8/20) us	80 kA
Short-circuit current rating I_{SCCR}	25 kA

4. UL specifications

SPD Type 1

Maximum continuous operating voltage	MCOV (L-L)	750 VAC
Maximum continuous operating voltage	MCOV (L-N)	750 VAC
Maximum continuous operating voltage	MCOV (L-G)	385 VAC
Maximum continuous operating voltage	MCOV (N-G)	385 VAC
Nominal voltage		277/480 VAC
Modes of protection	L-L, L-N, L-G, N-G	
Power distribution system	480/277 Wye	
Nominal frequency	50/60 Hz	

5. Standards and regulations: meets IEC 61643-11

6. Control Panel surge protection device shall be Phoenix Contact Type 1 surge protection device – VAL-US-277/90/4+-FM 2910380 (for 480VAC 4-wire and equipment protection ground).

E. Type 3 Surge Protection Device. Type 3 surge protection shall be provided for the 120VAC power at each control panel. The device shall provide the following Surge Protection Performance Requirements:

1. Ambient Conditions:

Degree of protection	IP20
Ambient temperature	-40ºC to 80ºC (-40ºF to 176ºF)
Altitude	<2000 m

Permissible humidity	5% through 95%
Shock (operation)	30g (half-sine / 11 ms / 3x +/-X, +/-Y, +/-Z)
Vibration (operation)	5g (10 – 500 Hz / 2.5 h / X, Y, Z)

2. General:

EN type	T2/T3
IEC Power Supply System	TN-S separate protective earth (PE) and neutral (N)
Mode of protection	L-N, L-PE, N-PE
Mounting type	DIN rail: 33 mm
Short-circuit current rating I_{SCCR}	0.25 kA DC(w/o additional backup fuse) 5 kA DC (for 20 A gG / B backup fuse)
Maximum continuous voltage U_C	150 V DC

3. Protective circuit:

Nominal voltage U_N	120 VAC (TN-S ot TT)	
Nominal frequency f_N	50 Hz / 60 Hz	
Maximum continuous voltage U_c (N-PE)		150 VAC
Rated load current I_L		26 A (at 30°C)
Residual current I_{PE}		< 5 uA
Nominal discharge current I_n (8/20) us		5 kA
Standby power consumption PC		<10.6 mVA (at U_{REF}), <13.5 mVA (at U_C)
Reference test voltage U_{REF}		132 VAC
Maximum discharge current I_{max} (8/20) us		10 kA
Combination Wave U_{OC} (8/20) us		6 kA
Voltage protection level U_p (L-N)		< 0.75 kV (at U_{OC}) and < 0.95 kV (at I_n)
Voltage protection level U_p (L-PE)		< 0.85
Voltage protection level U_p (N-PE)		< 0.85
TOV behavior U_T (L-N)	240 VAC (5 s / withstand mode), 240 VAC (120 min / withstand mode)	
TOV behavior U_T (L-PE)	240 VAC (5 s / withstand mode), 240 VAC (120 mins / withstand mode), 1332 VAC (200 ms / safe failure mode)	
TOV behavior U_T (N-PE)	1200 VAC (200 ms / safe failure mode)	
Response time t_A (L-N)	<25 ns	
Response time t_A (L-PE)	<100 ns	
Response time t_A (N-PE)	<100 ns	
Short-circuit current rating I_{SCCR}		10 kAC

4. UL specifications

SPD Type 2 (Open-Type SPD)	
Maximum continuous operating voltage	MCOV (L-L) 150 VAC, 150 VDC
Nominal voltage	150 VDC
Rated load current I_L	20 A
Modes of protection	L-N, L-G, N-G, (DC+)-(DC-), (DC+)-G, (DC-)-G
Power distribution system	single phase
Nominal frequency	50/60 Hz
Voltage protection rating VPR (L-N)	700V

Voltage protection rating VPR (L-G)	700V
Voltage protection rating VPR (N-G)	900V
Nominal discharge current I_n	5 kA
Short-circuit current rating (SCCR)	10 kA AC, 5 kA DC

5. Standards and regulations: meets IEC 61643-11

6. Surge protection device for 120 VAC shall be Phoenix Contact Type 3 surge protection device – PLT-SEC-T3-120-FM-UT 2907918.

F. Surge Protection Device for 2-wire floating signal circuit. Two wire surge protection shall be provided for sensors which utilize a 4-20 mA current loop. The device shall provide the following Surge Protection Performance Requirements:

1. Ambient Conditions:

Degree of protection	IP20
Ambient temperature	-40°C to 85°C (-40°F to 185°F)
Permissible humidity	5% through 95%
Altitude	<4000 m
Degree of protection	IP20

2. General:

Housing material	PBT
Mounting type	DIN rail: TH 35-7.5mm, two-section divisible module
Direction of action	Line-Line & Line-Signal Ground/Shield

3. Protective circuit:

IEC test classification	C1, C2, C3, D1
Nominal voltage U_N	24 VDC
Max. continuous voltage U_C	30 VDC, 21 VAC
Rated current	600mA (56°C)
Operating effective current I_c at U_c	< 5uA
Residual current I_{PE}	<1uA
Nominal discharge current I_n (8/20) us (line-line)	5kA
Nominal discharge current I_n (8/20) us (line-earth)	5kA
Pulse discharge current I_{imp} (10/350) us (line-line)	0.5kA
Pulse discharge current I_{imp} (10/350) us (line-earth)	0.5kA
Total discharge current I_{total} (8/20) us	10kA
Voltage protection level U_p (line-line)	<200V (C1 – 1 kV/500A), <320 V (C2 – 10kV / 5kA) <50 V (C3 – 25A) <55 V (C3 – 100A)

4. UL specifications

SPD Type 2 (Open-Type SPD)		
Maximum continuous operating voltage	MCOV (L-L)	150 VAC, 150 VDC
Nominal voltage	150 VDC	
Rated load current I_L	20 A	

Modes of protection	L-N, L-G, N-G, (DC+)-(DC-), (DC+)-G, (DC-)-G
Power distribution system	single phase
Nominal frequency	50/60 Hz
Voltage protection rating VPR (L-N)	700V
Voltage protection rating VPR (L-G)	700V
Voltage protection rating VPR (N-G)	900V
Nominal discharge current I_n	5 kA
Short-circuit current rating (SCCR)	10 kA AC, 5 kA DC

5. Standards and regulations: meets IEC 61643-21 2000

6. Surge protection device for 4-20mA devices shall be Phoenix Contact surge protection device – TTC-6P-1X2-M-24DC-PT-I 2906750.

2.2 ENCLOSURE

A. Enclosure shall be NEMA 4X. NEMA 4X enclosures shall be water-tight and dust-tight suitable for outdoor installation, protecting enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation. Enclosure shall also be corrosion resistant. NEMA 4X enclosures located outdoors shall be stainless steel or painted fiberglass for enhanced UV protection.

B. Enclosure Construction
1. Enclosure shall be constructed of a minimum of 14 gauge steel.
2. Seams shall be continuously welded and ground smooth, with no holes or knockouts.
3. Exterior hardware shall be stainless steel.
4. Enclosure shall be provided with gray prime finish over phosphatized surface inside and out with a white enamel interior unless otherwise specified.

C. Enclosure Door
1. Enclosure shall be provided with front access single door, as required for the enclosure size. Door shall be provided with three point latches operated by a key locking handle. Latch rods shall have rollers to facilitate door closing.
2. Door shall be mounted with continuous piano hinges. A rolled lip around minimum three sides of door shall be provided to prevent dirt and liquid from dropping into the panel when door is open.
3. Door shall be fitted with a neoprene gasket applied with oil resistant adhesive and held in place with stainless steel retaining strips.
4. Provide an interior door swing-out panel. Swing-out panel shall be by the same manufacturer as the enclosure and shall be specifically designed by the manufacturer for this application. Swing-out panel shall provide an area to mount devices (instead of mounting these devices on the exterior door) so that these devices will be afforded a degree of protection from outdoor weather.

D. Interior Subpanels

1. Interior subpanels shall be constructed of minimum 14 gauge steel finished in white enamel paint. Fasteners, screws, and equipment mounting racks shall be stainless steel.

E. Enclosure Accessories
1. A print pocket shall be provided on interior face of the enclosure.

F. Internal Wiring
1. Terminal blocks for external connections shall be suitable for No. 12 AWG wire, fabricated complete with marking strip, covers, and pressure connectors. Terminal blocks shall be rated for 30A at 600 VAC unless noted otherwise. An additional 25 percent spare terminals shall be provided.
2. Terminals shall be labeled to agree with identification shown on supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Wires shall be numbered using wire markers. Wire numbers shall agree with terminal numbers, associated with remote equipment wiring designations, as indicated on the submittal drawings.
3. Wiring shall be grouped or cabled and firmly supported in the panel. Plastic wireway, Panduit or equal, shall be used to route wire within the panel. Wireway shall be run in continuous length with snap on covers.

G. Circuit Identification
1. Each circuit shall be identified by a typewritten directory with transparent sealed plastic cover, fastened to the inside surface of the door of the enclosure.
2. Devices mounted on or within the enclosures shall be permanently identified. The device and terminal identifications shall agree with those shown on the Contract Drawings

2.3 PROGRAMMABLE CONTROLLER

A. General
1. The PLC processor and related equipment shall be the product of one manufacturer and the components shall be completely compatible.
2. The PLC processor shall be designed and tested to operate in an industrial, high electrical noise environment. The system shall be provided with RFI protected shields and barriers to prevent interference with other electrical systems.

B. PLC Processor
1. The PLC shall be a 16 bit microprocessor-based stand-alone device. It shall be a process and logic controller designed for industrial environments. It shall be capable of a mix of logic, timing, counting, and computation functions. It shall also include a library of preprogrammed subroutines, and PID loop control capabilities.
2. The PLC shall come complete with central processors, memory, communication ports, uninterruptible power supply, interconnecting cables, and discrete and analog I/O interfaces.
3. The PLC and associated hardware shall have the following ratings (minimum):

Operating Temperature:	0 Deg. C to 60 Deg. C (32 Deg. F to 140 Deg. F)
Storage Temperature:	-40 Deg. C to 85 Deg. C (-40 Deg. F to 185 Deg. F)
Humidity:	5% to 95% relative (non-condensing)
Vibration:	5g @ 10-500 Hz
Shock	20g

Emissions	CISPR 11 Group 1, Class A	
ESD immunity	IEC 61000-4-2 6kV contact discharge, 8kV air discharge	
Radiated RF immunity	IEC 61000-4-3 10V/m with 1 kHz sine-wave 80% AM from 80-2000 MHz 10V/m with 200 Hz 50% 100% AM from 900 MHz 10V/m with 200 Hz 50% 100% AM from 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000-2700 MHz	
EFT/B immunity	IEC 61000-4-4 +/- 3kV at 5kHz on power ports and communications ports	
Surge Transient Immunity	IEC 61000-4-5 +/- 2kV line-earth (CM) on communication ports	
Controller Tasks:	continuous	32 tasks
	Periodic	100 programs/task
	Event Tasks	all event triggers
Memory Size and Type	1.5MB	
Number of I/O modules	30	
Current draw	660mA @ 5VDC, 90mA @ 24VDC	
Power dissipation	5.5W	
Isolation voltage	30V	
Communication Ports	RS-232 Fully isolated 38.4 Kbps Ethernet/IP port 10/100 BASE-T	

4. The PLC shall monitor the internal operation of the PLC system for failures. If a failure is detected, the system shall shut down and freeze all inputs and outputs in their last states until the error is cleared. As a minimum, the following failures shall cause the PLC to shut down:
   a. Memory Failure
   b. Memory parity failure
   c. I/O cycle failure
   d. Operating system failure

5. PLC memory shall be read/write RAM, with an EEPROM or Flash module provided. The RAM shall be battery-backed and shall retain a program for a minimum of six months if there is a loss of external power.
6. PLC Processor shall be Allen-Bradley Modular Compact1769.

C. Isolated Analog Input Module
   1. Where indicated on the Contract Drawings, the PLC system shall include an Isolated Analog Input Module. The Analog Input Module shall be capable of reading 4-20mA signals for the instruments indicated.
   2. The Analog Input Module shall have the following ratings:
      a. 8 channel voltage or current analog input
      b. Resolution 16 bits
      c. Input range +/-10V or 0-20mA
      d. Input Impedance 220kohms (voltage) and 250 ohms (current)
      e. Accuracy +/- 0.2% full scale (voltage) and +/- 0.35% full scale (current)
      f. Normal Mode Rejection -50 dB @50/60 Hz

3. Analog Input Module shall be Allen-Bradley Model 1769-IF8.

D. Compact Current Output Analog Module
1. Where indicated on the Contract Drawings, the PLC system shall include an Analog IOutput Module. The Analog Output Module shall be capable of generating 4-20mA signals for the instruments indicated.
2. The Analog Output Module shall have the following ratings:
   a. 8 channel 4-20mA or 0-20mA current output
   b. Resolution 16 bits
   c. Output range 4-20mA or 0-20mA
   d. Resistive load on current output: 0-500 ohms (including wire resistance)
   e. Accuracy +/- 0.35% full scale @25ºC(77ºF)
   f. Output Impedance >1MOhm
   g. Open and short circuit protection
3. Analog Output Module shall be Allen-Bradley Model 1769-OF8C.

E. Digital Input Module
1. Where indicated on the Contract Drawings, the PLC system shall include a Digital Intput Module. The Digital Input Module shall be capable of reading 16 discrete 120 VAC input points.
2. The Digital Input Module shall have the following ratings:
   a. Number of digital inputs: 16 120VAC
   b. Input delay 20msec
   c. Input Current: 5mA typical
   d. Response Time: Off to On 7msec, On to Off 24msec typical
   e. Isolation: 1500VAC
   f. Power Requirements: 5V @ 115mA
3. Digital Input Module shall be Allen-Bradley Model 1769-IA16.

F. Relay Contact Output Module
1. Where indicated on the Contract Drawings, the PLC system shall include an AC/DC relay contact Output Module. The Digital Input Module shall be capable of reading 16 discrete relay outputs rated for 120VAC.
2. The Relay Contact Output Module shall have the following ratings:
   a. Number of relay outputs: 16 normally open
   b. Delay 10msec
   c. Current per point: 2.5 Al
   d. Response Time: Off to On 7msec, On to Off 24msec typical
   e. Isolation: 1800VAC
   f. Power Requirements: 5V @ 2005mA
3. Relay Contact Output Module shall be Allen-Bradley Model 1769-OW16.

G. Operator Interface
1. Contractor shall provide an Operator Interface Terminal (OIT) to display status and fault messages, and to receive inputs from the operator.
2. The OIT display shall be a touch screen interface for programmable controllers to display pictorial information, data, and messages that are preloaded into it. The touch screen area shall be programmed to perform various functions to receive inputs from the operator. The

OIT display shall receive messages from the PLC processor via an Ethernet or RS-232 communication link.

3. The display shall have a display area of 211mm(W) by 158mm(H) with a pixel resolution of 640(W) x 480(H).
4. The Operator Interface display shall have the following ratings:

Input Power	18-32 VDC 2.9A at 24VDC
UL	UL Listed Industrial Control Equipment
CE	EN61000-6-2 Industrial Immunity
	EN61000-6-4 Industrial Emissions
EMI	Complies with FCC Class A
Vibration endurance	10 to 25 Hz (X Y Z direction 2G 30 minutes)
Environmental	NEMA 4 / IP65 front panel with high bright panel
Operating Environment:	0°C to 55°C (32°F to 131°F)
Operation Humidity	5 to 95% relative humidity, non-condensing
LCD Display	5.7" STN 256 color
Contrast Ratio	30:1
Brightness	150 cd/m^2
MTBF	25,000 hours
Pixel size	0.33mm (W) x 0.33mm (H)
Touch Panel	4 wire resistive type
Touch Granularity	2mm grid
Touch Feedback	Beeper and graphic indicator
Surface Hardness	4H
Processor	32 bit RISC CPU 200 MHz
Flash Project Memory	2MB
System Memory	4MB DRAM

5. Operator Interface shall be Allen-Bradley PanelView Plus 1000.

H. The Contractor shall provide all discrete input modules, discrete output modules, analog input modules, and analog output modules required for interfacing to the instruments located at each pumping station.

I. The Contractor shall provide any modem, communications module, antenna, telephone interface, cables, or other equipment to establish communications with a programmable controller and central computer located at the Ocean Pines Wastewater Treatment Plant. The programmable controller shall be programmed to accept commands from the central computer and transmit the status of any device or the measured value of any instrument in the pumping station.

J. The programmable controller shall be programmed to provide a seamless and coordinated operation of all devices in the treatment compound, SVE site, or the wells.

2.4 POWER SUPPLIES

A. DC power supplies shall be of sufficient size to power all connected equipment with an additional 20% reserve.

B. Performance Requirements

1. Nominal Input Voltage: 100-240VAC (wide range input)
2. Input Voltage Range: 85-264 VAC (0.82 – 0.33A, 1.4A for 120VAC input) 45-65 Hz, 90-350 VDC
3. Inrush current limiting: < 35A
4. Switch-on time: < 1 sec
5. Built in Transient Surge Protection Device: Varistor
6. Nominal Output Voltage: 24VDC +/- 1%
7. Output Voltage Range Setting: 22.5-28.5 VDC
8. Nominal Output Current: 2A
9. Startup of capacitive Loads: Unlimited
10. Derating: from 60oC (140oF), 5% per Kelvin
11. Internal Surge Protection: limited to approximately 33VDC
12. Maximum Power Loss (no load/nominal load): 2W/10W
13. Connection in parallel to increase redundancy and power

C. General Requirements
1. Isolation Voltage (input/output): 4kV/3kV
2. Enclosure Package Degree of Protection: IP 20
3. MTBF: greater than 500,000 hours
4. Ambient Temperature (Operation): -25oC to +70oC (-13oF to +158oF)
5. Storage Temperature: -40oC to +85oC (-40oF to +185oF)
6. Humidity: up to 95% at 25oC (77oF), no condensation
7. Conformance to the EMC Directive 89/336/EEC and the Low Voltage Directive 72/23/EEC

D. DC Power Supplies shall be one of the following: Phoenix Contact MINI-PS-100, or equal

2.5 UNINTERRUPTIBLE POWER SUPPLY

A. The PLC system shall include an Uninterruptible Power Supply that shall provide for interrupted service by the PLC processor in the event of a power failure. The Uninterruptible Power Supply shall consist of two parts: 1) 24VDC Power Supply Unit and 2) Uninterruptible Power Supply unit containing the energy storage.

B. The 24VDC Power Supply shall have the following performance characteristics:

1. Enclosure degree if protection: IP20
2. Ambient Temperature: 13ºF to 158ºF (-25ºC to 70ºC)
3. Humidity: <95% (25ºC non-condensing)
4. Nominal Input Voltage: 100-240VAC or 110-250 VDC
5. Input Voltage Range: 100 -240 VAC (-15% / +10%) or 110-250VDC -18%/+40%
6. Frequency range: 50-60 Hz +/- 10%
7. Power consumption: 163 VA
8. Inrush current: 14A
9. Input fuse: 6.3A
10. Power factor: 0.82
11. Nominal output voltage: 24VDC
12. Nominal output current: 5A
13. Output power: 120W

14. Typical response time: 300msec
15. Efficiency: >88%
16. Insulation voltage input/output: 4kVAC (type test) and 2kV AC (routine test)

The 24VDC power supply shall be Phoenix Contact QUINT4-PS/1AC/24VDC/5 2904600

C. The Uninterruptible Power Supply unit shall have the following performance characteristics:
1. Enclosure degree if protection: IP20
2. Ambient Temperature: 32°F to 104°F (0°C to 40°C)
3. Humidity: <95% (25°C non-condensing)
4. Input Voltage: 24VDC
5. Input Voltage Range: 18 VDC to 30 VDC
6. Current consumption (maximum): 9.3A (at 24 VDC)
7. Current consumption (idle): 9.7 mA
8. Current Consumption (charging process): 1.7A
9. Nominal output voltage: 24 VDC
10. Nominal output current: 5A
11. Power boost: 7.5A
12. Efficiency: >97%
13. Battery technology: VRLA

The Uninterruptible power supply shall be Phoenix Contact QUINT-UPS/24VDC/24VDC/5/1.3AH 2320254

2.6 ELECTRIC HEATERS

A. Provide electric heaters for outdoor control panels. Electric heaters shall be sized to protect sensitive mechanical, electrical, and electronic equipment from the harmful effects of condensation, corrosion, and low temperatures.

B. Electric heaters shall be thermostatically controlled, fan driven units that can maintain a stable temperature within the control panel. Thermostat shall be adjustable from 0°F to 100°F (-18°C to 38°C).

C. Electric heaters shall be Hoffman model DAH or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Enclosures shall be provided with wiring, schematic, layout, connection, and control diagrams.

3.2 INSTALLATION

A. Enclosure wiring shall be installed by the manufacturer and shall be brought out to identified terminal blocks. Interwiring between sections shall be from terminal blocks to terminal blocks. Terminal blocks for wiring shall be correlated with those for the electrical equipment by the

enclosure manufacturer. Each terminal block shall contain no more than two wires on each side. Additional terminal blocks shall be provided when connection of more than two wires are required.

B. Wiring for panel enclosures shall be neatly arranged in bunches taped or tied together at six inch intervals and shall be securely attached to the interior of the panel unless continued within plastic wireways. Identification of panel component and wiring shall be as shown on the submittals. Wiring to door mounted components shall be bundled and enclosed in flexible spiral wrap to provide protection to the wiring.

C. Panels shall be grounded, and equipment and circuits included in the panels, as shown or required to be grounded, shall be connected to the grounding conductors.

D. Equipment shown or specified to be furnished with the panels shall be mounted by the panel manufacturer. Panel mounted controls and components shall be mounted a minimum of 30" above finished floor and a maximum of 72" above finished floor. The panels shall be furnished as completely assembled units, requiring only field connections of power and control wiring.

E. Pole or wall mounted panels shall be provided with brackets designed for pole or wall mounting.

F. Where multiple power sources enter a single enclosure, a nameplate shall be provided indicating: "CAUTION: MULTIPLE POWER SOURCES" or similar warning.

G. Not less than eight inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space.

H. AC and DC wiring shall be run in separate plastic wireways.

I. Where different voltages are present within the enclosure, provide nameplates indicating the voltage levels applicable to terminals. Terminals for 480 VAC and 120 VAC shall be separated a minimum of six inches. If the enclosure contains low voltage instrumentation wiring and terminals, the wiring and terminal blocks shall be separated from the 120 VAC and 480 VAC wiring by a minimum of six inches. The terminal blocks for low voltage instrumentation wiring shall be enclosed in a separate steel enclosure inside the terminal cabinet for shielding.

J. Power terminal blocks shall be provided with clear Lexan shields removable without removing the power terminal blocks.

3.3 PROGRAMMING

A. Develop application software and program the programmable controller to operate the treatment system. The programmable controller shall monitor the status of all digital and analog inputs and control all of the equipment connected to its outputs. All equipment shall operate in a manner consistent with the equipment manufacturer’s recommendations.

B. The Regenerative Blower and the SVE System shall be programmed to operate continuously, in accordance with the manufacturer’s instructions and recommendations.

C. The butterfly valves shall be programmed to balance the air flow from the wells. The air flow shall be user adjustable to maximize their performance.

D. The transfer pump shall be programmed to pump any water from the moisture separator, as indicated by the level/float switches.

E. The Operator Interface Terminal shall be programmed to display a graphical representation of the equipment and systems shown on drawing C-508 or C-509: the Regenerative Blower, the Soil Vapor Extraction Blower Module, the Transfer Pumps, the Air/Water Separation Vessels, The Deep Wells, the Shallow Wells, the Surge Tank, the butterfly valves, and the instrumentation.

This graphical representation shall consist of multiple screens logically organized to provide the user with an intuitive feel for navigating through these multiple screens. These multiple screens shall be organized around a main screen that shall depict an overview of the Treatment System. Additional screens shall depict an overview of each equipment system that makes up the Treatment System. These additional screens shall be user selectable from the overview screen by choosing an appropriate icon. Additional screens depicting the Treatment System shall be available and user selectable from the main screen.

F. Information on each screen shall be arranged in a concise and orderly appearance, with options to select (or "drill down to") more detailed information that shall be provided on additional screens. The status of all input and output points shall be depicted on either the site overview screen, or on one of the detail screens. It shall be possible to determine the status of each input or output point by selection of the appropriate screen.

G. All screens be designed to provide a consistent appearance and feel for the operator, and shall be maximized to the greatest extent possible and practicable. All overview or summary screens shall present a similar appearance where possible and practicable. The additional screens depicting the details at each system or piece of equipment should also present a consistent appearance and feel.

H. Appropriate symbols shall be chosen for each graphical element. Design of the graphical elements shall be done to maximize readability and minimize confusion. Graphical elements shall be designed to replicate an appropriate symbol for the item that is to be represented, to give a realistic appearance for the item to be represented, or to represent that item in a manner so that it cannot be misunderstood.

3.4 FIELD TESTS

A. The panel shall be checked and necessary adjustments shall be made in the field after installation, by representatives of the manufacturers of the equipment included in the panel.

B. The panel shall be functionally tested by simulating the inputs. Tests shall be in the presence of the Engineer.

END OF SECTION

SECTION 26 09 16 - MISCELLANEOUS ELECTRICAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes miscellaneous controls, electric indicating instruments, instrument transformers, elapsed time meters, pressure and limit switches, control stations, pushbuttons, selector switches, and indicators and all appurtenances necessary for a complete installation.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electric Code (NEC)
   2. National Electrical Manufacturers Association (NEMA)
   3. Underwriters Laboratories, Inc. (UL)
   4. International Electrotechnical Commission (IEC)

B. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General. In addition, submittals shall include the manufacturer's name, trade name, place of manufacturer, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification, and technical paragraph reference.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications, associated standards and test requirements.

C. Prior to obtaining any material in connection with this section, catalog data and detailed wiring connection diagrams shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Drawings shall include elementary and interconnection diagrams showing connections to internal components, and indicate field termination points for power and control interface. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted.

D. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly and section views, and all necessary details pertaining to coordinating the work of the Contract, lists of materials and finishes, parts list and the

descriptions thereof, lists of spare parts and tools where such parts or tools are required, and any other information that is required to demonstrate compliance with the Contract Documents. Drawings for electrical equipment shall include elementary and interconnection diagrams showing connections to internal components, and indicating field termination points for power and control interface.

E. Submittal shall contain manufacturer's descriptive data including ratings, circuit diagrams, and dimensional data.

F. Samples of any material shall be submitted upon Engineer's request.

1.4 CLOSE OUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCTS

2.1 CONTROL RELAYS AND CONTACTORS

A. Plug-In Control Relays (Control Panel Applications)
1. General purpose control relays shall be provided where control functions require remote indicating functions, use of interposing relays, or for other control functions where installed in control panels, annunciator panels, and display panel applications.
2. Control panel relays shall be plug-in type. Provide 120 VAC coil relays with pin-type construction for AC control wiring and 24 VDC coil relays for DC control wiring. AC coil relays shall be pin type construction and DC coil relays shall be blade-type construction. Provide 8 or 11 pin-type or blade-type sockets as required for mounting relays.
3. Control panel relays shall be provided with a pushbutton for testing the operation of the relay and other control functions.
4. Control relays shall be provided with an integral indicating light to show the state of the relay coil (energized or de-energized) and contacts.
5. Contacts for use with analog circuits shall be Silver Cadmium Oxide type rated for 10 amperes at 240 VAC. Solid State Timing Relays (TR) shall have adjustable time settings within adjustable time
6. Control relays shall be as manufactured by:
   a. Square D – Class 8501 type K
   b. Idec – RR Series
   c. Potter & Brumfield
   d. equal

B. Solid State Timing Relays
1. Solid state timing relays shall have adjustable time settings within adjustable time ranges.
2. Timing ranges shall be adjustable from 0.5 seconds to 24 hours, unless noted otherwise.
3. Timing relays shall have four selectable modes: on-delay, off-delay, one-shot, and repeat cycle.
4. Solid state timing relays shall be as manufactured by Square D Class 9050 type JCK, or equal.

C. Pump Alternation Relays
   1. Alternation relays shall change the sequence of the pumps after every cycle of operation.
   2. The alternation relay shall plug into a standard octal pin relay socket and include position indicating lights.

D. Heavy Duty Machine Tool Relays
   1. Heavy duty control relays shall be provided for operation where installed in motor control centers or individually enclosed motor starters.
   2. Control relays shall be of the heavy duty, 600 VAC machine tool type, designed for rapid cycling duty or continuous operation.
   3. Relays shall be of modular construction capable of mounting adder decks to increase the number of output contacts. Contacts shall be convertible in the field from normally open to normally closed and vice-versa, without additional parts. Relay armatures shall be operable manually, without power, for testing purposes.
   4. Timing relays provided for use with reduced voltage motor starter applications shall be the standard product of the motor starter manufacturer.
   5. Heavy duty machine tool relays shall be as manufactured by:
      a. Square D – Class 8501 Type C
      b. General Electric – Type CR120B
      c. equal

E. Lighting Contactors
   1. Lighting contactors shall be designed for ballast lighting rated at 30 amperes. The contactors shall have two poles minimum and be used as a means to control the lighting in the lighting control panels.
   2. The contactors shall have the following features:
      a. Electrically and mechanically held
      b. Field convertible with N.O. and N.C. indicators, 8 N.C. contacts maximum.
      c. Silver-Cadnium-Oxide double break contacts
   3. The contactors shall be UL listed and labeled.
   4. Contactors shall be as manufactured by Square D Class 8903, or equal.

F. Three Phase Power Monitor Relays
   1. Three phase power monitor relays shall detect phase loss, voltage and phase reversal, and low voltage line conditions. The relay shall continuously monitor the three phase power lines for abnormal conditions. The monitor shall consist of a solid state voltage and phase angle sensing circuit coupled to a electromechanical relay.
   2. The three phase power monitor shall be suitable for monitoring 480 VAC, 3 phase, 60 Hz. power systems. The output relay shall be provided with a field adjustable trip delay feature and provided with a single pole double throw form contacts rated at 5 amperes minimum.
   3. The relay shall be provided with a red LED type failure indicator.
   4. The relays shall be as manufactured by:
      a. SSAC Inc.- RLM Series
      b. Time Mark Corporation - Model 252
      c. equal

2.2 PUSHBUTTONS, SELECTOR SWITCHES, INDICATOR LIGHTS

A. All field mounted devices shall be heavy duty, oiltight, with die cast operator bodies, and molded modular type contact blocks.

B. Unless noted otherwise, pushbuttons, selector switches, and indicator lights mounted on the front of control panels shall be the 30mm, heavy duty, industrial style.

C. Pushbuttons, selector switches, and indicating lights shall be configured as shown on the Contract Drawings, specified, or detailed. (e.g. momentary contacts, maintained contacts, 2-position, lockout type, spring return to center, or other control functions).

D. Pushbuttons
1. Pushbuttons shall have color button operator with guards, engraved legend plates, and contact blocks as required.
2. Stop pushbuttons shall be of the mushroom head type.
3. Emergency stop pushbuttons shall be of the maintained contact type, push to stop, pull to release, with the extra large mushroom style knob, legend plate, and color appropriate for an emergency stop function.
4. Lockout stop pushbuttons shall be designed to accommodate a padlock in the stop position

E. Selector Switches
1. Selector switches shall have glove hand type operators, engraved legend plates, and contact blocks as required.
2. Selector switches for use with analog circuits shall be provided with gold plated contacts

F. Indicating Lights
1. Indicating lights shall be wired for "push-to-test" operation when specified, shown, or required.
2. Indicating lights shall be 120 volt transformer type unless otherwise noted.
3. Indicating lights shall be provided with interchangeable color caps.
4. Indicating lights shall be provided with engraved legend plates stating the intended control function and purpose.

G. Pushbutton and Indicator Light Colors
1. Unless otherwise noted, pilot light and pushbutton colors shall be in accordance with NFPA-79 Industrial Machinery, modified below to provide additional definition.
2. Indicator Lights Colors
   a. Red – On/Open/Danger/Alarm
   b. Green – Off/Closed/Ready
   c. Yellow or Amber – Caution/Attention
   d. White – Power On/Energized
   e. Blue – Miscellaneous
3. Pushbutton Colors
   a. Red – Stop/Off/Emergency Stop
   b. Green – Start/On
   c. Yellow or Amber – Intervention/Return
   d. Black – No specific function

H. Manufacturers
   1. Square D Class 9001 Type K
   2. Allen-Bradley Bulletin 800T
   3. General Electric CR2940
   4. equal

2.3 CONTROL STATIONS

A. Control stations of less than sixteen units, located in non-hazardous areas and in Dry Locations shall be rated NEMA 13, oiltight, die cast, with synthetic rubber gaskets, threaded conduit openings, pre-punched gasketed pushbutton openings, and concealed hinge covers.

B. Control stations of more than sixteen units, located in non-hazardous areas and in Dry Locations shall be rated NEMA 12, with hinged and gasketed covers, and punched pushbutton openings.

C. Control stations located in Hazardous Areas shall be approved for Class 1, Division 1, Group D atmospheres. Control stations shall be rated NEMA 7 with approved pushbutton assemblies.

D. Control stations located in Wet Locations or Corrosive Areas shall be NEMA 4X, fiberglass reinforced thermoplastic enclosures with gasketed covers and conduit holes. Grounding bushings shall be provided on all metallic conduits entering the control stations and metallic pushbuttons.

E. Control station manufacturers:
   1. Non-hazardous control stations (less than sixteen units)
      a. Allen- Bradley Bulletin 800T Series TZ
      b. General Electric CR2940 Series BC
      c. Square D Class 9001 Type KYK
      d. equal
   2. Non-hazardous control stations (greater than sixteen units)
      a. Hoffman NEMA 12 or NEMA 4X enclosures
      b. equal
   3. Hazardous location control stations
      a. Crouse-Hinds NEMA 7 control station
      b. equal
   4. Corrosive Area and Wet location control stations
      a. Square D Class 9001 Type SK
      b. Hoffman Series PBRFG
      c. Equal

2.4 MISCELLANEOUS CONTROLS FUNCTIONS

A. Elapsed Time Meters
   1. Elapsed time meters shall be provided where shown on the Contract Drawings. The time meters shall have synchronous clock motor movements for service at 115 VAC, single phase at 60 Hertz, and 3 inch dials with 6 digits, calibrated in hours and tenths of an hour. The elapsed time meters shall be Westinghouse Type BH-351, General Electric Type 240 or equal.

B. Power Conditioner

1. Power conditioners shall be furnished to provide power protection against sags, surges, swells, spikes, and electrical noise. The power protection unit shall provide noise suppression and fast microcomputer-controlled voltage regulation.
2. Power conditioners shall be rated for 10 kVA with a 208 VAC, 3 phase input power rating and a 208/120 VAC, 3 phase power output rating. Unit shall be hardwired to a 208/120 VAC, 3 phase lighting panelboard.
3. Power conditioners shall be Model 62610-Line 2 as manufactured by Square D Company, or equal.

C. Photocells
1. Photocells shall be provided to control automatic operation of the site and area lighting fixtures. The Photo-controller shall be mounted inside the Lighting Control Panel and the sensor mounted outside the building against the wall in an area where it is less likely to be illuminated by car lights.
2. Photocells shall be suitable for operation on a 120VAC, single phase power and UL listed.
3. Photocell shall include a built-in time delay to prevent false triggering and shall be able to control up to 64 circuits of lighting.
4. Photocells shall be provided where shown on the Contract Drawings. Provide two (2) spare photocell units.
5. Photocells shall be Lithonia, model Panelmax/LPC with the features specified above or equal.

D. Limit Switches
1. Mechanical limit switches shall have a heavy duty, snap action mechanism that prevents false contact opening. Limit switches shall be the lever arm with hardened roller configuration.
2. Limit switch enclosure shall be metal and rated NEMA 4. Limited switch shall use a booted shaft design to prevent penetration of foreign materials.
3. Provide 1 N.O. and 1 N.C. set of contacts, rated for 20 amperes. Wire insulation shall be rated for 600VAC and DC.
4. Limit switch shall meet the following requirements:
   a. Temperature range: 0°F to 200°F (-17°C to 93°C)
   b. Vibration resistance: 30G max (10-55 hz)
   c. Repeatability: 0.03°.

PART 3 EXECUTION

3.1 INSTALLATION

A. General
1. All controls unless shown otherwise shall operate at 120 VAC.
2. All electrical control components shall be installed as shown and specified in the Contract Documents, as directed by the County and as recommended by the manufacturers.
3. The enclosures containing electrical components shall be solidly grounded with a ground conductor as specified in Section 26 05 26 – Electrical Grounding.
4. Where existing controls are shown to be utilized for new functions, a new, permanent tag shall be provided to identify the new control function.

B. Field Tests
1. After installation, all controls shall be checked and the required adjustments shall be made.

2. Each control function on each piece of equipment shall be field tested and certified to be functioning by the Contractor. Contractor shall notify Engineer three days in advance of this test and allow the Engineer to be present during testing. Equipment shall be field tested in the presence of the Engineer and shall be demonstrated to operate satisfactorily.
3. In the event of failure of the field test, the Contractor shall retest the equipment, at his own cost and expense, as directed by the Engineer.

END OF SECTION

SECTION 26 21 01 - INCOMING SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all material required, shown or specified for the incoming electrical and telephone services for the two treatment systems which will be located at 6703 Bandera Road, and 6600 Bandera Road, (both of San Antonio TX 78238) , and requirements for providing underground distribution systems of raceway and necessary appurtenances as indicated.

B. The Contractor shall be responsible for making arrangements with the electrical utility company, CPS Energy, relative to a timely installation of the incoming electric services and for coordination of his work with the power company.

1.2 QUALITY ASSURANCE

A. The incoming electrical service shall be inspected and approved by CPS Energy and any local electrical inspection agency responsible for such inspections. A certificate of inspection from that agency shall be provided before the incoming service is energized.

B. Material and installation shall be in accordance with the latest revision of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)

C. Qualifications of manufacturer. Provide materials and equipment that are the products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer.

D. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General.

B. A copy of the inspection certificate from the local electrical inspection agency for the incoming electrical service shall be submitted to the Engineer.

C. Any and all utility company permits, electric service orders (ESO), etc., shall be submitted.

D. Submit details of service entrance plaques.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCT

2.1 ELECTRICAL SERVICE

A. All material shown on the Contract Drawings, specified below, or required by the utilities shall be in accordance with the applicable sections of the specifications.

B. The incoming electrical service at the Treatment Compound shall be 480VAC 3 phase, and sized to operate all of the equipment at the Treatment Compound.

2.2 DETAILED MATERIAL REQUIREMENTS

A. Provide all labor, materials, equipment and services necessary for and incidental to the complete installation and operation of electrical work as indicated on the Contract Drawings and specifications.

B. Grounding shall be in accordance with the requirements of Section 26 05 26 – Electrical Grounding.

2.3 UNDERGROUND DUCT BANKS (DIRECT BURIAL)

A. Underground duct banks shall be PVC coated rigid galvanized steel conduits direct buried, unless otherwise noted. Conduit shall be as specified in Section 26 05 33 – Conduits and Raceway Systems.

B. Duct banks shall conform to installation details indicated on Contract Drawings

PART 3 EXECUTION

3.1 COORDINATION WITH THE ELECTRICAL UTILITY

A. The Contractor shall make arrangement and coordinate with the Engineer and with AEP Texas to obtain the electrical services at this site. The Contractor will be responsible for the cost of the new services, as defined in Section 01 20 00 Price and Payment Procedures.

B. The Contractor shall coordinate with CPS Energy to obtain the most economical installation.

C. The Contractor shall be responsible for scheduling installation of the electrical service.

3.2 INSTALLATION

A. The Contractor shall perform all manual excavating and backfilling and site preparation necessary to install the underground conduit included in this section of the work.

B. The Contractor shall install the underground conduit minimum of 24" below grade.

C. Penetrations shall be sealed to a watertight condition.

D. Keep conduit free from concrete, dirt, and other substances during the construction. After conduit have been installed, pull standard flexible mandrel not less than 12 inches long, having a diameter approximately 1/4" inch less than the inside diameter of the conduit, after which pull a brush with stiff bristles through the conduit to make certain that no particles of earth, sand, or gravel have been left in the conduit. Replace conduit that do not allow the passage of the mandrel at no additional cost to the Owner.

E. Contractor shall backfill and regrade to original condition after installation of the conduit.

F. Install detectable, non-biodegradable 3" wide yellow metallic marker tape 12" below grade above every ductbank. The word “ELECTRIC” shall appear continuously along its length.

END OF SECTION

SECTION 26 22 00 - LOW VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes dry type distribution transformers, enclosures, and accessories. Electrical ratings shall be as shown on the contract drawings.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revision of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)
   2. National Electrical Manufacturers Association (NEMA)
   3. Underwriters Laboratories (UL)
   4. American National Standard Institute (ANSI)

B. Qualifications of manufacturer. Provide materials and equipment that are the products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer.

C. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General. In addition, submittals shall include the manufacturer's name, trade name, place of manufacturer, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification, and technical paragraph reference.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications, associated standards and test requirements.

C. Prior to obtaining any material in connection with this section, catalog data and detailed wiring connection diagrams shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Drawings shall indicate field termination

points. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted.

D. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly and section views, and all necessary details pertaining to coordinating the work of the Contract.

E. Submittal shall contain manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and heat dissipation to ambient. Submittals shall also contain manufacturer's part number for the equipment.

F. Manufacturer's standard wiring diagrams and specific modifications to the wiring of the equipment shall be submitted. All terminal points for field and interconnecting wiring shall be identified.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCT

2.1 TRANSFORMERS

A. Dry Type Transformer – General
1. Three phase transformers shall be 480 volt delta primary and 208Y/120 secondary unless otherwise noted.
2. Transformers shall be 115ºC temperature rise above 40ºC ambient. All insulating materials to be in accordance with NEMA ST20-1972 standards for a 220ºC UL component recognized insulation system.
3. Transformer coils shall be of the continuous wound and copper construction.
4. Cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with structural steel angles. The completed core and coil shall then be bolted to the base of the enclosure but isolated therefrom by means of rubber, vibration-absorbing mounts. There shall be not metal-to-metal contact between the core, coil, and the enclosure.
5. The entire transformer enclosure shall be primed, and finished with a gray, baked enamel top coat.
6. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
7. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.
8. Dry type transformers shall be "Sorgel" as manufactured by Square D Company; types QB, ML, QMS or QL as manufactured by General Electric Company; or equal.

B. Variable Frequency Drive Isolation Transformers

1. Isolation transformers shall meet the requirements of Part II, A.1 above. In addition to the requirements of Part II, A.1, drive isolation transformers shall include the following:
   a. Designed for harmonics per IEEE 519-1992.
   b. Designed per UL Standard 1561/1562 for effects of harmonic heating.
   c. Designed with 4% minimum reactance for 150 degree C temperature rise.
   d. Conform to IEEE-597 Class B overload.
   e. Designed for mechanical stress of dc drive current spikes.
   f. Isolation transformer shall be of the typed designed to suppress electrical noise.
   g. Provide load regulation of 3% from no load to full load.
   h. Provide the following noise regulation:
      1) i. Common-Mode: 100 million to 1 (140 dB)
      2) ii. Transverse-Mode: 1000 to 1 (60 dB)
2. Isolation transformers shall be as manufactured by Square D Company, Class 7400 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Transformers shall be installed as shown, specified and recommended by the manufacturer.

END OF SECTION

SECTION 26 27 16 - ENCLOSURES

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes enclosures of the type suitable for their locations to protect all electrical equipment and controls.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following:
   1. National Electrical Code (NEC)
   2. Underwriters Laboratories, Inc. (UL)
   3. National Electrical Manufacturers Association (NEMA)
   4. International Electrotechnical Commission (IEC)

B. Qualifications of manufacturer: All equipment furnished under this Section shall be furnished by manufacturers who meet the industry standards for quality, workmanship, and experience.

C. In general, all electrical equipment furnished shall be listed and labeled by Underwriters Laboratories, Inc. (UL) or another acceptable organization to the Engineer and owner. Submit name of organization that will label equipment if other than Underwriters Laboratories. Organization shall certify that the equipment meets applicable UL,ANSI, and NEMA standards.

D. Control panels shall be constructed and UL Labeled by a UL certified panel shop.

1.3 SUBMITTALS

A. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures.

B. Enclosures shall be submitted with each piece of equipment they are protecting.

C. Submittals shall contain the NEMA or IEC type designation and manufacturer data describing the enclosure and showing its compliance with specifications and associated standards.

D. A list of nameplate titles shall be submitted for each annunciator panel or enclosure as part of the shop drawing submittals.

E. Samples of any material shall be submitted upon Engineer’s request.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCTS

2.1 GENERAL

A. Enclosures for Protected Work
1. The enclosures for electrical equipment shall be NEMA Type 1 – Gasketed or IEC-IP42 except as modified below.
2. In Outdoor areas, or areas designated as a Wet Location, all work shall meet the requirements of the National Electrical Code for Wet Locations. All electrical equipment and enclosures shall be NEMA Type 4 (or Type 4X), or IEC-IP66.
3. In areas designated as a Corrosive Location, all electrical equipment and enclosures shall be NEMA Type 4X, or IEC-IP66.

B. Where electrical equipment is installed in motor control centers, panels, panelboards, or other control assemblies, no additional enclosures are required except where specifically specified or shown.

C. Lighting fixtures shall be of the type specified in Section 26 50 00 - Lighting Equipment.

D. Device, junction, pull-boxes, and other conduit system accessories shall be as specified in Section 26 05 33 - Conduits and Raceway Systems.

2.2 ENCLOSURES

A. NEMA 12 Enclosures
1. NEMA 12 enclosures shall be dust-tight, drip-tight, and suitable for protecting enclosed equipment and components from fibers, filings, lint, dust and dirt. NEMA 12 enclosures shall provide a degree of protection against light splashing, seepage, dripping and external condensation of non-corrosive liquids.

B. NEMA 3R Enclosures
1. NEMA 3R enclosures shall provide protection from falling rain, formation of ice, windblown dust, and other weather hazards. NEMA 3R enclosures shall be suitable for outdoor installation.

C. NEMA 4 Enclosures
1. NEMA 4 Enclosures shall be water-tight and dust-tight suitable for outdoor installation, protecting enclosed equipment against splashing water, seepage of water, falling or hose-directed water, severe external condensation. NEMA 4X enclosures, in addition to the requirements for NEMA 4, shall be corrosion resistant. NEMA 4X enclosures located outdoors shall be stainless steel.

D. Enclosure Construction
1. Enclosures shall be constructed of a minimum of 14 gauge steel.
2. Seams shall be continuously welded and ground smooth, with no holes or knockouts.
3. Exterior hardware shall be stainless steel.
4. Enclosures shall be provided with gray prime finish over phosphatized surface inside and out with a white enamel interior unless otherwise specified.

5. Dimensions of enclosures shown on the Contract Drawings are approximate and represent the minimum size required. Contractor shall size each enclosure as required to house the electrical equipment shown or specified and coordinate space availability.

2.3 ENCLOSURE IDENTIFICATION

A. All enclosures shall have nameplates on the exterior of each enclosure identifying the application function of the equipment enclosed such as "SLUDGE PUMP NO. 1."

B. For Control Stations, a factory installed legend plate shall be provided to indicate the function each station performs, such as "ON" or "OFF."

C. Identification Tags
1. Identification nameplates shall be engraved ¼ -inch high letters on a 1/8-inch thick plastic black nameplate mechanically attached to the enclosure.
2. Legend plates shall be metal with black lettering mechanically attached to control station.
3. Nameplates and circuit identification shall be as specified in Section 26 05 53 – Identification of Electrical Systems.

D. Devices mounted on or within the enclosures shall be permanently identified. All control functions shall be identified. The device and terminal identifications shall agree with those shown on the Contract Drawings.

E. Each circuit shall be identified by a typewritten directory with transparent sealed plastic cover, fastened to the inside surface of the door of the enclosure.

2.4 ENCLOSURE DOORS

A. Enclosures shall be provided with front access single door or double doors as required for the enclosure size. For large enclosures requiring double doors, doors shall be provided with three point latches operated by a key locking handle. Latch rods shall have rollers to facilitate door closing.

B. Doors shall be mounted with continuous piano hinges. A rolled lip around minimum three sides of door shall be provided to prevent dirt and liquid from dropping into the panel when door is open.

C. Doors shall be fitted with a neoprene gasket applied with oil resistant adhesive and held in place with stainless steel retaining strips.

D. Enclosure doors shall be provided with stainless steel door strips to hold the doors in the open position. The open position shall be field adjustable. The doors shall be capable of being opened at a minimum of 90° angle from their closed positions.

E. Provide interior door swing-out panel for outdoor mounted control panels. Swing-out panel shall be shall be shall be by the same manufacturer as the enclosure and shall be specifically designed by the manufacturer for this application. Swing-out panel shall provide an area to mount devices (instead of mounting these devices on the exterior door) so that these devices will be afforded a degree of protection from outdoor weather elements.

2.5 INTERIOR SUBPANELS

A. Interior subpanels shall be constructed of minimum 14 gauge steel finished in white enamel paint. Fasteners, screws, and equipment mounting racks shall be stainless steel.

2.6 INTERNAL WIRING

A. Terminal blocks for external connections shall be suitable for No. 12 AWG wire, fabricated complete with marking strip, covers, and pressure connectors. Terminal blocks shall be rated for 30A at 600 VAC unless noted otherwise. Not less than 25 percent spare terminals shall be provided.

B. Terminals shall be labeled to agree with identification shown on supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Wires shall be numbered using wire markers. Wire numbers shall agree with terminal numbers, associated with remote equipment wiring designations, as indicated on the submittal drawings.

C. Wiring shall be grouped or cabled and firmly supported in the panel. Plastic wireway, Panduit, or equal, shall be used to route wire within the panel. Wireway shall be run in continuous length with snap on covers.

2.7 CONTROL PANEL ENCLOSURE AND CONDUIT SYSTEM ACCESSORIES

A. Conduit system accessories shall be as specified in Section 26 05 33 - Conduits and Raceway Systems.

B. A large print pocket shall be provided on the interior face of the enclosure door.

C. For enclosures housing a programmable controller, provide a folding shelf or equivalent accessory to accommodate a laptop computer or other programming tools for servicing and programming the programmable controller. Provide a 115 VAC, 15 A utility receptacle for use with laptop computer or other programming tools.

D. Provide a fluorescent light in floor mounted, or freestanding enclosures.

E. For floor mounted, or freestanding enclosures housing a programmable controller, provide a window on the enclosure door so the status of the programmable controller processor and input/output modules may be monitored without opening the enclosure door.

2.8 ABOVE GROUND ENCLOSURES

A. Above ground enclosures shall be weatherproof, clamshell design, and provide drip-proof edges which assure the flow of rain water away from the enclosure. Material of construction shall be fiberglass suitable for outdoor installation. Provide corrosion resistant hardware, including hinges, restraining line (to limit the opening of the cover), handle, and locking hasp. Above

ground enclosure shall permit access to the interior contents. Above ground enclosure to be as manufactured by Diffused Gas Technologies, Inc., or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Enclosures shall be provided with wiring, schematic, layout, connection, and control diagrams. These diagrams shall be placed in the print pocket contained on the inside of the enclosure door.

3.2 INSTALLATION

A. Enclosure wiring shall be brought out to identifying terminal blocks. Interwiring between units or sections shall be from terminal block to terminal block. Terminal blocks for wiring shall be correlated with those for the electrical equipment by the Systems Integrator. Each terminal block shall contain no more than two wires on each side. Additional terminal blocks shall be provided when a connection of more than two wires are required. Use the full complement of wiring accessories available to provide a neat and organized appearance.

B. Wiring for panel enclosures shall be neatly arranged in bunches taped or tied together at six inch intervals and shall be securely attached to the interior of the panel unless contained within plastic wireways. Identification of panel component and wiring shall be as shown on the Contract Drawings. Wiring to door mounted components shall be bundled and enclosed in flexible spiral wrap to provide protection to the wiring.

C. Panels shall be grounded, and equipment and circuits included in the panels, as shown or required to be grounded, shall be connected to the equipment grounding conductors.

D. The panel manufacturer shall mount equipment shown or specified to be furnished with the panels. Panel mounted controls and components shall be mounted a minimum of 30” above finished floor and a maximum of 72” above finished floor. The panels shall be furnished as completely assembled units, requiring only field connections of power and control wiring.

E. Where multiple power sources enter a single enclosure, a nameplate shall be provided indicating: “CAUTION: MULTIPLE POWER SOURCES” or similar warning. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

F. Not less than eight inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space.

G. AC and DC wiring shall be routed in separate plastic wireways.

H. Where different voltages are present within the enclosure, provide nameplates indicating the voltage levels applicable to terminals. Terminals for 480 VAC and 120 VAC shall be separated a minimum of six inches. If the enclosure contains low voltage instrumentation wiring and terminals, the wiring and terminal blocks shall be separated from the 120 VAC and the 480 VAC wiring by a minimum of six inches. The terminal blocks for low voltage instrumentation wiring

shall be enclosed in a separate steel enclosure inside the solid state motor controller cabinet for shielding.

I. Component mounting and panel layout shall meet the requirements of NEMA and U.L. for location, type of mounting, separation of components for proper ventilation and air circulation to prevent heat build-up and accessibility for maintenance.

3.3 FIELD TESTS

A. The enclosure shall be checked and necessary adjustments shall be made in the field after installation, by representatives of the manufacturers of the equipment included in the panel.

B. The enclosure shall be functionally tested by simulating the inputs. Tests shall be in the presence of the Engineer.

C. In the event of failure of the field test, the Contractor shall retest, at his own cost and expense, the equipment as directed by the Engineer.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes switches, receptacles, and accessories required for a complete installation as shown and specified.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. American National Standard Institute (ANSI)
   2. National Electrical Code (NEC)
   3. National Electrical Manufacturers Association (NEMA)
   4. Underwriters Laboratories (UL)
   5. Association of Edison Illumination Companies (AEIC)
   6. Insulated cable Engineers Association (ICEA)
   7. American Society of Testing Materials (ASTM)

B. Qualifications of manufacturer: All equipment furnished under this Section shall be furnished by manufacturers who meet the industry standards for quality, workmanship, and experience.

C. All electrical materials and equipment falling within the scope of the Underwriters' standards shall bear the UL Label.

1.3 SUBMITTALS

A. Submittals and samples shall be submitted in accordance with the provisions set forth in the General Conditions, Section 01 33 00 – Submittal Procedures, and Section 26 00 00 - Electrical General.

B. Submit product information for each type of wiring device.

C. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted. Submittals shall contain manufacturer data describing the material and showing its compliance with specifications, associated with standards and test requirements.

D. Samples are not required for specified manufacturers and part numbers. If "equal" products are proposed, samples of both the "equal" and the specified product shall be submitted for comparison purposes. Equal products will not be considered unless samples are submitted.

PART 2 PRODUCT

2.1 GENERAL

A. Provide industrial grade heavy-duty wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated, which are UL listed and which comply with NEMA WD 1 and other applicable UL, Federal, and NEMA standards.

B. Provide ivory color devices except as otherwise indicated.

C. Model or series numbers, where indicated, refer only to the specified manufacturer. Identical numbers by other manufacturer are not considered equal.

2.2 SWITCHES AND RECEPTACLES

A. Receptacles (Wall Plug): Wall plug receptacles shall be NEMA 5-20R rated 15 amperes at 120 VAC of the two-pole, three-wire type. They shall be suitable for use with a three-wire polarized plug having two parallel blades and shall have the third leg grounded. They shall meet the requirements of Federal Specifications WC596.

B. All duplex receptacles shall be:
1. Hubbell 5262 Series heavy-duty industrial grade.
2. Leviton 5262 Series heavy-duty industrial grade.
3. Arrow Hart 5262 Series heavy-duty industrial grade
4. Daniel Woodhead 5262 Series heavy-duty industrial grade.
5. Equal (samples of any proposed equal products shall be submitted as noted above).

C. GFCI Receptacles: Receptacles marked as GFI shall be of the ground fault interrupter type. They shall be UL rated Class A, Group 1. They shall be Hubbell Series GF5262 or equal.
1. Single GFCI receptacles providing “downstream” protection are not acceptable unless specifically shown.
2. GFCI circuit breakers used with conventional receptacles are not acceptable where GFCI receptacles are indicated.
3. GFCI receptacles shall be installed for all wet locations, including service receptacle on roof for HVAC unit, and all analytical instruments, unless otherwise noted.
4. All GFCI receptacles shall have plastic rainshield covers installed, unless otherwise noted.

D. Receptacles (other): Other receptacles shall be industrial grade heavy duty of the type specified on the drawings, or as required to feed the corresponding equipment. Device boxes for the receptacles shall be of the type appropriate for each location.

E. Switches: Lighting switches shall be rated 20 amperes at 277 VAC, toggle operated, plastic enclosed, single pole, three-way, or four-way as shown or required. They shall meet Federal Specification WS896. Switches shall be: Hubbell 1221 Series heavy-duty industrial grade, Leviton 1221 Series heavy-duty industrial grade, Arrow Hart 1221 Series heavy-duty industrial, or equal. Samples of any proposed equal products shall be submitted as noted above.
1. Dimming switches shall be used with fluorescent dimming ballasts. The dimming switches shall be coordinated to work with the ballasts as recommended by the manufacturer. The

dimming switches shall be paddle switch type, single pole or three-way as required, and shall include selected light level slider and an On/Off at selected level.

2. Switches shall have silver cadmium oxide alloy contacts and provisions for side and back wiring.
3. Device boxes for switches shall be of the type appropriate for each location. Switches in hazardous locations shall be suitable for installation in Class I, Group D, Division1 Hazardous Locations.

F. Corrosion Resistant Devices. Devices used in area noted as corrosive, wet, or classified (hazardous) shall be "corrosion resistant". Devices shall be industrial grade heavy-duty constructed with additional protection from corrosive environments including additional nickel plating on metallic parts, melamine bodies, and weatherproof boots. Devices shall be Hubbell Series CM, Leviton Series CM, Arrow Hart Series CR, or equal.

G. Plates. Unless otherwise specified, flush plates for devices shall be smooth stainless steel type 302. Plates in unfinished areas shall be galvanized steel, unless otherwise noted . Plates in wet, corrosive, or outdoor areas shall be of the corrosive resistant weatherproof design. Plates shall be Hubbell S1 Series, Leviton S Series, Arrow Hart S1 Series, or equal.

H. Weatherproof Outlet Covers. Weatherproof outlet enclosures shall be provided for receptacles and switches installed in Wet Locations. Covers shall protect electrical devices while the device is in use (cord is plugged in). Covers shall be constructed of a UV protected clear Lexan material. Covers shall be provided with provisions for pad-locking the cover in the closed position. Covers shall be provided for installation for single gang and multi-gang device boxes, and GFCI type receptacles where required. Weatherproof covers shall be as manufactured by Carlon Electrical Products, Mulberry Metal Products (Weathersafe Outlet Enclosures), or equal.

2.3 POWER PLUGS AND RECEPTACLES FOR PROCESS EQUIPMENT

A. Power plugs and receptacle shall be provided for connection of submersible mixer motor equipment and sample pumps where shown on the Contract Drawings. Power plugs and receptacle shall be designed for use with highly inductive and resistive loads. The power plugs and receptacles shall be UL listed as a combination disconnect switch, plug and receptacle per UL Standard 98 and 508.

B. Plug and receptacle assembly shall be watertight, suitable for installation in Wet Locations. When not in use, the receptacle shall be shielded by a protective lid. Receptacle shall be provided with an angle adapter and junction box suitable for wall or backboard mounting. Parts shall be provided with a corrosion protective finish.

C. Power plug and receptacle shall be a 3 pole, 4 wire, 480 VAC, 30 amperes and rated for 10 horsepower minimum. Units shall have a UL 10,000 ampere short circuit rating. Plugs and receptacles shall be provided with 2 sets of integral pilot contacts (total of 4 contacts) which shall allow connection of 2 closed loop auxiliary control signals.

D. Power plugs and receptacles shall be Type DSM3 as manufactured by Meltric Corporation or equal, with accessories as specified.

PART 3 EXECUTION

3.1 INSTALLATION

A. Wall receptacles shall be mounted 18 inches above floor unless otherwise noted or required by the National Electrical Code.

B. Switches shall be mounted 48 inches above floor on knob side of doors unless otherwise noted or required by the National Electrical Code. Coordinate switch locations with cabinets, temperature controls, and other devices to avoid conflicts.

C. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

D. Coordinate with Work, including painting, electrical boxes, and wiring installations, as necessary to interface installation of wiring devices with other Work.

E. Install wiring devices only in electrical boxes, which are clean, free from building materials, dirt, and debris.

F. Install wiring devices after wiring work is completed.

G. Install wall plates after painting work is completed.

H. All metallic raceways shall be electrically continuous and bounded in accordance with the NEC for proper grounding.

END OF SECTION

SECTION 26 28 00 - PANELBOARDS AND CIRCUIT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes low voltage panelboards, circuit breakers, disconnect switches, fuses, and other circuit protective devices for service at 600 VAC or less.

1.2 QUALITY ASSURANCE

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)
   2. National Electrical Manufacturers Association (NEMA)
   3. Underwriters Laboratories, Inc. (UL) 1449
   4. American National Standards Institute (ANSI)

B. Qualifications of manufacturer. Provide materials and equipment that are the products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer.

C. Uniformity. Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General. In addition, submittals shall include the manufacturer's name, trade name, place of manufacturer, catalog model, layout dimensions, project specification, and technical paragraph reference.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications, associated standards and test requirements.

C. Prior to obtaining any material in connection with this section, detailed shop drawings on all material shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Drawings shall include elementary and interconnection diagrams showing connections to internal components, and indicate field

termination points for power and control interface. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted.

D. Submittals shall also contain descriptive data and time-current characteristic trip curves for each type of circuit breaker or fuse. These curves shall be submitted on full size manufacturer's drawings.

E. Samples of any material shall be submitted upon Engineer's request.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual circuit directories, as well as actual locations of components and circuits.

PART 2 PRODUCT

2.1 PANELBOARDS

A. Panelboards
1. Panelboards shall meet Federal Specification W-P-115B, Type 1, Class 1, and shall conform to UL50 UL67, and NEMA PB-1.
2. Loadcenters (Federal Specification W-P115C Type 1 Class 2) shall not be substituted for panelboards unless specifically indicated.
3. Panelboards shall be circuit breaker type as shown on the drawings with neutral bar, ground bar, and main and branch circuit breakers as scheduled.
   a. Unless otherwise shown, scheduled or specified, bus bars, ground bar, and neutral bar shall be copper or tin plated aluminum.
   b. Panelboards shall be furnished and installed in accordance with the panelboard schedules as shown.
   c. Subject to Engineer's review, such schedules may be revised to obtain more convenient grouping and better balance of the actual connected load.
4. Panelboards shall be provided with ample wiring gutters and shall have a single door with spring door hinges, lock, keys, and cardholder on the side of the door. Circuit identification cards shall be typewritten with circuits identified as actually installed.
5. Panelboards shall have single, double, or triple pole bolt-on branch circuit breakers as scheduled.
   a. Branch circuit breakers shall be in accordance with subsection headed "Molded Case Circuit Breakers".
   b. Unless otherwise shown, circuit breakers shall be rated at 20 amperes.
   c. Circuit breakers shall be provided for all spares shown on the schedule.
6. Short circuit current requirements shall be obtained only from the schedules, specifications, or the Contract Drawings.
   a. If this information is not shown, the Engineer shall be consulted.
   b. Under no circumstances shall any short circuit requirements be assumed by the Contractor.
   c. Integrally rated panelboards utilizing branch breakers with reduced short circuit ratings are acceptable.

7. Panelboards with main circuit breakers serving as building disconnecting means shall be service entrance rated, and shall be provided with a plaque designating the circuit breaker as a building disconnecting means.
8. Provide surge suppression for panelboards. Devices for surge suppression may be an integral part of the panelboard.
9. Panelboard enclosures shall be provided with key-locked doors. Provide a minimum of two keys for each lock.
10. Manufacturers
    a. 120/208 VAC and 120/240 VAC, 3 Phase Panelboards. Unless otherwise indicated, four wire 120/208 VAC and 120/240 VAC panelboards shall be: bolt-on AQ Series manufactured by General Electric Co., Type NQOD manufactured by Square D Company, or equal.
    b. 277/480 VAC, 3 Phase Panelboards. Unless otherwise indicated, four wire 277/480 VAC panelboards shall be: bolt-on AE Series manufactured by General Electric Co., Type NF as manufactured by Square D Company, or equal.

B. Panelboard Circuit Breakers
1. Circuit breakers, where included as part of panelboards, shall be mechanically and electrically similar to molded case circuit breakers.
2. Single pole breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical at 240 VAC or 14,000 amperes at 480 VAC unless otherwise shown or specified.
3. Except where otherwise shown, trip ratings shall be 20 amperes.
4. 120/208 VAC circuit breakers shall be Q Line manufactured by General Electric Co., Type QOB manufactured by Square D Company, or equal.
5. 277/480 VAC circuit breakers shall be TEY Line manufactured by General Electric Company, Type ED/EG/EJ manufactured by Square D Company or equal.
6. GFCI circuit breakers shall be provided where scheduled on the Contract

2.2 CIRCUIT BREAKERS

A. Molded Case Circuit Breakers
1. Except as modified below, the material and construction of molded case circuit breakers shall be in accordance with NEMA AB-1 and UL 489 standards for breakers.
2. Circuit breakers shall be of the air-break type.
3. Circuit breaker mechanisms shall be so designed that an overload or a fault on any one pole shall trip all poles simultaneously.
4. All poles shall be effectively barriered from one another.
5. Circuit breaker handles shall be trip-free. Circuit breakers in motor control centers or individual enclosures shall be interlocked with the door latching mechanism so that the door of the circuit breaker enclosure or motor control center compartment cannot be opened unless the circuit breaker contained is in the open position.
6. Number of poles and trip ratings of circuit breakers shall be as shown, specified, or required.
7. Motor control center main and tie circuit breakers shall be provided with auxiliary contacts for remote monitoring of the circuit breaker status.

B. Individual Circuit Breakers
1. Circuit breakers shall have a minimum of 14,000 amperes RMS symmetrical interrupting rating at 480 VAC or 10,000 amperes at 240 VAC except where different ratings are shown on the Contract Drawings, or unless otherwise specified.
2. Circuit breakers, 225 ampere frame and above, shall have interchangeable thermal and adjustable magnetic tripping elements.
3. Circuit breaker enclosures of the type shown on the drawings shall be provided.

C. Motor Circuit Protectors
1. Motor Circuit Protectors (MCP) shall have a quick make, quick break, switching mechanism, mechanically trip free from the handle, enclosed in a molded case.
2. The Contractor shall field verify actual motor starting and running currents in sizing the MCPs. Any replacement of MCPs due to this verification not being performed shall be done at no additional cost to the Contract.
3. MCPs shall have provisions for adjusting the instantaneous magnetic trip element.
4. Each pole shall provide instantaneous short circuit protection and all poles shall be constructed to open, close, and trip simultaneously.
5. Where higher short circuit protection is required, MCPs shall be provided with current limiters with trip indicators that are fully coordinated with the motor circuit protector so all three phases open if the current limiter is operated. Current limiters shall be constructed so replacement can only be made with an identical limiter having the same interrupting capacity. The minimum interrupting short circuit ratings of the MCP shall be known as shown on the Contract Drawings (integral rating).
6. MCPs shall be Type MCP manufactured by Cutler-Hammer Co., type Mag-Break manufactured by General Electric Co., or equal.

D. Service Entrance Circuit Breakers
1. Where shown or required, a service entrance breaker shall be provided to disconnect all conductors in a building or structure from the service-entrance conductors.
2. The service entrance breaker shall be UL listed, service entrance rated.
3. Where a 480 Volt System 1,000 ampere breaker or larger is shown or required, ground fault protection shall be provided in accordance with NEC 230-95.
4. The service entrance breaker shall be provided with an appropriate enclosure labeled as "Service Disconnect," and the enclosure shall be connected to the grounding grid in accordance with Section 26 05 26 - Electrical Grounding and the National Electrical Code.

2.3 SWITCHES

A. Disconnect Switches
1. Disconnect switches as indicated on the plans and specifications shall be NEMA Heavy Duty Type HD, Underwriter's Laboratories listed. The switches shall be fusible type unless otherwise indicated on the Contract Drawings.
2. Switch Interior. All switches shall have switchblades that are fully visible in the OFF position when the door is open. Switches shall have removable arc suppressors, where necessary, to permit easy access to line-side lugs. Lugs shall be UL listed for aluminum and/or copper cables and front removable. All current carrying parts shall be plated.
3. Switch Mechanism. Switches shall have a quick-make, quick-break, operating handle and mechanism, which shall be an integral part of the box, not the cover. Switches shall have interlock to prevent unauthorized opening of the switch door in the ON position or closing of

switch mechanism with the door open. Handle position shall indicate if switch is ON or OFF. Switch shall be lockable in the OFF position.

4. Enclosures. Switches shall be furnished in NEMA 1 general-purpose enclosures unless specified as NEMA 3R (rainproof), NEMA 4 (stainless steel), or NEMA 7 (Class1, Div 1) on the Contract Drawings. Covers on NEMA 1 enclosures shall be attached with pin type hinges.
5. Ratings. Switches shall be rated as indicated on the Contract Drawings. The switch must have a UL listed rejection feature to reject all fuses except Class R. UL listed short circuit ratings, when equipped with Class J or Class R fuses, shall be 200,000 amperes RMS symmetrical.

B. Molded Case Switches
1. Molded case switches shall be provided where shown on the Contract Drawings. Molded cases switches shall be automatic type designed to open instantaneously at a factory preset magnetic trip point. Molded case switches shall be designed for 600 VAC, 3 pole, with a minimum withstand rating of 25,000 amperes.
2. Molded case switches shall be as manufactured by Square D, or equal.

2.4 FUSES

A. Low Voltage (less than 600 volts) cartridge fuses shall be of the voltage and amperage rating listed on the drawings. Fuses shall be selected to provide overcurrent , short circuit, and blackout protection. They shall be of the type listed below unless otherwise indicated.
1. Main service and feeder protection (above 600 amps) – Current limiting UL Class L above 600 amperes (current UL standards do not rate Class L fuses at 600 amperes or below).
2. Main service and feeder protection at 600 amps and below – Current limiting UL Class J.
3. Motor branch circuit, transformer, inductive loads protection (such as MCCs, starters,etc.) – UL Class J current limiting, time delay for motor inrush and short circuit protection.

B. Refrigeration or air-conditioning equipment. Where refrigeration or air conditioning equipment includes requirements for a particular overcurrent device type (i.e., fuse) and maximum size, this requirement shall be adhered to. If a particular type of equipment is listed for "Maximum fuse size", a fuse must be used to protect this equipment. Refrigeration equipment will be protected with UL Class J time delay fuses.

C. Manufacturers
1. Bussman
2. Littlefuse
3. Eagle
4. equal.

D. Spare Fuse Cabinet. Provide Spare Fuse Cabinet Enclosure. Spare Fuse Cabinet shall be wall mounted enclosure with piano-hinge door for spare. Size adequate for storage of spare fuses with 25% spare capacity. Enclosure shall have pained finish with "SPARE FUSES" stenciled on front door. Spare Fuse Cabinet shall be Bussman, SFC, or equal.

2.5 ENCLOSURES

A. Enclosures for Circuit Protective Devices shall be of the type appropriate for each location as specified under Section 26 27 16 - Electrical Cabinets and Enclosures.

PART 3 EXECUTION

3.1 INSTALLATION

A. Electrical Contractor shall refer to all pertinent Sections of these Specifications for installation details of other equipment associated with panelboards and individual circuit breakers.

B. Provide all miscellaneous bolts, washers, nuts, clips, Belleville washers, lockwashers, small hardware, etc., of corrosion resistant material to make installation complete.

C. Provide minimum working clearance, as described in the National Electrical Code Article 110.26, for all electrical equipment.

D. Verify the location of each piece of equipment at the site before installing enclosures or conduits.

E. Mount all cabinets level and plumb, flush or surface as scheduled.

F. Install recessed cabinet flush with finished wall.

G. Be sure wall thickness will accept panel enclosures before ordering equipment.

H. Paint all scratches, marrs, and other imperfections in the finish, resulting from installation. Use matching paint.

I. Provide complete and professional installation for all items of equipment included in this Section, and in accordance with the National Electrical Code.

3.2 INSTALLATION OF PANELBOARDS

A. Mount panelboards 6’-6” minimum to centerline to top circuit breakers; 3’-0” to bottom of cabinet where possible, unless noted otherwise.

B. Properly align panel in cabinet.

C. Provide for empty 1-inch conduits from panel to ceiling space for all flush mounted panels. Arrange for future continuation of work.

3.3 FUSES

A. Install fuses in fusible devices as shown. Arrange fuses such that fuse ratings may be read without removing the fuse.

B. Install spare fuse cabinet with spare fuses in location shown (or adjacent to distribution switchgear).

C. Spare Fuses. Furnish quantity equal to 20 percent of each type and six installed, but not less than one set of three of each of type and size.

END OF SECTION

SECTION 26 29 13 - MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes motor controllers for the three-phase and single-phase motors operating at voltages not in excess of 600 VAC.

1.2 QUALITY ASSURANCE

A. Material and installation shall be in accordance with the latest revision of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electrical Code (NEC)
   2. National Electrical Manufacturers Association (NEMA)
   3. Underwriters Laboratories (UL)
   4. International Electrotechnical Commission (IEC)

B. Qualifications of manufacturer. Provide materials and equipment that are the products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for two (2) years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer.

C. Uniformity: Unless otherwise specified, equipment or material of the same type of classification, used for the same purpose shall be the product of the same manufacturer. All material shall be new and of the current design of the manufacturer providing equipment or material. Solid state motor controllers, AC magnetic contactors, NEMA rated overloads, and molded case circuit breakers for motor circuit shall be of the same manufacturer.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the requirements given in Section 26 00 00 - Electrical General. In addition, submittals shall include the manufacturer's name, trade name, place of manufacturer, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification, and technical paragraph reference.

B. Submittals shall contain a material list with manufacturer's name and data describing the material and showing its compliance with specifications, associated standards and test requirements.

C. Prior to obtaining any material in connection with this section, catalog data and detailed wiring connection diagrams shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams,

performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Drawings shall include elementary and interconnection diagrams showing connections to internal components, and indicate field termination points for power and control interface. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted.

D. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly and section views, and all necessary details pertaining to coordinating the work of the Contract, lists of materials and finishes, parts list and the descriptions thereof, lists of spare parts and tools where such parts or tools are required, and any other information that is required to demonstrate compliance with the Contract Documents. Drawings for electrical equipment shall include elementary and interconnection diagrams showing connections to internal components, and indicating field termination points for power and control interface. Solid State Motor Controller Equipment supplier shall submit manufacturer's catalog data and diagrams, output cable lug sizes and ratings, and elevation view of Solid State Motor Controller with the door removed. Project specific wiring diagrams shall be provided.

E. Submittal shall contain manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and heat dissipation to ambient. Submittals shall also contain manufacturer's part number for the equipment.

F. Manufacturer's standard wiring diagrams and specific modifications to the wiring of the equipment shall be submitted. All terminal points for field, and interconnecting wiring shall be identified.

G. Submittals shall include a list of the setup parameters for the solid state motor controller.

H. Samples of any material shall be submitted upon Engineer's request.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCT

2.1 NEMA MAGNETIC MOTOR CONTROLLERS

A. NEMA Magnetic Motor Starters
1. Magnetic motor starters shall be 3-pole, 60 cycle magnetic starters, and shall be of the NEMA size appropriate for the motor horsepower and voltage shown but not be less than NEMA Size 1.
2. Unless otherwise specifically shown or specified, all magnetic motor starters shall be provided with:
a. Vertical lift operation.
b. A replaceable type, encapsulated operating coil rated at 120 VAC.
c. Overload relays.

d. Starter coils and contacts shall be easily replaceable without removing contractor from the enclosure.

3. Magnetic motor starters shall be rated to meet minimum number of load/life operations (contact electrical life under load) when motor starter is used for starting of squirrel cage motors and switching motor off only after the motor is up to speed, as follows:

NEMA Size	# of Operations	Operational Current
1	2 million	27 amperes
2	2 million	45 amperes
3	1.5 million	90 amperes
4	1.5 million	135 amperes
5	2 million	270 amperes

4. Individual magnetic motor starters shall be provided with the required accessories to perform the control circuit as shown on Contract Drawings or specified. These accessories shall include but shall not be limited to the following:
   a. Single-phase control transformers of rating suitable for the load of the control circuit as actually installed, with fused secondary rated for 120 VAC.
   b. Pushbutton stations or selector switches with legend plates or engraved nameplates as specified in Section 26 09 16 - Miscellaneous Electrical Controls.
   c. Hand-Off-Auto selector switch, unless otherwise noted.
   d. Push-to-test indicating lights with interchangeable covers as specified in Section 26 09 16 - Miscellaneous Electrical Controls.
   e. Control circuit fuse where a separate control circuit is shown.
   f. Two electrically convertible contact interlocks.
5. Each magnetic motor starter shall be of a type suitable to perform the control function shown and be in accordance with one of the following:
   a. Constant Speed, Full Voltage, Non-Reversing Starters (FVNR) shall provide basic contactors for forward control.
   b. Constant Speed, Full Voltage Reversing Starters (FVR) shall provide basic contactors for the forward and reverse speed. Mechanical and electrical interlocks shall be provided to preclude the possibility of both contactors being closed at the same time.
   c. Constant Speed, Reduced Voltage Starters (RV) shall be of the closed transition, auto-transformer type and shall include the required 3 pole and 5 pole contactors, auto-transformers, timing relays and appurtenances.
   d. Multi-Speed Motor Starters shall provide the basic contactors for each speed, suitable interlocked. Where shown, sequence-compelling relays shall be provided.
6. Magnetic motor starter manufacturers:
   a. Allen-Bradley Bulletin 500, 505 Series
   b. General Electric CR-306, CR-309 Series
   c. Sq D Class 8536, 8702 Series
   d. Cutler-Hammer A-200 Series, A-210 Series
   e. equal (Samples of equal products shall be submitted in accordance with Part I)

B. NEMA Combination Motor Starter with Circuit Breaker (MCP) Disconnect
   1. Combination magnetic motor starters shall be the combination type consisting of a motor circuit protector (MCP) and NEMA magnetic motor starter assembled and wired into a self-contained unit.
   2. The magnetic motor starter shall be designed to coordinate with the circuit protective device to withstand a minimum short circuit current of 22,000 AIC or as shown on the Contract Drawings.
   3. MCP and magnetic motor starter shall be packaged by one manufacturer. Combination motor starters shall be:
      a. Allen-Bradley Bulletin 513, 507 Series
      b. General Electric Type CR387, CR390 Series
      c. Sq D Class 8539, 8739 Series
      d. Cutler-Hammer Class A206, A216 Series
      e. equal (Samples of equal products shall be submitted in accordance with Part I)

C. NEMA Combination Magnetic Motor Starter with Fused Switch Disconnect
   1. Combination magnetic motor starters shall be the combination type consisting of a fused switch and NEMA magnetic motor starter assembled and wired into a self-contained unit.
   2. The magnetic motor starter shall be designed to coordinate with the fused switch to withstand a minimum short circuit current of 100,000 AIC or as shown on the Contract drawings.
   3. Fused switches shall be provided with Class R fuse clips.
   4. Fused type combination starter shall be provided certified Type 2 coordination in accordance with IEC 947-4-1.
   5. Fused switch and magnetic motor starter shall be packaged by one manufacturer. Combination motor starters shall be:
      a. Allen-Bradley Bulletin 512, 506 Series
      b. General Electric Type CR308, CR311 Series
      c. Sq D Class 8538, 8738 Series
      d. Cutler-Hammer Class A204, A214 Series
      e. equal (Samples of equal products shall be submitted in accordance with Part I)

D. NEMA Manual Motor Starting Switches
   1. Manual motor starting switches shall be provided for the control and protection of all single-phase motors which do not require control from a remote location.
   2. Manual motor starting switches shall provide thermal overload protection, including trip-free operation, and a manual reset overload.
   3. Integral start-stop pushbuttons or on-off toggle switches shall be provided as shown on the Contract Drawings.
   4. Manual motor starting switch manufacturers:
      a. Allen-Bradley Bulletin 600 Series
      b. General Electric CR101, CR1062
      c. Sq D Class 2510, 2511, 2512
      d. equal (Samples of equal products shall be submitted in accordance with part I)

E. NEMA Overloads
   1. The Contractor shall verify the ratings of overloads and install overloads suitable for the actual motors installed, and based on the actual nameplate information and other supplemental information furnished with the installed motors. Any replacement of motor

overloads due to this verification not being performed shall be done at no additional cost to Engineer.

2. Overload relays shall be class 20, manual reset, eutectic alloy, thermal type overload device with visual trip indication, unless shown or specified otherwise. Overload relays shall be current transformer operated if required for coordination.
3. Three spare overload relay thermal elements shall be provided for each type of element installed.
4. Overload relay manufacturers:
   a. Allen-Bradley Bulletin 592
   b. General Electric CR324
   c. Square D Class 9065
   d. equal (Samples of equal products shall be submitted in accordance with part I)

PART 3 EXECUTION

3.1 INSTALLATION

A. Overload relays shall be installed in each leg of the starter.
   1. Overload relay characteristics shall be closely parallel the motor thermal characteristics.
   2. Ambient compensated overload relay thermal elements shall be installed where motor and overload are in different locations.

B. Enclosures for motor controllers shall be of the type appropriate for each location, as specified in Section 26 27 16 – Electrical Cabinets and Enclosures.

END OF SECTION

SECTION 26 43 13 - TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of AC electrical circuits from the effects of lightning induced currents, substations switching transients and internally generated transients resulting from inductive and capacitive load switching. This section is applicable for transient voltage surge suppressors for protection of electrical equipment and electronic systems at 600 volts and below, and communication equipment from the effects of line and electromagnetic induced transient voltage surges and coupled lightning discharged transients.

1.2 QUALITY ASSURANCE

A. Materials and installation shall be in accordance with the latest revision of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
   1. National Electric Manufacturers Association (NEMA) LS-1, Specification Format for Low Voltage AC Surge Protective Devices (1000 volts or less).
   2. Underwriters Laboratories, Inc. (UL) 1449 – Standard for Safety for Transient Voltage Surge Suppressors.
   3. National Electrical Code (NEC)
   4. The Institute of Electrical and Electronic Engineers (IEEE) ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.
   5. The Institute of Electrical and Electronic Engineers (IEEE) ANSI/IEEE c62.1, standard for surge Arrestors for AC power circuits.
   6. The Institute of Electrical and Electronic Engineers (IEEE) ANSI/IEEE c62.33, standard for Test Specifications for Varistor Surge Protection Devices.

B. This specification requires that all grounding and grounding circuitry be equal to, or exceed the requirements of NEC Article 250. In the event of a conflict or discrepancy between these Specifications, the Contract Documents, and NEC Article 250, the more stringent requirement shall apply.

C. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products, which are of equal material, design, and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

D. Uniformity. Unless otherwise specified, equipment of same type of classification shall be a product of same manufacturer. All equipment shall be new and of the latest design of manufacturer providing equipment or material.

1.3 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01 33 00 – Submittal Procedures, and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification, and technical paragraph reference.

B. Prior to obtaining any material in connection with this section, catalog data and detailed wiring connection diagrams for each type of equipment shall be submitted. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets. Submittal shall include ratings, circuit diagrams, and dimensional data, as a minimum. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

C. Submittals shall contain a material list with manufacturer data describing the material and showing its compliance with the specifications, associated standards, and test requirements.

D. UL Standard 1449 Listing, Standard for Safety, Transient Voltage Surge Suppressors, documentation.

E. UL Standard 1283 Listing, Electromagnetic Interference Filters, documentation.

F. IEEE C62.41-1991 Category C3 (20kV-1.2/50, 10kA-8/20useec waveform) let through voltage test results.

G. Spectrum analysis of TVSS based on MIL-STD-220A test procedures between 50kHz and 200kHz verifying noise attenuation exceeds 50dB at 100kHz.

H. Independent third party test results verifying single impulse current rating capabilities.

I. Conductor size, rating, and type for connection of surge protection.

J. Submit manufacturer’s installation instructions and testing requirements for each type of surge suppressor utilized.

K. Submit Operations and Maintenance Manual for each type of unit.

1.4 CLOSEOUT SUBMITTALS

A. Provide project record documents which record actual locations of components and circuits.

PART 2 PRODUCT

2.1 GENERAL

A. Surge protective devices (SPD) furnished for use on this project are to incorporate protective elements in all applicable modes. Hardwired and direct plug-in type units are to incorporate line to neutral (L-N), line to ground (L-G), and neutral to ground (N-G) protective elements, unless otherwise noted. TVSS shall be UL Listed.

B. SPD shall be housed in an enclosure that is compatible with the system being protected.

C. Voltage class and type of unit shall be compatible with system voltage being protected.

2.2 480 VAC SYSTEM SURGE PROTECTIVE DEVICE

A. Minimum surge current capacity shall be 240 kA per phase at service entrance and panelboard applications.

B. SPD shall be designed withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.

C. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of UL 1449 suppression voltage ratings by more than 10%.

D. The UL 1489 suppression voltage ratings (based on IEEE Category C3 Combination Wave):

Voltage	L-G	L-N	N-G
480 V	900V	900V	900V

E. SPD shall be made of solid-state components and operate bidirectionally.

F. SPD shall have a response time no greater than one nanosecond for any of the individual protection modes.

G. Visual indication of proper SPD connection and operation shall be provided. Visual indication shall be by means of solid state status indicator lights on the front of the SPD.

H. SPD shall have an integral disconnect switch to disconnect all phases simultaneously.

I. Surge counter to monitor the occurrence of transients entering the facility through the suppressor.

J. Dry contacts to monitor each phase and provide a summary alarm.

K. Approved Manufacturer:
1. Advanced Protection Technologies Inc., TE/XGA Series
2. Equal

2.3 120/208 VAC System Surge Protective Device and 120/240 Surge Protective Device

A. Minimum surge current capacity shall be 80kA per phase.

B. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.

C. Pulse life test: Capable of protecting against and surviving 2000 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of UL 1449 suppression voltage ratings by more than 10%.

D. The UL 1449 suppression voltage ratings (based on IEEE Category C3 Combination Wave):

Voltage	L-G	L-N	N-G
480 V	900V	900V	900V

E. SPD shall be made of solid-state and operate bidirectionally.

F. SPD shall have a response time no greater than one nanosecond for any of the individual protection modes.

G. Visible indication of proper SPD connection and operation shall be provided. Visual indication shall be by means of solid state status indicator lights on the front of the SPD.

H. SPD shall have an integral disconnect switch to disconnect all phases simultaneously.

I. Dry contacts to monitor each phase and provide a summary alarm.

J. Approved Manufacturer:
1. Advanced Protection Technologies Inc., TE/HPS Series
2. Equal

2.4 PANELBOARD SUPPRESSORS

A. Panelboard surge suppression devices shall be modular design with field-replaceable modules and the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with copper busbars and for bolted connections to phase bus, and ground bus.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Red and green LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5-a and 250-V ac, for remote monitoring of protection status.
11. Coordinate with building power monitoring and control system.
12. Surge event operations counter.

13. Peak Single-Impulse Surge Current Ratings: 80 kA per phase.
14. Protection modes and UL 1449 clamping voltage for grounded wye circuits on 3-phase, 4-wire circuits, shall be as follows:
    a. Line to Neutral:
        1) 800 V for 480Y/277VAC
        2) 400 V for 208Y/120VAC
    b. Line to Ground:
        1) 800 V for 480Y/277VAC
        2) 400 V for 208Y/120VAC
    c. Neutral to Ground:
        1) 800 V for 480Y/277VAC
        2) 400 V for 480Y/277VAC
15. Protection modes and UL 1449 clamping voltage for 240/120 VAC, single-phase, single-phase, 3-wire circuits, shall be as follows:
    a. Line to Neutral: 400V
    b. Line to Ground: 400V
    c. Neutral to Ground: 400V
16. Protection modes and UL 1449 clamping voltage for 240/120 VAC, 3-phase, 4-wire circuits, with high leg shall be as follows:
    a. Line to Neutral: 400V, 800V from high leg
    b. Line to Ground: 400V
    c. Neutral to Ground: 400V
17. Protection modes and UL 1449 clamping voltage for voltages of 240, 480, or 600; 3-phase, 3-wire, delta circuits shall be as follows:
    a. Line to Line:
        1) 2000 V for 480 VAC
        2) 1000 V for 240 VAC
    b. Line to Ground:
        1) 1500 V for 480VAC
        2) 800 V for 240 VAC

2.5 PLUG-IN SURGE SUPRESSORS

A. Non-modular, plug-in suppressors shall have at least four 15-ampere, 120 VAC, NEMA WD 6, with configuration for 15-15R receptacles, suitable to plug into a NEMA WD 6, Configuration 15-15R receptacle. Plug-in suppressors shall have the following features and accessories:
    1. LED indicator lights for power and protection status.
    2. LED indicator lights for reverse polarity and open outlet ground.
    3. Circuit breaker and thermal fusing. When protection is lost, circuit shall open and cannot be reset.
    4. Circuit breaker and thermal fusing. Unit shall continue to supply power if protection is lost.
    5. Cord connected with nominal 15-foot line cord.
    6. Rocker-type on-off switch, illuminated when in on position.
    7. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220-volt peak on pins Nos. 3 and 4.

B. Peak Single-Impulse Surge Current Rating shall be 33kA per phase.

C. Protection modes and UL 1449 clamping voltage shall be as follows:

1. Line to Neutral : 475 V.
2. Line to Ground: 475 V.
3. Neutral to Ground: 475 V.

2.6 CONTROL AND DATA TERMINALS

A. Protection for copper control, data, antenna, and telephone conductors entering the building form the outside shall be as recommended by manufacturer for the type of line being protected and selected by Engineer based on application.

PART 3 EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Install surge protective devices as indicated on the drawings, as specified, and according to manufacturer's recommendations.

B. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

C. Hardwired suppressors shall be close-nippled to the device being protected. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection.

D. Securely mount surge suppressor to wall, or panel with stainless steel hardware.

E. Conductors for connection of surge suppression shall be as recommended by the manufacturer for this application, and shall be wrapped together the full length of the conductor.

F. Neutral and ground shall not be bonded together at panelboard locations.

G. Minimum conductor size for hardwire connection of SPD to phase, neutral, and grounding connection points shall be as follows:
1. For 480 VAC system applications where surge capacity is 160 kA/phase or greater, #1 AWG shall be used.
2. For 240 VAC (or 208 VAC) system applications where the surge capacity is below 160 kA, #6 AWG shall be used.

H. Exposed ground conductors shall be installed in conduit.

I. Install devices at service entrance suppressors on load of the service entrance disconnecting, with ground lead bonded to service entrance grounded conductor bus.

J. Provide multi-pole circuit breakers as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
   2. Complete startup checks according to manufacturer's written instructions.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.19. Certify compliance with test parameters.

B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities from outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Bedding, backfilling and compaction.

B. Related Sections:
1. Section 31 23 16 – Excavation.
2. Section 31 23 23 – Fill.
3. Section 40 05 13.73 – Plastic Process Piping.

1.2 REFERENCES

A. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D2488 - Standard Practice for Description and Identification of Soils.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

B. Trench Zone: The trench zone includes the portion of the trench from the top of the pipe zone to the existing surface in unpaved areas.

C. Pipe Zone: The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level 12 inches above the top of the highest or topmost pipe.

D. Pipe Bedding: The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be shown on the drawings or as described in these specifications for the particular type of pipe installed.

E. Excess Excavated Material
1. The Contractor shall make the necessary arrangements for and shall remove and dispose of all excess excavated material and potential debris encountered during investigative trenching in accordance with applicable regulations.
2. No excavated material shall be deposited on private property unless written permission from the Engineer is given to the Contractor.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Materials Source: Submit name of fill materials suppliers.

C. Material test results

1.5 QUALITY ASSURANCE

A. Perform Work according to appropriate local, state and federal standards and in accordance with International Building Code 2012.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to construction activity.

B. Verify existing buried utilities and requirements prior to construction activity.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Native earth backfill, acceptable for use, shall be fine-grained material free from roots debris and rocks with a maximum dimension not larger than 1 inches.
   1. Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material that is capable of attaining the required relative density.
   2. The Contractor shall dispose of the excess trench excavation as specified in the preceding section. Backfilling with imported material shall be done in accordance with the methods described herein.

B. Sand Pipe Bedding:
   1. Gradation per ASTM C136

SIEVE SIZE	PASSING SIEVE BY % WEIGHT
3/8"	100
#4	90-100
#50	10-40
#100	3-15
#200	0-7

   2. Shall not contain angular material as described in ASTM D2488
   3. Free from ice, clay, organic matter, and rocks.

C. Topsoil:
   1. Excavated and reused material.
   2. Graded.
   3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Call Local Utility Line Information service not less than one week before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCHING

A. Excavation for pipe, fittings, appurtenances and for investigation shall be open trench to the depth and direction necessary for the proper installation of the facilities as shown on the Drawings.

B. Trench Banks shall be kept as near to vertical as possible.

C. Do not advance open trench more than the distance necessary to accommodate the amount of pipe installed in a single day.

D. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

E. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.

F. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered.

G. Correct over excavated areas with compacted backfill or replace with crushed rock or gravel as directed by Engineer.

H. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.

I. Trim excavation. Remove loose matter.

J. Remove excess subsoil not intended for reuse from site.

3.4 SHEETING AND SHORING

A. Contractor shall comply with the OSHA Trenching and Excavation Standards 29 CFR 1926.651 and 1926.652.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

B. Organic material from clearing and grubbing operations shall not be incorporated in the trench backfill.

C. Placing pipe bedding:
1. Prepare the existing subgrade by removing rocks and other protrusions over 1" high and leveling the bottom of the trench.
2. Place at least six inches of Sand Bedding material over the full width of trench.
3. Grade the top of the pipe bedding ahead of pipe to provide firm, uniform support along the full length of pipe.

D. Backfill within pipe zone:
1. After pipe has been installed in the trench, place Sand Bedding material simultaneously on both sides of the pipe, keeping the level of backfill uniform.
2. Voids and uncompacted areas shall not be left beneath pipe.
3. Trench shall be backfilled to prevent lateral movement of the pipe.

E. Backfill within Trench Zone
1. Do not permit free fall of the native soil or Base Course material.
2. Backfill in horizontal lifts of not greater than 12 inches in depth.

3.6 COMPACTION

A. Compaction of native backfill and Base Course shall be to 95% Standard Proctor minimum.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements

B. Perform compaction testing on each lift of native soil backfill and Base Course every 100 feet of trench backfilled.

C. Submit results of compaction testing to the Engineer.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fill for trenchless utility boring pits.
2. Treatment Compound surfacing
3. Asphalt Base Course

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Topsoil:
1. Excavated and reused material.
2. Graded.
3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

B. Native earth backfill, acceptable for use, shall be fine-grained material free from roots debris and rocks with a maximum dimension not larger than 1 inches.
1. Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material that is capable of attaining the required relative density.
2. The Contractor shall dispose of the excess trench excavation as specified in the preceding section. Backfilling with imported material shall be done in accordance with the methods described herein.

C. Sand Bedding: See Section 31 23 17 – Trenching.

D. Base Course:
1. Base Course shall be crushed rock or gravel with a percent (%) retained gradation range of:
1 3/4": 0 – 10%
#4: 45 – 75%
#40: 60 – 85%
2. Submit a sample to the Engineer for approval
3. Submit manufacturer's gradation analysis results to the Engineer.

E. Gravel Surfacing Aggregate
1. Gravel Surfacing Aggregate shall be crushed rock with a percent retained gradation range of:
7/8": 0 – 2
3/4": 20 – 35
5/8": 85 – 100
3/8": 95 – 100
#8: 99 – 100
2. Submit a sample to the Engineer for approval

3. Submit gradation analysis results to the Engineer.

PART 3 EXECUTION

3.1 GRAVEL SURFACING AGGREGATE PLACEMENT AND COMPACTION

A. The Gravel Surfacing Aggregate material shall be deposited uniformly with a thickness of 6 inches upon an approved subgrade. The aggregate shall be spread into a uniform layer and proof rolled using a smooth drum roller and water as required.

3.2 BASE COURSE PLACEMENT AND COMPACTION

A. Place Base Course to the thickness and horizontal extents shown in the Drawings and compact to 95% Standard Proctor minimum.

3.3 EXAMINATION

A. Verify fill materials have been tested and approved by Engineer prior to transporting fill material.

3.4 SURFACE RESTORATION

A. After backfill, compaction, testing, and acceptance, restore surface to original condition.

B. Refer to Sections 32 12 16 – Asphalt Paving and 32 92 19 – Seeding.

END OF SECTION

SECTION 32 12 16 – ASPHALT PAVING

PART 1 GENERAL

1.1 Section Includes:

A. Asphalt materials.

B. Aggregate materials.

C. Aggregate subbase.

D. Asphalt paving base course, binder course, and wearing course.

E. Asphalt paving overlay for existing paving.

F. Surface slurry.

1.2 Related Requirement:

A. Section 312323 - Fill: Compacted subbase for paving.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

1.4 QUALITY ASSURANCE

A. Obtain materials from same source throughout.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section.

1.6 AMBIENT CONDITIONS

A. Do not place asphalt mixture when ambient air or base surface temperature is less than 40, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 ASPHALT PAVING

A. Performance / Design Criteria:
   1. Paving: Design for parking

2.2 SOURCE QUALITY CONTROL

1. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
2. Submit proposed mix design for review prior to beginning of Work.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
   1. Verify compacted subgrade is dry and ready to support paving and imposed loads.
   2. Verify gradients and elevations of base are correct.

3.2 DEMOLITION

A. Saw cut and notch existing paving.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.3 INSTALLATION

A. Subbase:
   1. Aggregate Subbase: Install.

B. Tack Coat:
   1. Include tack coat to improve bond between new and existing paving.
   2. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate.
      a. Existing Surfaces: 0.05 gal/sq yd.

3.4 PROTECTION

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Immediately after placement, protect paving from mechanical injury for 8 hours or until surface temperature is less than 100 degrees F.

END OF SECTION

SECTION 32 31 13 - CHAIN-LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts and center drop for gates.
4. Manual gates and related hardware.

1.2 REFERENCES

A. ASTM International:
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
4. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
5. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.

B. Chain-Link Fence Manufacturers Institute:
1. CLFMI - Product Manual.

1.3 SUBMITTALS

A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

B. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of fencing.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 3 years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

B. Identify each package with manufacturer’s name.

C. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Materials shall be new.

B. Materials and Components: Conform to CLFMI Product Manual.

C. Fabric:
1. Size: 2 inch mesh, 9 gauge.
2. Material: Zinc-Coated Steel Fabric: ASTM A392 hot dipped galvanized (1.2 oz/sqft) before or after weaving.
3. Privacy Insert: White Privacy Wing Slat. 90% privacy and 25 year pro-rated warranty.

D. Steel Fence Framework
1. Round steel pipe and rail: ASTM F1043 Group IA Table 3 Heavy Industrial Fence Framework, regular grade, schedule 40 galvanized pipe per ASTM F1083. Exterior zinc coating Type A, interior zinc coating Type A.
a. Line post: 2 inch diameter
b. End, Corner, Pull post: 3 inch diameter
c. Top, brace, bottom and intermediate rails, 2 inch diameter

E. Tension Wire
1. Metallic Coated Steel Marcelled Tension Wire: 7 gauge marcelled wire complying with ASTM A824. ASTM A392 hot dipped galvanized (1.2 oz/sqft).

F. Barbed Wire
1. Metallic Coated Steel Barbed Wire: Comply with ASTM A121, Design Number 12-4-5-14R, double 12-½ gauge twisted strand wire, with 4 point 14 gauge round barbs spaced 5 inches on center. ASTM A392 hot dipped galvanized (1.2 oz/sqft).

2.2 FITTINGS

A. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge, minimum width of ¾ in. and minimum zinc coating of 1.20 oz/ft².

B. Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, Rail Sleeves: In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft².

C. Truss Rod Assembly: In compliance with ASTM F626, 3/8 in. diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/ft², assembly capable of withstanding a tension of 2,000 lbs.

D. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length 2 in. less than the fabric height. Minimum zinc coating 1.2 oz. /ft².
1. Bars shall have a cross section of 1/4 in. by 3/8 in.

E. Barbed Wire Arms: In compliance with ASTM F626, pressed steel galvanized after fabrication, minimum zinc coating of 1.20 oz. /ft², capable of supporting a vertical 250 lb load. Type I – three strand 45 degree arm.

2.3 TIE WIRE and HOG RINGS

A. Tie Wire and Hog Rings: Galvanized minimum zinc coating 1.20 oz/ft² 11 gauge steel wire in compliance with ASTM F626.

2.4 SWING GATES

A. Swing Gates: double opening. Galvanized steel welded fabrication in compliance with ASTM F900. Gate frame members 3 in. OD. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780. ASTM F1043 Group IA F1083 schedule 40 pipe. Positive locking gate latch fabricated of 5/16 in. thick by 1 ¾" pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Match gate fabric to that of the fence system. Gateposts 3 in. OD.

B. Factory-assembled gates.

C. Design gates for operation by one person.

D. Fabricate gates to permit 180-degree swing, or the maximum swing allowable by the adjacent fencing.

E. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.5 ACCESSORIES

A. Accessories shall be new.

B. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

C. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

D. Extension Arms: Cast steel galvanized, to accommodate three strands of barbed wire, single arm, sloped to 45 degrees.

E. Gate Hardware: Center gate stop and drop rod and hardware for padlock.

F. Privacy slats: aluminum sized to fit fabric.

2.6 CONCRETE

A. Concrete for post footings shall have a minimum 28-day compressive strength of 2,500 psi. (17.2 MPa).

PART 3 EXECUTION

3.1 SURVEY

A. Construction layout of fence location as shown on the Drawings.

3.2 INSTALLATION

A. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

B. Install framework, fabric, accessories and gates in accordance with ASTM F567.

C. Set intermediate, terminal, gate and corner posts plumb, in concrete footings with top of footing level with finish grade.

D. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.

E. Install top rail through line post tops and splice with six long rail sleeves.

F. Install center and bottom brace rail on corner gate leaves.

G. Place fabric on outside of posts and rails, away from the treatment building site.

H. Do not stretch fabric until concrete foundation has cured 7 calendar days.

I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

J. Position bottom of fabric 2 inches above finished grade.

K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

M. Install bottom tension wire stretched taut between terminal posts.

N. Install support arms sloped outward and attach barbed wire; tension and secure.

O. Support gates from gate posts.

P. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf, latch, catches, retainer and locking clamp.

Q. Provide concrete center drop to footing depth and drop rod receivers at center of double gate openings.

R. Install posts with 4 inches maximum clear opening from end posts to buildings, fences and other structures.

S. Install aluminum privacy slats

3.3 ERECTION TOLERANCES

A. Maximum Variation From Plumb: ¼ inch.

B. Minimum distance from property line: 6 inches.

END OF SECTION

SECTION 32 92 19 - SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fertilizing.
   2. Seeding.
   3. Mulching.
   4. Maintenance.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Seed Product Data: Contractor shall submit data for seed mix, fertilizer, and mulch.

1.3 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 MATERIALS

2.1 SEED

A. Unless otherwise specified herein, seed shall be certified by the Texas Department of Agriculture and shall conform to requirements of Texas Seed Law and Regulations.

B. Provide the following for improved areas:
   1. During the March to September planting season, the mix shall consist of hulled Bermuda grass applied at a rate of 8 pounds per 1,000 square feet.
   2. During the October to February planting season, the above mix shall be augmented with annual rye grass at a rate of 3.5 pounds per 1,000 square feet.

C. Alternate seed mixtures may be submitted by the subcontractor if accompanied by information from the local Texas Agricultural Extension Service supporting such mixes for the locale and

planting season. In lieu of such a submittal, the Engineer must approve the use of the mixture prior to its use on the project.

2.2 FERTILIZER

A. Fertilizer shall be uniform in composition, free-flowing, and delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name or trademark, and warranty of the producer.

B. For the first application, provide 13-13-13, or equivalent, at the rate of 200 pounds per acre.

C. For the second application, which is to occur 6 weeks after the initial germination, provide 200 pounds of 13-13-13 grade fertilizer per acre, using ammonium sulfate and 21 percent Nitrogen.

2.3 MULCH

A. Native grass hay (certified noxious weed free) with viable seed; 4,000 lb/acre.

B. Native or introduced grass hay (certified noxious weed free); 4,000 lb/acre.

C. Legume hay (certified noxious weed free); 4,000 lb/acre.

D. Straw (certified noxious weed free); 4,000 lb/acre.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify prepared soil base is ready to receive the Work of this section.

B. Prepare seeding surface to a smooth and equipment- track-free surface.

3.2 PERMANENT SEEDING

A. Harrow, disc, or otherwise loosen subsoil to a depth of 4 inches.

B. Remove objectionable material such as stones, 1 inch or larger, clods, brush, roots, and trash from the top 4 inches of soil.

C. Apply fertilizer at the rates specified herein. Thoroughly mix into the top 6 inches of soil. Scarify and rake the area until the surface is leveled to provide a maximum of 2 inches in variation, and until the soil is friable and has a uniform fine texture.

D. Do not apply fertilizer at same time or with same machine used to apply seed. Apply fertilizer before seed.

E. Seed shall be uniformly drilled to an average depth of 1/2 inch and at the rates specified using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder.

F. Do not seed areas in excess of that which can be mulched on same day.

G. Do not seed immediately following rain, when ground is too dry, or when winds are over 12 mph.

H. Immediately following seeding, apply mulch at the rates specified herein.

3.3 TIME RESTRICTIONS

A. When permanent seeding is specified or directed but seeding is not appropriate, utilize one or more of the following methods to prevent erosion and sedimentation until such time as permanent seeding or sodding is appropriate:
   1. Place and anchor straw mulch or wood chips.
   2. Apply temporary seeding.
   3. Prepare soil as for permanent seeding and then mulch as specified; overseed during next seasonal seeding period.
   4. Provide other erosion control measures acceptable to the Engineer.

B. Remove straw or wood chips used as temporary mulch or work into subsoil at a minimum depth of 6 inches prior to initiation of permanent seeding application.

3.4 SEED PROTECTION

A. Do not allow equipment on seeded areas unless approved by Engineer.

3.5 MAINTENANCE OF SEEDED AREAS

A. Maintain seeded areas until accepted in writing by the Engineer.

B. Water seeded areas as necessary to maintain adequate moisture in the upper 4 inches of soil until 60% of grass reaches a height of 2 to 3 inches.

C. Inspect seeded areas for failures in need of repairs due to poor vegetative growth, traffic or equipment damage, weather damage, or erosion.

D. Provide repairs or replacements during the specified planting seasons for areas where they are deemed necessary by the Engineer at no additional cost. This shall include repairs and replacements due to erosional or weather-related damage.

END OF SECTION

SECTION 33 05 24 - UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavation for approach trenches and pits.
2. Horizontal directional drilling.
3. Pipe.

B. Related Requirements:
1. Section 31 23 16 - Excavation.
2. Section 31 23 17 - Trenching.
3. Section 31 23 23 - Fill.
4. Section 40 05 13.73 – Plastic Process Piping

1.2 REFERENCE STANDARD

A. ASTM International:
1. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

B. National Utility Contractors Association:
1. NUCA - HDD Installation Guidelines.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with trenching and SVE conveyance pipe installation.

1.4 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Identify source of water used for drilling.
2. Submit copy of approvals and permits for use of water source.

C. Shop Drawings:

1. Submit technical data for equipment, method of installation, and proposed sequence of construction.
2. Include information pertaining to equipment size and capacity, equipment capabilities including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade and detection of surface movement, name plate data for drilling equipment and mobile spoils removal unit.

D. Qualification Statement:
1. Submit installer history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of pipe and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

D. Record actual depth of pipe at 25-foot intervals.

E. Record actual horizontal location of installed pipe.

F. Show depth and location of abandoned bores.

G. Record depth and location of drill bits and drill stems not removed from bore.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with the following:
1. NUCA HDD Installation Guidelines.
2. ASTM F1962.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 2 years documented experience.
1. Work Experience: Include projects of similar scope and conditions.
2. Furnish list of references upon request.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Provide temporary end caps and closures on piping and fittings until pipe is installed.

C. Protect pipe from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

D. Accept products on site in manufacturer's original containers or configuration. Inspect for damage.

E. Use shipping braces between layers of stacked pipe. Stack piping lengths no more than 3 layers high.

F. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

G. Support pipes with nylon slings during handling.

1.10 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.11 EXISTING CONDITIONS

A. Maintain access to existing facilities and protect structures indicated to remain.

PART 2 PRODUCTS

2.1 HORIZONTAL DIRECTIONAL DRILLING

A. Performance / Design Criteria:
1. Drilling Steering System: Remote with continuous electronic monitoring of boring depth and location.

2. Ratio of Reaming Diameter to Pipe Outside Diameter:
a. Submit recommended ratio and reaming procedures for review.

2.2 DRILLING FLUID

A. Drilling Fluid: Liquid bentonite clay slurry; totally inert with no environmental risk.

2.3 CASING PIPE

A. Polyethylene Pipe, Manufacturers:
1. Carlon.
2. Charter Plastics, Inc.
3. JM Eagle.
4. Substitutions: Section 01 60 00 - Product Requirements.

2.4 CARRIER PIPE

A. Provided by Others.

2.5 WATER SOURCE

A. Shall be provided by Contractor.

2.6 FLOWABLE FILL

A. Fill and seal around pipe ends with flowable fill.
   1. Mix: One part Portland cement, 6 parts mortar sand, sufficient water to make sufficiently flowable for sealing.

2.7 UNDERGROUND PIPE MARKERS

A. Trace Wire: Electronic detection materials for non-conductive piping products.
   1. Unshielded 10 AWG THWN insulated copper wire.
   2. Conductive tape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify entry and exit locations and invert elevations are in accordance with Drawings.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

C. Locate, identify, and protect utilities indicated to remain from damage.

D. Notify Engineer of potential interference with private utilities.

E. Identify required lines, levels, contours, and datum locations.

F. Protect survey control points, existing structures, fences, sidewalks, and paving from excavating equipment and vehicular traffic.

G. Establish pipe elevations with not less than 1.5 feet of cover.

3.3 DEWATERING

A. Intercept and divert surface drainage, precipitation, and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop and maintain substantially dry subgrade during drilling and pipe installation.

C. Comply with applicable requirements for discharging water and erosion and sediment control.

3.4 EXCAVATION

A. Excavate subsoil as specified in Section 31 23 16.

B. Excavate approach trenches and pits in accordance with shop drawings and as site conditions require. Minimize number of access pits.

C. Provide sump areas to contain drilling fluids.

D. Restore areas after completion of drilling and carrier pipe installation.

3.5 DRILLING

A. Drill pilot bore with vertical and horizontal alignment as indicated on Drawings.

B. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.
   1. Monitor depth, pitch, and position.
   2. Adjust drill head orientation to maintain correct alignment.

C. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.

D. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.
   1. Provide relief holes when required to relieve excess pressure.
   2. Minimize heaving during pullback.

E. Calibrate and verify electronic monitor accuracy during first 50 feet of bore in presence of Engineer before proceeding with other drilling. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

F. After completing pilot bore, remove drill bit.

3.6 DRILLING OBSTRUCTIONS

A. When obstructions are encountered during drilling, notify Engineer immediately. Do not proceed around obstruction without Engineer's approval.

B. For conditions requiring more than 3 feet deviation in horizontal alignment, submit new shop drawings to Engineer for approval before resuming work.

C. Maintain adjusted bore alignment within private property.

3.7 PIPE INSTALLATION

A. After completing pilot bore, remove drill bit. Install reamer and pipe pulling head.
   1. Select reamer with minimum bore diameter required for pipe installation.

B. Attach pipe to pipe pulling head. Pull reamer and pipe to entry pit along pilot bore.

C. Inject drilling fluid through reamer to stabilize bore and lubricate pipe.

D. Install piping with horizontal and vertical alignment as shown on Drawings.

E. Protect and support pipe being pulled into bore so pipe moves freely and is not damaged during installation.

F. Do not exceed pipe manufacturer's recommended pullback forces.

G. Install trace wire continuous with each bore. Splice trace wire only at intermediate bore pits. Tape or insulate trace wire to prevent corrosion and maintain integrity of pipe detection.
   1. Terminate trace wire for each pipe run at structures along pipe system.
   2. Provide extra length of trace wire at each structure, so trace wire can be pulled 3 feet out top of structure for connection to detection equipment.
   3. Test trace wire for continuity for each bore before acceptance.

H. Terminate pipe in such a way that carrier pipes can be freely installed without significant bending or fittings requirements.

I. Seal around pipe ends with flowable fill.

J. Mark location and depth of bore with spray paint on paved surfaces, and wooden stakes on non-paved surfaces at 25 foot intervals.

3.8 SLURRY REMOVAL AND DISPOSAL

A. Contain excess drilling fluids at entry and exit points until recycled or removed from site. Provide recovery system to remove drilling spoils from access pits.

B. Remove, transport and legally dispose of drilling spoils.
   1. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
   2. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.

C. When drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.

D. Complete cleanup of drilling fluid at end of each work day.

3.9 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Horizontal Position: 12 inches.

C. Maximum Variation From Vertical Elevation: 6 inches.

D. Minimum Horizontal and Vertical Clearance From Other Utilities: 12 inches.

E. When pipe installation deviates beyond specified tolerances, abandon bore, remove installed pipe, re-bore, and reinstall pipe in correct alignment.

3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting, testing.

3.11 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

C. Restore approach trenches and pits to original condition.

D. Remove temporary facilities for drilling operations in accordance with Section 01 50 00 - Temporary Facilities and Controls.

END OF SECTION

SECTION 33 11 13.13 – AMENDMENT INJECTION WELL INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. This specification prescribes the construction of amendment injection wells of emulsified vegetable oil injectate with bioaugmentation for the purpose of creating a permeable reactive barrier to promote enhanced reductive dechlorination (RDC).

1.2 REFERENCES

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C200 (2012) Steel Water Pipe - 6 In. (150 mm) and Larger

AWWA C206 (2017) Field Welding of Steel Water Pipe

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M (2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)

ASTM D2487 (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D2488 (2017; E 2018) Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

ASTM D4318 (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D5088 (2020) Decontamination of Field Equipment Used at Nonradioactive Waste Sites

ASTM D5521/D5521M (2013) Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Contractor's Field Reports: Summary reports of all activities performed on site shall be submitted to the Engineer on a daily basis.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Operation Data:
   1. The Contractor shall provide injection data to the Engineer. Information shall include mixture quantities, injection quantities, injection rates, and injection pressures.

1.5 QUALITY ASSURANCE

A. Section 01 40 00 - Quality Requirements

B. The Contractor shall arrange and pay for all necessary official inspections and permits and shall install or change work as required by official inspection. All such indicated changes shall be documented by the Contractor and reported to the Engineer to allow for construction options to be exercised.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. The Contractor will be responsible for safe and timely transportation of all necessary equipment and appurtenances to the site. The Contractor's representative on site will inspect for damage and assumes the responsibility for any issues which may arise from equipment transportation.

C. The Contractor will be responsible for providing any equipment required for system unloading and temporary storage.

D. Store and maintain materials in a clean, uncontaminated condition throughout the course of the project.

1.7 PROJECT AND SITE CONDITIONS

A. Access to each well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work, is the responsibility of the Contractor. Furnish a copy of all permits, licenses, and other legal requirements necessary for execution of the work before commencement of the work. Obtaining rights-of-entry is the responsibility of the Government. Visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site.

PART 2 PRODUCTS

All casing and other well material must be of compatible materials to prevent galvanic reaction between components of the completed well. Submit catalog data, and name of supplier, for well casing, riser pipe, bentonite, cement, centralizers, surface protective covers, well vaults, locking caps,

and drill fluid additives, if used. Catalog data must include any information, supplied by the manufacturers or suppliers of the above listed items.

2.1 WELL CASING

A. Steel casing must be new carbon steel, conforming to ASTM A139/A139M steel pipe or conforming to ASTM A53/A53M type 304 or type 316 stainless steel and nominal 8-inch diameter, schedule 5S meeting the requirements of ASTM A312/A312M, as applicable. Joints must be either threaded and coupled, or field welded in accordance with AWWA C206.

2.2 CEMENT GROUT

A. Provide cement grout consisting of Portland cement conforming to ASTM C150/C150M, Type I or II, sand and water. Proportion cement grout not to exceed 2 parts, by weight, of sand to 1 part of cement with not more than 23 liters6 gallons of water per 42.6 kg94 lb bag of Portland cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

2.3 WATER SOURCE

A. Water Source - Water will not be provided to the Contractor. Contractor is responsible for obtaining water from a clean source. Source shall be approved by Engineer.

2.4 SCREENED INTERVAL

A. The wells shall be completed open borehole. No screens or filter packs will be used.

2.5 EQUIPMENT

A. AIR ROTARY DRILLING RIG – Drilling rig capable of drilling to 100 ft below ground surface with a 12-inch nominal bit.

B. SUPPORT EQUIPMENT – Vehicles and support equipment necessary to support drilling activities and contain drill cuttings and fluids, if needed.

C. WELL DEVELOPMENT RIG – Rig with overhead mast used to raise and lower a development tool along the well open interval.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. After becoming familiar with the details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancies before performing the work.

3.2 PROTECTION OF EXISTING CONDITIONS

A. Maintain existing survey monuments and wells, and protect them from damage from equipment and vehicular traffic. Repair any items damaged during this work. Reinstall wells requiring replacement due to Contractor negligence according to these specifications. Protect wells scheduled for abandonment from damage so that abandonment may be performed according to these specifications. Prior to commencement of drilling, obtain written approval from the local utility companies to drill at each site, to avoid disturbing buried utilities.

3.3 DECONTAMINATION

A. Clean the drill rig, drill rods, drill bits, augers, temporary casing, well developing equipment, tremie pipes, grout pumping lines, and other associated equipment with high-pressure hot water/steam prior to drilling at each well location. Decontaminate in accordance with ASTM D5088 or ASTM D5608. Decontaminate at a central decontamination station in an area that is remote from, and cross- or down-gradient from the well being drilled. Clean screen and well casing with high-pressure hot water immediately prior to installation in the well. The use of factory sealed (plastic wrapped) screen and well casing does not waive this requirement for pre-installation cleaning. Decontaminate samplers in accordance with the Sampling and Analysis Plan. Use water for cleaning from an approved source.

3.4 WELL DRILLING AND CONSTRUCTION

A. Use the drilling method approved by the Contracting Officer and in conformance with all state and local standards for well construction. Execute the work under the direct supervision of an experienced well driller licensed in the State of Texas. The drilling method must prevent the collapse of formation material during installation of the well.

Drill the well straight, plumb, and circular from top to bottom. Initially drill the well from the ground surface to 70 ft bgs and set the bottom of the outer casing at this elevation.

During construction of the wells, use precautions to prevent tampering with the well or entrance of foreign material. Prevent runoff from entering the well during construction.

B. The outer casing must not be less than 8 inches in diameter. The hole must be of sufficient size to leave a concentric annular space of not less than 2 inches and not more than 6 inches between the outside of the outer casing and the walls of the hole. Fill the annular space between the outer casing and the walls of the holes with cement grout. Acceptable methods of grouting are detailed in AWWA A100; select a method specifying the forcing of grout from the bottom of the space to be grouted towards the surface. Provide a suitable grout retainer, packer, or plug at the bottom of the outer casing so that grout will not leak into the bottom of the well. Continuously grout to ensure that the entire annular space is filled in one operation. After grouting is completed, do not resume drilling operations for at least 24 hours to allow proper setting of the grout.

C. After the casing has been installed, mechanically mix a non-shrinking cement grout in accordance with paragraph CEMENT GROUT, and place by tremie pipe, in one continuous operation without damaging the well casing into the annulus around the outer casings to within 3 feet of the ground surface. Grout injection must be in accordance with AWWA A100.

Add additional grout from the surface to maintain the level of the grout within 3 feet of the ground surface as settlement occurs. Do not conduct work in the well within 24 hours after cement grouting.

D. After grouting is completed and allowed to set for 24 hours, resume drilling to 100 ft bgs with a 6.75-inch nominal drill bit.

E. All wells shall be completed below grade, capped with a locking cap, and completed with a flush mount well vault over the wells. The well vault will be EMCO Wheaton A721-101, 12" bolt down manhole and vault or engineered approved equivalent. The concrete pads shall be 8-inches thick, 2 ft by 2 ft, square cast-in-place reinforced concrete slab (compressive strength 3,000 psi). Reinforcement shall be # 3 rebar set on 4-inch centers. The well pads shall be sloped at approximately 1- inch per 2 feet away from the casing in order to allow water to drain.

3.5 WELL DEVELOPMENT

A. Maintain a well development record.

B. Development is complete when all of the following criteria are met:

1. Well water is clear to the unaided eye[, and turbidity less than or equal to 10 Nephelometric Turbidity Units (NTUs)],
2. A minimum of three times the standing water volume in the well is removed plus three times the volume of all added water and drilling fluid lost during drilling and installation of the well is removed, and
3. Temperature, specific conductivity, pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity readings, measured before, twice during and after development operations, have stabilized. Stabilization is defined as variation of less than 0.2 pH units, variation of plus or minus +0.5 degrees C1 degree F, +3 percent change in specific conductance; and less than a +10mV for ORP; and +10 percent for DO, and turbidity, measured between three consecutive readings with one casing volume of water removed between each reading. Determine ORP in accordance with AWWA 10084. Conduct temperature, specific conductance, DO, turbidity, and pH readings in accordance with EPA 600/4-79/020.

END OF SECTION

SECTION 33 23 16 - SOIL VAPOR EXTRACTION WELL INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. Soil vapor extraction (SVE) well drilling
   2. SVE well installation
   3. SVE well surface completion

B. Related Sections:
   1. Section 33 05 24 – Utility Horizontal Directional Drilling
   2. Section 40 05 13.73 – Plastic Process Piping

1.2 DESCRIPTION OF WORK

A. Section has been prepared to detail the material and equipment requirements necessary for the construction of SVE wells to varying depths below ground surface (bgs). The locations, depths, sizes, and screen interval of the proposed SVE wells are shown in the Drawings.

B. The Contractor shall provide all tools, equipment, materials, design documents, and labor to install the SVE wells.

C. The Contractor shall allow the Engineer to collect soil samples during drilling activities.

D. The Contractor shall familiarize himself with the local conditions of the project sites. Failure to do so shall in no way relieve Contractor of the responsibility for performing any of the work or operations required as a part of this contract.

1.3 REFERENCES

A. Code of Federal Regulations
   1. 29 CFR 1910.120, OSHA Regulations, Hazardous Waste Operations and Emergency Response

B. Texas Water Code
   1. Texas Water Code, Title 2, Water Administration, Subtitle D, Water Quality Control, Chapter 32, Water Well Drillers
   2. Texas Water Code, Title 2, Water Administration, Subtitle D, Water Quality Control, Chapter 33, Water Well Pump Installers

C. Texas Administrative Code
   1. 16 TAC 76, Texas Department of Licensing and Regulation, Water Well Drillers and Water Well Pump Installers

1.4 PROTECTION OF SITE

A. Except as otherwise provided herein, the Contractor shall protect all existing fences, pavement, structures, utilities, etc. During the progress of the work, the Contractor shall

remove all debris and unused materials. Upon completion of the work, the Contractor shall restore the site as nearly as possible to its original condition to the satisfaction of the Engineer. The restoration shall include the replacement, at the Contractor's expense, of any facility, pavement, or landscaping that has been destroyed or damaged beyond restoration.

1.5 UTILTIES

A. Unless otherwise indicated in this section, the Contractor shall arrange for and provide any required utilities. This includes, but is not limited to, water for drilling, power for operating the drill rig or equipment (including testing equipment), and personnel sanitation facilities. It shall be the Contractor's responsibility to notify all utility companies involved whenever activities are to occur that have the potential to cut, tap, move, or in any way disturb a utility line from its original placement. Sufficient notice shall be provided to the utility company so that its users can be informed of any disruption of service. Such notice shall be given no less than 96 hours in advance, excluding weekends.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. The following submittals shall be provided by the Contractor prior to mobilization:
   1. Copy of the Texas Water Well Contractor registration

C. The Contractor shall register well records with TCEQ. Copies of the registration shall be provided to the Engineer.

D. The Contractor shall submit to the Engineer Daily Drilling Logs as detailed as Section 3.2, within 7 days of well installation. The log shall accurately describe the following:
   1. Material
   2. Time
   3. Depth
   4. Problems encountered by the driller
   5. Well diameter
   6. Length of casing
   7. Screen installation

   The log shall be kept up to date with the progress of drilling. A copy of the drill log shall be maintained at the site at all times. The Contractor shall prepare and submit a final log in accordance with this Specification.

PART 2 PRODUCTS

2.1 DRILLING EQUIPMENT

A. The targeted depth for each SVE well is provided in the Drawings. The Contractor shall drill a horizontal drill rig. The Contractor shall propose the necessary equipment to advance soil borings with a nominal diameter of not less than 4 inches, and install a well casing and well screen of 3-inch diameter Schedule 80 polyvinyl chloride (PVC) to the targeted depths.

2.2 WELL CASING

A. Well materials shall consist of new, unused 3-inch diameter Schedule 80 PVC with flush-threaded joint fittings. Threaded joints shall include Viton O-ring gaskets.

2.3 WELL SCREENS

A. Well screen shall be constructed of new, unused 3-inch diameter Schedule 80 PVC with flush-threaded joint fittings. The screen shall have four (4) 2-inch ling machined slots per linear foot with a width of 0.020 inches. Threaded joints shall include Viton O-ring gaskets.

2.4 BENTONITE (CHIP) PELLET SEAL

A. Provide powdered, granular, pelletized, or chipped sodium bentonite or in sealed containers from a commercial source, free of impurities. Diameter of pellets shall be less than one-fifth (1/5) the diameter of the borehole annular space to prevent bridging. The bentonite shall be mixed with Type I/II Portland Cement.

2.5 RUBBER GROUT COLLARS

A. Two (2) rubber grout collars shall be set above well screen and secured with 304 stainless steel adjustable hose clamps. Rubber grout collars shall be sized based on the borehole size and to prevent grout from reaching the well screen.

2.6 SUMP

A. Provide flush-threaded cone-shaped sump at the bottom of the well. The sump shall be a 6-inch long 3" nominal schedule 80 PVC. Threaded joints shall include Viton O-ring gaskets.

2.7 PRESSURE GAUGE PORT

A. Provide a ¼" barbed fitting and valve for pressure gauge port (or equivalent) for each well location.

2.8 WELL VAULT

A. Provide 12" square manhole/vault (Emco-Wheaton Model #A0717 or engineering equivalent) for each well.

2.9 CONCRETE

A. Concrete shall attain 28-day strength of 3,000 pounds per square inch.

PART 3 EXECUTION

3.1 MOBILIZATION AND DEMOBILIZATION

A. The Contractor shall coordinate well installation with the trenching and associated piping activities, as described in Section 31 23 17 Trenching, Section 40 05 13.73 Plastic Process Piping, and the Drawings.

B. Before drilling activities begin, the Contractor shall be responsible for obtaining the necessary permits and underground utility clearances. Engineer will not be responsible for damage to underground or overhead utilities.

C. The Contractor shall mobilize and demobilize all equipment, tools, and personnel required to install the wells.

D. The Contractor shall avoid contaminating other project areas and shall not dump waste oil, fuels, rubbish, or other hazardous materials on the ground.

E. Drill Strings and other downhole drilling equipment shall be decontaminated before each well is initiated.

F. Upon completion of well installation, the Contractor shall remove from the site the drilling rig and all associated equipment, unused materials, debris, and other miscellaneous items resulting from or used during the operation.

3.2 DRILLING

A. The Contractor shall notify the Engineer one (1) week before drilling.

B. The Contractor shall provide, at all times, a licensed State of Texas driller and two helpers who shall be present during all drilling operations at the site.

C. The Contractor shall drill the holes at the locations designated by the Engineer.

D. The Contractor shall allow time for the Engineer to collect soil samples at multiple depths and shall assist as needed.

E. The Contractor shall drill each borehole to permit the installation of well casing and screen assembly in a plumb and true line.

F. The Contractor shall use Halliburton Bio-Bore™ Horizontal Directional Drilling Fluid or engineer approved equivalent.

3.3 DRILL CUTTINGS

A. The Contractor shall manage all drill cuttings as Investigation Derived Waste (IDW). The Contractor shall containerize and seal IDW, and it shall be stored neatly in the Contractor staging area. Contractor shall coordinate and pay for disposal of IDW. IDW disposal will be at a facility authorized by the TCEQ to accept the waste stream.

3.4 DECONTAMINATION

A. Drilling equipment shall be decontaminated (1) before the beginning of field activities, (2) between individual borings, and (3) prior to demobilization. The Contractor shall provide personnel, material, and equipment such as pressure washers, steamers, electric generator, hand tools, pumps, and any other necessary equipment needed to decontaminate drilling equipment. The Contractor shall establish temporary decontamination areas, as needed, to be used for decontamination. The Contractor shall be responsible for maintaining the decontamination system equipment and for providing all consumables for

the decontamination system. Decontamination shall consist of a combination of high pressure, hot water or steam cleaning; water rinse; and repeated water rinse. Soap, phosphates, and other surfactants shall not be used to decontaminate equipment. Decontamination shall be conducted in accordance with the site-specific Health and Safety Plan. The Contractor shall collect and containerize the decontamination water. The containerized decontamination water shall be placed in a location onsite as designated by the Engineer. The location will also be in accordance with other provisions stated in the design specifications.

3.5 WELL CONSTRUCTION

A. The wells will be constructed in accordance with Drawings. Actual construction details may be modified by the Engineer based on field conditions.

3.6 CASING AND SCREEN ASSEMBLY

A. Well screens shall be located as indicated on the Drawings or as revised by the Engineer based on field conditions.

B. The Contractor shall install the well screen and casing assembly in the hole plumb and true to line. The Contractor shall not permit site soils or other contaminated substances to come into contact with the casing or screen.

C. Casing or screen that fails, collapses, or is not plumb and true to line shall be removed from the hole, and a new hole shall be drilled at the Contractor's sole expense.

3.7 WELL SEAL

A. The Contractor shall set a minimum of two (2) rubber grout collars at the base of the blank section. Each grout collar shall be secured to the blank casing with a stainless-steel hose clamp. Each collar shall be sized and set to prevent grout from entering the screened interval.

B. The Contractor shall use a tremie pipe to install grout comprised of a mixture of Type 1/II Low Alkali Portland cement and bentonite from the grout collar to the surface.

3.8 SURFACE COMPLETION

A. The surface completion shall consist of a well manhole and a concrete pad and be constructed in accordance with the Drawings and Specifications. The manhole shall be set in washed gravel, flush with the surrounding surface.

B. The Contractor shall connect the SVE conveyance piping to the well piping using pipe tees and reducers, as described in Section 40 05 13.73 – Plastic Process Piping.

3.9 WELL ABANDONMENT

A. In the event that the well is not accepted for completion because of poor alignment, loss of tools, or for any other cause, the Contractor shall, as directed by the Engineer, fill the abandoned hole with expansive clay or clay and concrete. In the event a constructed well is not usable and is abandoned for the above reasons, the Contractor may be required to move

to another location in the area and drill an additional. Well abandonment and re-drilling described in this section shall be at the Contractor's expense.

3.10 WELL DEVELOPMENT

A. The Contractor Shall lower and raise a jetting tool for a minimum of six (6) passes along the entire well screen length. The jetting solution shall be comprised of 500 gallons of clean portable water and 1 pint of liquid enzyme breaker.

END OF SECTION

SECTION 40 05 13.73 - PLASTIC PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. PVC pipe and fittings.
2. Polyethylene (PE) pipe, tubing and fittings
3. Accessories for plastic piping and fittings.

B. Related Requirements:
1. Section 31 23 17 – Trenching
2. Section 02 62 16 – SVE System
3. Section 33 23 16 – SVE Well Installation
4. Section 33 51 33 – Injection Well Installation
5. Section 33 04 24 – Utility Horizontal Direction Drilling
6. Section 40 05 23 – Common Work Results for Process Piping
7. Section 40 05 29 – Hangers and Supports for Process Piping and Equipment

1.2 REFERENCE STANDARDS

A. ASTM International:
1. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
2. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
3. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
4. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.
5. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
6. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
7. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
8. ASTM F2786 – Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems Using Gaseous Media Under Pressure

1.3 COORDINATION

A. Coordinate Work of this Section with well and equipment installation.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statements:
1. Submit qualifications for manufacturer, installer, and licensed professional.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations; Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements

B. Tools: Furnish special tools, equipment, and other devices required to maintain the system.

1.7 QUALITY ASSURANCE

A. Perform Work according to appropriate local, state and federal standards and in accordance with International Building Code 2012.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. Deliver materials in manufacturer's packaging according to ASTM D3892.

C. Protect piping and tubing from puncture, abrasion, moisture, and ultraviolet radiation by storing according to manufacturer's recommendations.

1.10 AMBIENT CONDITIONS

A. Temperature: Do not install underground piping when temperature is below 40 degrees F or above 90 degrees F if pipe is exposed to direct sunlight.

B. Do not install piping when bedding is wet or frozen.

C. Ultraviolet (UV) Protection: Provide pipe installed above ground or outside with UV protection.

1.11 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PVC PIPE, TUBE, AND FITTINGS

A. Manufacturer List:
1. Charlotte Pipe and Foundry Company
2. Georg Fischer Harvel, LLC
3. Texas United Pipe, Inc
4. Substitutions: Section 01 25 00 – Substitution Procedures

B. PVC Pipe and Fittings:
1. Pipe: ASTM D1785, Schedule 80 and Schedule 40
2. Fittings: ASTM D2467, Schedule 80 and Schedule 40
3. Joints: Socket, solvent-welded, ASTM D2855; threaded or flanged if later removal is required
4. Materials: ASTM D1784, minimum cell classification 12545-C.

2.2 PE PIPE, TUBE, AND FITTINGS

A. Manufacturer List:
1. Dultmeier Sales
2. ISCO Industries
3. WL Plastics
4. Ajax Environmental & Safety Supply
5. Geotech Environmental Equipment
6. Substitutions: Section 01 25 00 – Substitution Procedures

B. Polyethylene Pipe and Fittings:
1. Pipe: DR 11 calculated according to ASTM D3035
2. Fittings: Molded; ASTM D3261, butt welded.
3. Joints: Socket heat fusion or Butt fusion
4. Materials: ASTM D3350, minimum cell classification 324433-C.

2.3 ACCESSORIES

A. PVC Piping:
1. PVC Unions for Piping to other fittings
2. PVC Flanges for Piping to Equipment
3. Flange Bolting: Stainless steel, ASTM A193 Grade hex head bolts and ASTM A194 Grade hex head nuts.
4. Flange Gaskets: Full faced, red rubber, according to ASME B16.21.
5. Solvent Cement: ASTM D2564; primers according to ASTM F656.

B. PE Piping:
   1. Insert Fittings: ASTM D2609.
   2. Couplings: ASTM F1055.
   3. Flange Bolting: Stainless steel, ASTM A193 Grade hex head bolts and ASTM A194 Grade hex head nuts.
   4. Flange Gaskets: Full faced, EPDM, according to ASME B16.21.

C. Averaging Pitot Tube
   1. See Section 02 62 16, SVE System, Subsection 2.16 D

D. Differential Pressure Transmitter
   1. See Section 02 62 16, SVE System, Subsection 2.16 E

2.4 UNDERGROUND PIPING

A. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering.

2.5 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements

B. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Verify existing conditions before starting work

C. Verify that field dimensions are as indicated on Drawings

D. Verify equipment is installed in final locations and ready for piping

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Ream pipe and tube ends. Remove burrs.

C. Thoroughly clean pipe and fittings before installation.

D. Surface Preparation:
   1. Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Underground Piping Systems
1. Run piping straight along alignment indicated on Drawings with minimum number of joints.
2. Establish elevations of underground piping with not less than 18 inches of cover.
3. Underground pipe may be co-located where necessary
4. Apply open cut techniques for right of ways and road crossings.
5. Install pipe to allow for expansion and contraction without stressing pipe or joints.
6. Install valves at locations indicated on Drawings.
7. Install trace wire continuous over top of pipe. Buried 12 inches below finish grade, above pipe line

B. Above Ground Piping and Tubing
1. Run piping straight along alignment indicated on Drawings with minimum number of joints.
2. Install piping and components according to ASME B31.3.
3. Fittings:
   a. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
   b. Install fittings according to manufacturer's instructions.
   c. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer's recommendations.
   d. All valves and fittings shall be accessible.
4. Provide required upstream and downstream clearances from devices as indicated.
5. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
6. Support exposed piping as specified in Section 40 05 29 - Hangers and Supports for Process Piping and Equipment.
7. Provide pipe guides as specified in Section 40 05 29 - Hangers and Supports for Process Piping and Equipment to compensate for pipe expansion due to temperature differences.
8. Field Cuts: According to pipe manufacturer's recommendations.
9. Joining:
   a. Primers and Cleaners: ASTM F402.
   b. PVC Solvent-Cemented Joints: ASTM D2855.
10. Insulation: As indicated on Drawings.

C. Pitot Tubes and Differential Pressure Transmitters
1. Install pitot tubes and pressure transmitters in accordance to manufacturer’s installation instructions.
2. Mount differential pressure transmitters to piping as close to the pitot tubes as possible.
3. Connect pitot tubes to associated differential pressure transmitters in accordance to manufacturer’s installation instructions.

3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements.

B. Inspect for damage to pipe lining or coating, or other defects that may be detrimental as determined by the Engineer. Repair damaged piping, or provide new, undamaged pipe.

C. After installation, inspect for proper supports and interferences.

D. Pressure Testing:
1. Perform pneumatic leak testing on PE pipe in accordance with ASTM F2786
2. Pressurize the pipe and observe joints, fittings, and valves. Remove and renew cracked pipe, joints fittings and valves showing visible leakage. Retest.
3. Test pressure: Not less than 100 psig or 50 psi in excess of maximum static pressure, whichever is greater.
4. Test Duration: The total test time, including initial pressurization, initial expansion, and time at test pressure shall not be less than 30 minutes or exceed 1 hour. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, and then allow 8 hours before bringing the test section up to test pressure again.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements specifies requirements for cleaning.

B. Keep pipe interior clean as installation progresses.

C. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION

SECTION 40 05 23 - COMMON WORK RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ball valves
2. Check valves
3. Gate valves
4. Solenoid valves
5. Vacuum relief valves

B. Related Requirements:
1. Section 40 05 13.73 – Plastic Process Piping
2. Section 40 05 29 - Hangers and Supports for Process Piping: Product and execution requirements for valve supports specified by this Section.

1.2 REFERENCE STANDARDS

A. ASTM International:
1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
2. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
3. ASTM D 1785 – Standard Specification for Rigid PVC Compounds and CPVC Compounds
4. ASTM F436 - Standard Specification for Hardened Steel Washers.

B. American Water Works Association:
1. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

C. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 122 – Plastic Industrial Ball Valves.

D. NSF International:
1. NSF/ANSI Standard 14 - Plastic Piping System Components and Related Materials.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and appurtenances.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer’s catalog information with valve data and ratings for each service.

C. Valve-Labeling Schedule: Indicate valve locations and nametag text.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturers' Instructions: Submit installation instructions and special requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Project Record Documents: Record actual locations and settings of valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Tools: Furnish special tools, equipment, and other devices required to maintain system. Furnish compatible and appropriately labeled toolbox.

1.7 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings.

B. Perform Work according to federal, state, and local standards and in accordance with International Building Code 2012.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years of documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. Accept materials on-Site in original factory packaging, labeled with manufacturer's identification. Inspect for damage

C. Protect from weather and construction traffic, dirt, water, chemicals, and damage by storing in original packaging.

1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 Ball Valves

A. Manufacturers:
1. Hayward
2. Spears
3. Substitutions: Section 01 25 00 – Substitution Procedures

B. Schedule 80 PVC, slip ends

C. Schedule 80 PVC, lug ends, lever handle

2.2 Spring Loaded Check Valves

A. Manufacturers:
1. Spears
2. Hayward
3. Substitutions: Section 01 25 00 – Substitution Procedures

B. Schedule 80 PVC, slip ends, stainless steel spring, silent closing, integral seat

2.3 Gate Valves

A. Manufacturers:
1. Spears
2. Valterra
3. Substitutions: Section 01 25 00 – Substitution Procedures

B. Schedule 80 PVC, slip ends, knob handle

2.4 Solenoid Valves

A. Manufacturers:
1. ASCO
2. Substitutions: Section 01 25 00 – Substitution Procedures

B. 2-way, vacuum service, operating temperature: 0 to 125 degrees Fahrenheit, operating pressure differential: 0 to 200 inches of water column, 120VAC.

2.5 Vacuum Relief Valves

A. Manufacturers:
1. Rotron
2. Substitutions: Section 01 25 00 – Substitution Procedures

B. Range 20-360 inches of water column.

2.6 VALVES

A. Provide valves, operator, handwheel, lever handle, extension stem, operating nut, chain, wrench, and other accessories as required.

B. Valve Ends: Compatible with adjacent piping system.

C. Operation: Open by turning counterclockwise; close by turning clockwise. Cast opening/closing directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

D. Valve Marking and Labeling:
1. Marking: According to MSS SP25.
2. Labeling: As specified in Section 40 05 13.73 – Plastic Process Piping.

E. Valve Construction:
1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected; as specified in particular valve Section.
2. Bonnets: Clamped, screwed, or flanged to body and of same material and pressure rating as body; provide glands, packing nuts, or yokes as specified in valve Sections.
3. Stems and Stem Guides:
   a. Of materials and with seals as specified in valve Sections.
   b. Space stem guides 5 ft o.c.
   c. Submerged Stem Guides: Type 304 stainless steel.
4. Nuts, Bolts, and Washers:
   a. Nuts: ASTM A563 heavy hex type or Engineer approved equivalent
   b. Bolts: ASTM A307; Grade A or B
   c. Washers: ASTM F436; Type 1

2.7 INSULATION

A. As indicated on Drawings and according to Section 40 42 13 – Plumbing Insulation.

2.8 FINISHES

A. Do not coat flange faces of valves unless otherwise specified.

2.9 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:
1. Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for installation examination.

B. Verify that piping system is ready for valve installation.

3.2 INSTALLATION

A. Install valves and accessories according to manufacturer's instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds to remove slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Install valves with clearance for installation of insulation and allowing access.

G. Provide access where valves and fittings are not accessible.

H. Install insulation as indicated on Section 40 42 13 – Plumbing Insulation.

I. Valve Applications:
1. Install shutoff valves at locations as indicated on Drawings, according to this Section.
2. Install shutoff and isolation valves; isolate equipment, part of systems, or vertical risers, as indicated on Drawings.
3. Install valves for throttling, bypass, or manual flow control services, as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Valve Field Testing:
1. Test for proper alignment.
2. Where specified by individual specification Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Engineer will witness field testing.

END OF SECTION

SECTION 40 05 29 - HANGERS AND SUPPORTS FOR PROCESS PIPING AND EQUIPMENT

1.1 SUMMARY

A. Section Includes:
1. Pipe supports.

B. Related Requirements:
1. Section 40 05 13.73 - Plastic Process Piping
2. Section 40 05 23 - Common Work Results for Process Valves

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:
1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:
1. ASTM A36/36M - Standard Specification for Carbon Structural Steel.
2. ASTM A47/47M - Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A181/181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
4. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code Steel - Reference Manual.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

A. Coordinate meetings with Engineer prior to installation

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer's catalog data including load capacity.

C. Shop Drawings: Indicate system layout with location - including critical dimensions, sizes, and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements

B. Project Record Documents: Record actual locations and details of trapeze hangers, anchors, and guides.

C. Tools: Furnish special tools, equipment, and other devices required to maintain system. Furnish compatible and appropriately labeled toolbox.

1.7 QUALITY ASSURANCE

A. Perform Work according to federal, state, and local standards and in accordance with International Building Code 2012.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years experience.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum five years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements.

B. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.

C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturer List:
1. Haydon Corporation
2. PHD Manufacturing, Inc
3. PHS Industries, Inc
4. Substitutions: Section 01 60 00 - Product Requirements

B. Description:
1. Conform to MSS SP58.
2. Provide means of vertical adjustment after erection.
3. Pipe Sizes 1 to 1-1/2 in: ASTM A36, steel, adjustable swivel, split ring.
4. Pipe Sizes 2 in (50 mm) and Larger: ASTM A36, steel, adjustable, clevis.
5. Vertical Support: Riser clamp.
6. Floor Supports: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

C. Performance and Design Criteria:
1. Pipe Hangers:
a. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
b. Provide linkage to permit lateral or axial movement where anticipated.
c. Where horizontal pipe movement is greater than 1/2 in, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.
2. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
3. Point Loads:
a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
b. Avoid point loads on plastic piping by providing extra wide pipe saddles or galvanized steel shields.

2.2 HANGER RODS

A. Hanger Rods:
1. ASTM A576, steel.
2. Threaded both ends.
3. Diameter: ASME B31.1; as indicated on Drawings.

2.3 STRUCTURAL ATTACHMENTS

A. Manufacturer List:
1. Anvil International
2. Cooper B-Line, Inc.
3. Globe Pipe Hanger Products Incorporated
4. Haydon Corporation
5. PHD Manufacturing, Inc
6. PHS Industries, Inc
7. Unitron Product, Inc./US Strut
8. Substitutions: Section 01 60 00 - Product Requirements

B. Concrete Inserts
1. Manufacturer List:
a. PHS Industries, Inc
b. Unitron Product, Inc./US Strut
c. Substitutions: Section 01 60 00 - Product Requirements.

2. Description:
    a. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
    b. Size inserts to suit threaded hanger rods.

C. Mounting Brackets: ASTM A36, welded steel.

D. Beam Clamps:
1. Manufacturer List:
    a. Haydon Corporation
    b. PHD Manufacturing, Inc
    c. PHS Industries, Inc
    d. Substitutions: Section 01 60 00 - Product Requirements
2. ASTM A36; MSS SP-58.
3. Clamp Size: Based on load to be supported and load configuration.
4. Anchoring: Locknuts and cup-point set screws.
5. Reversible top or bottom flange.

E. Offset Clamps:
1. Manufacturer List:
    a. Anvil International
    b. PHS Industries, Inc
    c. Substitutions: Section 01 60 00 - Product Requirements.
2. Double leg, two-piece.

2.4 PIPE GUIDES

A. Intermediate Guides:
1. Pipe clamp with oversize pipe sleeve.

B. Alignment Guides:
1. Pipes 8 in and Smaller: Sleeve type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

A. Obtain permission from Engineer before using powder-actuated anchors.

B. Obtain permission from Engineer before drilling or cutting structural members.

C. Inserts:
1. Install inserts for placement in concrete forms.

2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

D. Pipe Hangers and Supports:
1. Install according to: MSS SP 58.
2. Support horizontal piping as indicated on Drawings.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
7. Support riser piping independently of connected horizontal piping.
8. Design hangers for pipe movement without disengagement of supported pipe.
9. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
10. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
11. Use beam clamps where piping is to be suspended from building steel.
12. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
13. Use offset clamps where pipes are indicated as offset from wall surfaces.

E. Insulation:
1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
2. Conform to Section 40 42 13 - Plumbing Insulation.

F. Equipment Bases and Supports:
1. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with Section 40 05 13.73 – Plastic Process Piping.

END OF SECTION

SECTION 43 13 13.13 - VAPOR-PHASE GRANULAR ACTIVATED CARBON SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. The design, construction, operation, and consumable materials related to Vapor Phase Granular Activated Carbon (GAC) treatment systems.

B. Related Sections:
1. Section 40 05 13.73 - Plastic Process Piping
2. Section 40 05 23 – Common Work Results for Process Valves

1.2 DESCRIPTION OF WORK

A. Provide two vapor-phase GAC adsorption systems, each as a complete once-through, forced-flow system. Each system shall be a minimum two vessel system with a lead-lag configuration. Each system shall be complete with two carbon vessels in series, granular activated carbon, instruments, controls, valves, piping, and other specified appurtenances. The system shall be capable of reducing the levels of the listed organic contaminants to the levels required by applicable state and Federal standards.

B. Fill the unit with granular activated carbon for removal of organic contaminants from soil vapor extraction off gas. Equipment shall include vessels containing granular activated carbon, supporting equipment, and accessories. The piping shall be arranged to allow either of the 2 carbon vessels to serve as the primary vessel and shall also allow either of the vessels to operate alone while the other vessel is being emptied and refilled with fresh carbon. The granular activated carbon adsorption system shall be designed to operate continuously, 24 hours per day, 7 days per week.

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME)
1. ASME B40.100 - Pressure Gauges and Gauge

B. American Society of Testing and Material International (ASTM)
1. ASTM D2652 - Standard Terminology Relating to Activated Carbon.
2. ASTM D2854 - Standard Test Method for Apparent Density of Activated Carbon
3. ASTM D2862 - Particle Size Distribution of Granular Activated Carbon.
4. ASTM D2866 - Total Ash Content of Activated Carbon.
5. ASTM D2867 - Moisture in Activated Carbon.
6. ASTM D3802 - Ball-Pan Hardness of Activated Carbon.
7. ASTM D4607 - Determination of Iodine Number of Activated Carbon.
8. ASTM D5228 - Determination of the Butane Working Capacity of Activated Carbon.

C. International Building Code
1. International Building Code, latest edition

1.4 DESIGN REQUIREMENTS – AOI1 SVE SYSTEM

A. The following requirements shall be met:

1. Minimum equipment design life: 10 years.
2. Vessel type: Permanent with carbon.
3. Adsorption system design requirements:
   a. Maximum vertical projection: 10 feet (ft).
   b. Maximum ground surface coverage: 20 ft by 20 ft.
4. Wind speed (maximum): 90 miles per hour (mph).
5. Ground snow load: 15 pound per square foot (psf).
6. Average Relative Humidity 83%
7. Ambient air temperature:
   a. Maximum: 110 degrees F.
   b. Minimum: 0 degrees F.

B. Influent Air/Air Gas Conditions

Contaminant	**Concentration (µg/m3)**
Tetrachloroethene	750,000
Trichloroethene	37,000
cis-1,2-Dichloroethene	245,000
trans-1,2-Dichloroethene	1,850
Vinyl Chloride	1,000
Benzene	3,900
Toluene	6,500
Ethyl Benzene	2,950
m,p-Xylene	8,500
o-Xylene	2,300
1,2,4-Trimethylbenzene	2,450
1,3,5-Trimethylbenzene	950
2,2,4-Trimethylpentane	1,450
4-Ethyltoluene	2,100
Cyclohexane	1,150
Ethanol	1,000
Heptane	1,600
Hexane	1,800
Propylbenzene	750
Tetrahydrofuran	42.5

C. Physical Requirements

Parameter	Minimum	Maximum	Unit
Gas flow rate	450	500	standard cubic feet per minute (scfm)
Gas temperature	40	140	°F
Inlet Pressure	1	10	pounds per square inch gauge (psig)

D. Performance Requirements

1. Treat up to 500 scfm of vapor to applicable requirements related to Volatile Organic Compound (VOC) emissions regulations.

E. Carbon Replacement

1. Intervals between carbon replacements shall not be less than 90 days.

1.5 DESIGN REQUIREMENTS – AOI2 SVE SYSTEM

A. The following requirements shall be met:

1. Minimum equipment design life: 10 years.
2. Vessel type: Permanent with carbon.
3. Adsorption system design requirements:
   c. Maximum vertical projection: 8 feet (ft).
   d. Maximum ground surface coverage: 7 ft by 7 ft.
4. Wind speed (maximum): 90 miles per hour (mph).
5. Ground snow load: 15 pound per square foot (psf).
6. Average Relative Humidity 83%
7. Ambient air temperature:
   c. Maximum: 110 degrees F.
   d. Minimum: 0 degrees F.

B. Influent Gas Conditions

Contaminant	Concentration (µg/m3)
Tetrachloroethene	160,000
Trichloroethene	37,000
cis-1,2-Dichloroethene	210,000
trans-1,2-Dichloroethene	19,000
Vinyl Chloride	17,000
Benzene	110
m,p-Xylene	270
1,2,4-Trimethylbenzene	2,000
1,3,5-Trimethylbenzene	750

4-Ethyltoluene	2,000
Hexane	67
Propylbenzene	460
Tetrahydrofuran	220

C. Physical Requirements

Parameter	Minimum	Maximum	Unit
Gas flow rate	200	250	standard cubic feet per minute (scfm)
Gas temperature	40	140	°F
Inlet Pressure	1	10	pounds per square inch gauge (psig)

D. Performance Requirements

1. Treat up to 250 scfm of vapor to applicable requirements related to Volatile Organic Compound (VOC) emissions regulations.

E. Carbon Replacement

1. Intervals between carbon replacements shall not be less than 90 days.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Drawings showing complete equipment layout, piping, wiring and schematic diagrams, manufacturer's description and technical literature, performance charts, catalog cuts, installation instructions, other details required to show equipment relationships, clearances for maintenance and operation, and a demonstration showing that the system will function properly as a unit. Process flow diagrams and instrumentation diagrams showing all major pieces of process equipment with controls. Details on the carbon adsorber shell including information on vapor diffusion, carbon contact shell dimensions, construction materials and structural and supporting design calculations.

C. Product Data:

1. Instrumentation and controls; capacities and pressure drop; make and model; complete list of equipment and materials, including manufacturer's descriptive and technical literature; spare parts data; performance charts and curves; catalog cuts; and installation instructions.
2. Design calculations or computer modeling results for the carbon adsorption system indicating removal of each of the organic compounds listed. Demonstration of, or design calculations for, the total head loss through the carbon unit.

3. Isotherm and design calculations or manufacturer's computer models shall be provided along with the breakthrough curves to estimate the mass of carbon required. Calculations showing how the vapor phase carbon adsorption system functions with the entire gas system including carbon vessel, instrumentation and controls, dimensions, capacities, make and model, materials of construction, coating systems, pressure drop through each component of the system, including line sizing, valving, pressure and temperature gauges.
4. Structural calculations for fabrication and erection drawings if requested.
5. A complete list of parts, supplies, special tools, instruments, accessories, and special lifting and handling devices required for periodic maintenance, repair, adjustment and calibration. Also, recommended spare parts for each different item of material and equipment specified, with current unit prices and source of supply. A list of the parts recommended by the manufacturer to be replaced after one and three years of service.
6. Type of activated carbon including isotherms for each of the volatile organic compounds listed in the effluent requirements for the anticipated temperature range at 90 percent relative humidity. Design calculations or vendor computer models shall be used to estimate the mass of carbon required and the breakthrough curves for the listed organic compounds in the carbon bed.
7. Framed and other instructions, containing wiring and control diagrams and condensed operating instructions.

D. Manufacturer's Installation Instructions: Required

E. Manufacturer's Certificate: Certify vapor phase carbon treatment system meets or exceeds the specified requirements.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Project Record Documents: Record actual locations and installation details of the carbon system.

C. Operation and Maintenance Data:
1. Operating instructions outlining the step-by-step procedures required for system startup, operation, and shutdown. Include in the instructions layout, wiring, and control diagrams of the system as installed. Also the manufacturer's name, model number, service manual, parts list, brief description of all equipment and their basic operational features, and operating instructions for each piece of equipment and bulletins, cut sheets and descriptive data.
2. Maintenance instructions listing routine preventative maintenance procedures, possible breakdowns and repairs, and trouble shooting guides

1.8 QUALITY ASSURANCE

A. Certificates:
1. Manufacturer's certificates attesting that the activated carbon furnished meets the specified requirements. Copies of certificate from system supplier showing that the

equipment has been tested and has passed all quality control criteria. Copies of the Department of Transportation licenses of carbon transporter service.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years experience.

C. The Contractor shall have had a minimum of 2 years experience in the construction, startup, and operation of industrial air pollution control devices.

D. Assign to a single supplier full responsibility for furnishing of the activated carbon system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire adsorption system. The supplier shall have been in the business of manufacturing these systems for a minimum of 2 years and shall have manufactured and supplied a minimum of 5 vapor phase carbon adsorption units.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Contractor to accept delivery on site and immediately inspect for damage.

B. Preassemble parts to the largest extent possible, compatible with transportation limitations and equipment protection considerations. Field assembly, if any, shall require merely bolting together of match-marked components. Equipment shall be crated and delivered to protect against damage during shipping. Flange faces shall be protected from damage. All openings shall be covered to prevent entrance of dirt, water, and debris. Properly protect all parts so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and until the units and equipment are ready for operation. Properly protect finished iron or steel surfaces to prevent rust and corrosion. Protect all equipment, delivered and designated for storage, from the weather (humidity and temperature), dirt and dust, and other contaminants.

1.11 WARRANTY

A. Furnish five year manufacturer’s warranty for all components of the vapor phase carbon system.

1.12 EXTRA MATERIALS

A. Within 30 days of approval, furnish a spare parts list for each different item of material and equipment specified along with the shop drawings. Include in the parts list a schedule for supplies, prices, and sources. Furnish those spare parts and special tools which are recommended by the manufacturer. Also provide a 12 month supply of any expendable items and frequently replaced parts, except for carbon, as identified by the manufacturer. Following completion of the startup and operating period, replenish the spare parts inventory

and provide a 12 month supply of spare parts. Also, supply the carbon regeneration facility name, address and price schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. At AOI 1 Tigg Corporation N-2500-PDB
   2. At AOI 2 Tigg Corporation N-5000-PDB
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Vapor Phase Granular Activated Carbon System.

2.2 STANDARD PRODUCTS

A. Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Materials and equipment shall be supported by a service organization that is located within 500 miles of the Site.

B. Major equipment items such as adsorption vessels shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.3 VAPOR PHASE ACTIVATED CARBON

A. Material shall conform to the following:
   1. The initial charge of carbon shall be virgin carbon.
   2. The carbon adsorption system shall be capable of reducing emissions for individual compounds to below the levels required by applicable state and Federal regulations.
   3. Approximate average volatile organic composition of the vapor stream shall be based on estimated influent component levels as specified in Paragraphs 1.4 and 1.5.
   4. Minimum iodine number of virgin or reactivated carbon shall be 850 as determined by ASTM D4607.
   5. Maximum moisture content shall be 3 percent by weight as determined by ASTM D2867.
   6. Maximum total ash content shall be 10 percent by weight as determined by ASTM D2866.
   7. Minimum hardness number shall be 95 as determined by ASTM D3802.
   8. Activated carbon particle size shall be uniform for consistent pressure drop characteristics. Maximum particle size shall be 0.2-inch-diameter as determined by ASTM D2862.
   9. The granular activated carbon shall be of the type that can be accepted for offsite regeneration by an approved carbon regeneration facility.
   10. Minimum apparent density shall be 0.48 g/cc as determined by ASTM D2854.
   11. US Sieve size shall be 4 x 10.

12. Material shall be free from impurities that affect the serviceability and appearance of the finished product.

2.4 ACTIVATED CARBON ADSORPTION UNITS

A. Velocity:
1. Vapor distribution/collection systems shall provide effective distribution across the bed throughout the stated capacity range. A system shall be provided to minimize short circuiting or channeling of contaminated gas through the carbon vessel. The system shall be designed to evenly distribute the contaminated gas flow across the cross section, with the nominal velocity under design conditions not to exceed 80 fpm for up-flow systems. Design of the inlet and outlet shall be adequate to prevent local pressurization in excess of the vessel rating or design.

B. Maximum pressure drop shall be 10 inches of water per vessel, measured in air at 70 degrees F.

C. Shell Design:
1. Corrosion resistant steel shall be used for shell construction or a steel shell with a corrosion resistant enamel coating. The lining system shall have a corrosion resistant epoxy or phenolic resin coating. Paint kits shall be furnished for use after assembly and finishing.
2. Minimum manway requirements, for access, addition and removal of carbon shall be 1 per adsorber and 22 inches minimum nominal diameter.
3. Vessel, the following shall be met:
   a. Minimum Number of Vessels: 2.
   b. Minimum Adsorber Diameter: 2 ft.
   c. Material of Construction: Carbon steel.
   d. Maximum Allowable Working Pressure: Must be greater than 10 psig.
   e. Minimum Carbon Quantity per Vessel: 300 lbs.
   f. Minimum Carbon Bed Depth: 36 inches.
   g. Flow Direction: Upflow.
   h. Inlet Distributor: Integral
4. Each unit shall be skid-mounted. Skids shall be fabricated of cast iron or steel channels and shall be designed to support the equipment and to distribute the weight in transit and in service; equipped with lifting lugs and pre-piped internally. Each vessel shall be secured to a structural steel frame suitable for shipment or transport with a forklift or crane and set on a level area for operation. Exterior structural steel surfaces shall be coated with a suitable primer and top coat to resist corrosion. Each unit shall have a minimum of one ground connection. Each unit shall be provided with an inlet gas distributor, if required. Sampling ports shall be provided on the inlet and outlet pipes of each vessel to allow independent sampling and measurement of breakthrough for each unit.

D. Seismic Requirements
1. Adsorption units shall be supported and braced to resist seismic loads and must meet the requirements of the International Building Code, latest edition, for Harris County, Texas.

2.5 ACTIVATED CARBON INSTRUMENTATION AND CONTROLS

A. Pressure Gauges
1. Dial type with bottom connection
2. 3 ½-inch diameter dial
3. 0 to 75 psi reporting range
4. For use with -4 degrees F to 150 degrees F operational range
5. Within 2% accuracy
6. Steel case material

B. Thermometer
1. Dial type with bottom connection
2. 4-inch diameter dial
3. 20 degrees F to 240 degrees F reporting range
4. Within 1% accuracy
5. Type 304 stainless steel case material

2.6 ACCESSORIES

A. Associated piping and valves shall be installed in accordance with the Drawings. The piping and valves shall be Schedule 80 PVC or an approved engineering equivalent.

B. Sampling ports should be located on the influent and effluent connections of each GAC vessel. The material of construction for the sampling ports shall be Schedule 80 PVC or an approved engineering equivalent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. After becoming familiar with the details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancies before performing the work.

3.2 INSTALLATION

A. Install equipment as shown and in accordance with written instructions from the manufacturer.

B. Connect piping to vessels in accordance with the Drawings.

3.3 PAINTING FOR CORROSION PREVENTION

A. All equipment shall receive a factory finish prior to shipment to the site. Factory painting shall conform to manufacturer's standard factory finish. All defects in the finish prior to or during installation of the equipment shall be repaired as recommended by the manufacturer.

3.4 POSTED FRAMED INSTRUCTIONS

A. Post installation instructions, sequences, and precautions, including tolerances for level, horizontal, and vertical alignment as specified inside the treatment enclosure within the compound. Submit for approval prior to posting: grouting requirements, including grout spaces and materials; wiring and control diagrams; system layouts and isometrics; instructions and other sheets; operating instructions explaining preventive maintenance procedures; and checks to assure the system is operating normally and safely. Methods of checking the system for normal safe operation; procedures for operating the system; and procedures for safely starting and stopping the system shall be prepared in typed form, framed and posted beside the diagrams. Instructions shall be written for any required sampling, carbon transfer and shipping of activated carbon to the regeneration or disposal facility. Catalog cuts are not acceptable.

3.5 FIELD QUALITY CONTROL

A. After installation of the carbon adsorption system is complete, operating tests shall be carried out to ensure that the unit installed operates properly. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of all equipment; all operating mechanisms shall be tested to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Tests shall assure that there is no vibration, or noise from any parts. If deficiencies are revealed during tests, such deficiencies shall be corrected and the tests shall be re-conducted at the Contractor's expense. Results of the tests shall be used in determining the capacity and performance of the adsorption unit.

END OF SECTION

Appendix C

Supporting Calculations

Appendix C-1

Head Loss Calculations

Appendix C - Savings Square (AOI 1) Head Loss Calculations

Well String Properties					
Well ID	Well Screen ID	Line Color	Required SCFM[1]	Required Vacuum at Well Head (in. WC)[1]	length of well string (ft)
Dilution Port	NA	NA	245	146.1	0
SA1-01	SA1-01-BL1	Black	17.5	145	118
	SA1-01-BB2	Baby Blue	17.5	145	118
SA1-02	SA1-02-BL1	Black	17.5	145	168
	SA1-02-SL2	Silver	17.5	145	168
	SA1-02-NY3	Neon Yellow	17.5	145	168
	SA1-02-NG4	Neon Green	17.5	145	168
SA1-03	SA1-03-BL1	Black	17.5	145	186
	SA1-03-SL2	Silver	17.5	145	186
	SA1-03-NY3	Neon Yellow	17.5	145	186
	SA1-03-NG4	Neon Green	17.5	145	186
SA1-HSVE-1	SA1-HSVE-1	White	35	45	250
SA1-HSVE-2	SA1-HSVE-2	White	35	45	250

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

EA Engineering, Science, and Technology, Inc., PBC

Appendix C - Savings Square (AOI 1) Head Loss Calculations

Well Head to Header - Head Losses by Equivalent Length															
Well Screen ID	Wellhead to Treatment Facility Length (ft)	Pipe Diameter (in)	2" tee (stem)	2" ball valve	2" gate valve	2" butterfly valve	2" tee (run)	2" to 1.5" reducer	Rotameter	1.5" to 2" (bushing) reducer	2"x6" reducer	6" tee (stem or elbow)	Manifold Equivalent Length Before Header (ft)	Total Equivalent Length at manifold (ft)	Head Losses 2" Section (in. WC)
Dilution Port	0	5.709	NA	NA	NA	NA	NA	NA	NA	NA	NA	60			
SA1-01-BL1	113	1.917	60	3	8	46	20	100	50	10	10	60	59	172	1.0
SA1-01-BB2	113	1.917	60	3	8	46	20	100	50	10	10	60	59	172	1.0
SA1-02-BL1	60	1.917	60	3	8	46	20	100	50	10	10	60	59	119	0.7
SA1-02-SL2	60	1.917	60	3	8	46	20	100	50	10	10	60	59	119	0.7
SA1-02-NY3	60	1.917	60	3	8	46	20	100	50	10	10	60	59	119	0.7
SA1-02-NG4	60	1.917	60	3	8	46	20	100	50	10	10	60	59	119	0.7
SA1-03-BL1	39	1.917	60	3	8	46	20	100	50	10	10	60	59	98	0.6
SA1-03-SL2	39	1.917	60	3	8	46	20	100	50	10	10	60	59	98	0.6
SA1-03-NY3	39	1.917	60	3	8	46	20	100	50	10	10	60	59	98	0.6
SA1-03-NG4	39	1.917	60	3	8	46	20	100	50	10	10	60	59	98	0.6
SA1-HSVE-1	47	1.917	60	3	8	46	20	100	50	10	10	60	59	106	2.8
SA1-HSVE-2	22	1.917	60	3	8	46	20	100	50	10	10	30	54	76	1.9

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

EA Engineering, Science, and Technology, Inc., PBC

Appendix C - Savings Square (AOI 1) Head Loss Calculations

Header - Head Losses by Equivalent Length									
Well Screen ID	**Flow (SCFM)**	Pipe Diameter	Number of 6" Tees (run)	6" Tee (run)	Manifold Equivalent Length Through Header (ft)	Head Loss Through Header (in. WC)	Dole Valve (in. WC)	Head Loss at manifold (in. WC) Through Manifold	Subtotal Head Loss (in. WC)
Dilution Port	**245**	5.709	0	0	0.0	0.0	146.1	146.1	146.1
SA1-01-BL1	245	5.709	1	20	9.5	0.0	0	0.0	146.0
SA1-01-BB2	227.5	5.709	2	20	19.0	0.1	0	0.1	146.1
SA1-02-BL1	210	5.709	3	20	28.5	0.1	0	0.1	145.8
SA1-02-SL2	192.5	5.709	4	20	38.1	0.1	0	0.1	145.8
SA1-02-NY3	175	5.709	5	20	47.6	0.1	0	0.1	145.8
SA1-02-NG4	157.5	5.709	6	20	57.1	0.1	0	0.1	145.8
SA1-03-BL1	140	5.709	7	20	66.6	0.1	0	0.1	145.7
SA1-03-SL2	122.5	5.709	8	20	76.1	0.1	0	0.1	145.7
SA1-03-NY3	105	5.709	9	20	85.6	0.1	0	0.1	145.7
SA1-03-NG4	87.5	5.709	10	20	95.2	0.1	0	0.1	145.7
SA1-HSVE-1	70	5.709	11	20	104.7	0.0	98.3	98.3	146.1
SA1-HSVE-2	35	5.709	12	20	114.2	0.0	99.2	99.2	146.1

Header to Atmosphere - Head Losses by Equivalent Length									Head Losses (In. WC)			
Flow (SCFM)	Pipe Diameter	12 x 6 elbows	5 x 6" Tee Stem	1 x 6" Tee Run	2 x Gate Valves	Pipe Length (ft)	Piping and Appurtenances Equivalent (ft)	Piping Head Losses Section (in. WC)	2 x GAC Vessels (in. WC)	Heat Exchanger (in. WC)	Moisture Separator (in. WC)	**Total Required Vacuum (in. WC)**
490	5.709	360	300	20	16	20	351.122	4.0	4.5	2.8	1	**158.4**

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - SA1-HSVE-1 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{45}{407} \cdot 1\ atm = 1.6\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 12.7\ psi$ SVE Applied Asolute Pressure

$L := 106\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{35\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0174\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 9.3644\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 26680$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0241$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 1.207 \cdot 10^8\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 86698.6945\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 693.325\ Pa$

$dP = 0.1006\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 2.8\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - SA1-HSVE-2 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{45}{407} \cdot 1\ atm = 1.6\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 12.7\ psi$ SVE Applied Asolute Pressure

$L := 76\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{35\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0174\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 9.3644\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 26680$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0241$$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 8.3394 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 86913.5855\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 478.434\ Pa$

$dP = 0.0694\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 1.9\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Vertebrae Well SA1-01 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{145}{407} \cdot 1\ atm = 5.2\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 9.1\ psi$ SVE Applied Asolute Pressure

$L := 172\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{17.5\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3484\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9540$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0314$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 3.1428 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 62244.4974\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 251.9447\ Pa$

$dP = 0.0365\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 1\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Vertebrae Well SA1-02 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{145}{407} \cdot 1\ atm = 5.2\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 9.1\ psi$ SVE Applied Asolute Pressure

$L := 119\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{17.5\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3484\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9540$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0314$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 2.2475 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 62316.3761\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 180.066\ Pa$

$dP = 0.0261\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0.7\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Vertebrae Well SA1-03 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{145}{407} \cdot 1\ atm = 5.2\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 9.1\ psi$ SVE Applied Asolute Pressure

$L := 98\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{17.5\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3484\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9540$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0314$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 1.7907 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 62353.017\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 143.4251\ Pa$

$dP = 0.0208\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0.6\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Through Header

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{146}{407} \cdot 1\ atm = 5.3\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 9\ psi$ SVE Applied Asolute Pressure

$L := 9.5\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 5.709\ in$ Pipe Diameter - Assume 6" Sch. 80 PVC

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{245\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.1777\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0869\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 5.2644\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 44669$ Reynold's Number

$er := \frac{e}{D} = 1.0344 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0213$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 9.7817 \cdot 10^5\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 62239.6287\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 7.8576\ Pa$

$dP = 0.0011\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Blower to Atmosphere

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{146.1}{407} \cdot 1\ atm = 5.3\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 9\ psi$ SVE Applied Asolute Pressure

$L := 351\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 5.709\ in$ Pipe Diameter - Assume 6" Sch. 80 PVC

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{490\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.1777\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.1737\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 10.5247\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 89302$ Reynold's Number

$er := \frac{e}{D} = 1.0344 \cdot 10^{-5}$ Relative roughness

$$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0184$$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 1.2423 \cdot 10^8\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 61216.1617\ Pa$ Final pressure at discharge

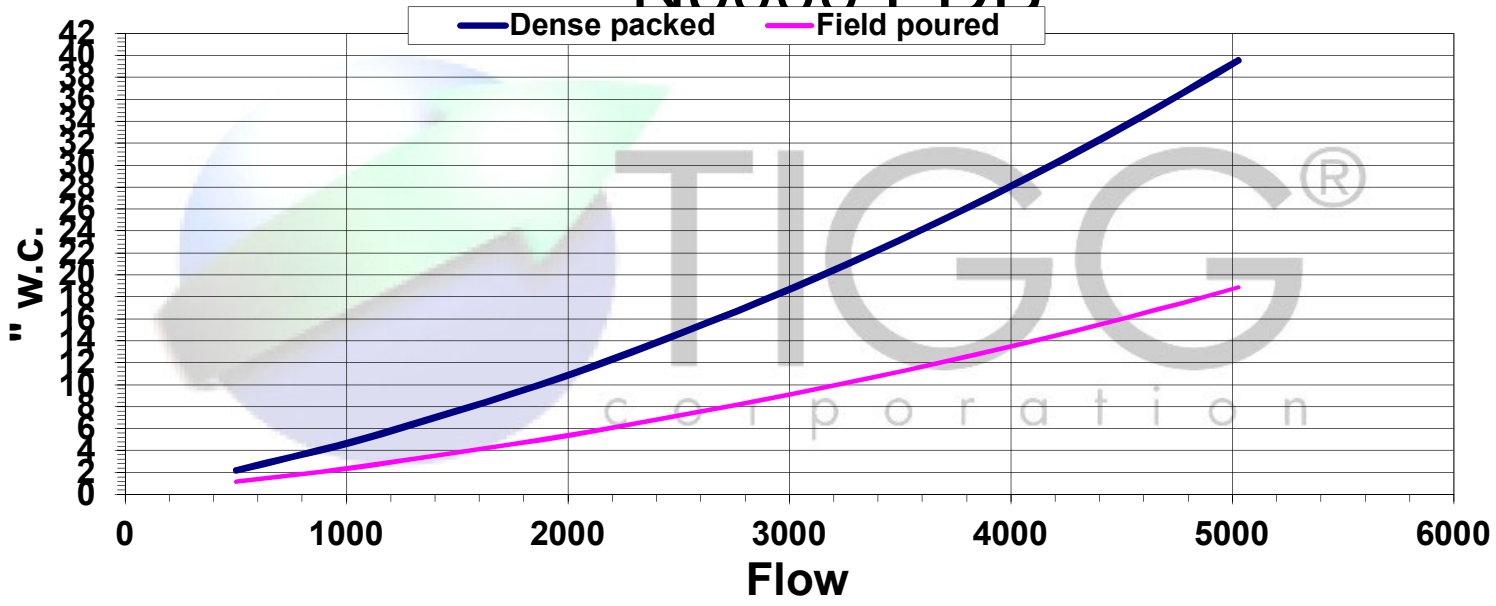
$dP := p1 - p2 = 1006.429\ Pa$

$dP = 0.146\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 4\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

N5000 PDB



Carbon	Type	Density	MPD	Bed Depth	Media
		(lbs/cuft)	(mm)	(in)	(lbs)
TIGG 5CC (0408)	408	26	3	68	7406

Appendix C - Pilgrim Cleaners (AOI 2) Head Loss Calculations

Well String Properties					
Well ID	Well Screen ID	Line Color	Required SCFM[1]	Required Vacuum at Well Head (in. WC)[1]	length of well string (ft)
SA2-03	SA2-03-BL1	Black	13	70	126
	SA2-03-SL2	Silver	13	70	126
	SA2-03-NY3	Neon Yellow	13	70	126
SA2-01	SA2-01-M1	Magenta	13	70	132
	SA2-01-BB2	Baby Blue	13	70	132
	SA2-01-BL3	Black	13	70	132
SA2-04	SA2-04-BL1	Black	13	70	115
	SA2-04-SL2	Silver	13	70	115
	SA2-04-NY3	Neon Yellow	13	70	115
SA2-02	SA2-02-BL1	Black	13	70	112
	SA2-02-SL2	Silver	13	70	112
	SA2-02-NY3	Neon Yellow	13	70	112
SA2-HSVE-1	SA2-HSVE-1	White	35	45	272
SA2-HSVE-2	SA2-HSVE-2	White	35	45	272

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

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Appendix C - Pilgrim Cleaners (AOI 2) Head Loss Calculations

Well Head to Header - Head Losses by Equivalent Length

Well Screen ID	Wellhead to Treatment Facility Length (ft)	Pipe Diameter (in)	2" tee (stem)	2" ball valve	2" gate valve	2" butterfly valve	2" tee (run)	2" to 1.5" reducer	Rotameter	1.5" to 2" (bushing) reducer	2"x6" reducer	6" tee (stem)	Manifold Equivalent Length Before Header (ft)	Total Equivalent Length at manifold (ft)	Head Losses 2" Section (in. WC)
SA2-03-BL1	61	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	124	0.6
SA2-03-SL2	61	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	124	0.6
SA2-03-NY3	61	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	124	0.6
SA2-01-M1	48	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	111	0.5
SA2-01-BB2	48	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	111	0.5
SA2-01-BL3	48	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	111	0.5
SA2-04-BL1	44	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	107	0.5
SA2-04-SL2	44	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	107	0.5
SA2-04-NY3	44	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	107	0.5
SA2-02-BL1	38	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	101	0.4
SA2-02-SL2	38	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	101	0.4
SA2-02-NY3	38	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	101	0.4
SA2-HSVE-1	203	1.917	75	3.3	9	46	25	100	50	10	10	67	63.14918	266	6.8
SA2-HSVE-2	236	1.917	75	3.3	9	46	25	100	50	10	10	20	55.64093	292	7.4

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

EA Engineering, Science, and Technology, Inc., PBC

Appendix C - Pilgrim Cleaners (AOI 2) Head Loss Calculations

Header - Head Losses by Equivalent Length								
Well Screen ID	Flow (SCFM)	Pipe Diameter	Number of 6" Tees (run)	6" Tee (run)	Manifold Equivalent Through Header (ft)	Head Loss Through Header (in. WC)	Dole Valve (in. WC)	Subtotal Head Loss (in. WC)
SA2-03-BL1	230	5.7	0	20	0	0	0	70.6
SA2-03-SL2	217	5.7	1	20	10	0	0	70.6
SA2-03-NY3	203	5.7	2	20	19	0.1	0	70.7
SA2-01-M1	190	5.7	3	20	29	0.1	0	70.6
SA2-01-BB2	177	5.7	4	20	38	0.1	0	70.6
SA2-01-BL3	163	5.7	5	20	48	0.1	0	70.6
SA2-04-BL1	150	5.7	6	20	57	0.1	0	70.6
SA2-04-SL2	137	5.7	7	20	67	0.1	0	70.6
SA2-04-NY3	123	5.7	8	20	76	0.1	0	70.6
SA2-02-BL1	110	5.7	9	20	86	0.1	0	70.5
SA2-02-SL2	97	5.7	10	20	95	0.1	0	70.5
SA2-02-NY3	83	5.7	11	20	105	0.1	0	70.5
SA2-HSVE-1	70	5.7	12	20	114	0.1	18.2	70.1
SA2-HSVE-2	35	5.7	13	20	124	0	18.2	70.6

Header to Reducer - Head Losses by Equivalent Length						Reducer
Flow (SCFM)	Pipe Diameter	6 x 6" Elbows	Pipe Length (ft)	Piping and Appurtenances Equivalent (ft)	Head Loss (in. WC)	6" to 4" Reducer - Head Loss (in. WC)
230	3.786	180	5	61.79	1.6	22.5

Blower to Atmosphere - Head Losses by Equivalent Length									Head Losses (In. WC)			
Flow (SCFM)	Pipe Diameter	6 x 4" Elbows	5 x 4" Tee Stem	1 x 4" Tee Run	2 x Gate Valves	Pipe Length (ft)	Piping and Appurtenances Equivalent (ft)	Head Loss (in. WC)	2 x GAC Vessels (in. WC)	Heat Exchanger (in. WC)	Moisture Separator (in. WC)	**Total Required Vacuum (in. WC)**
230	3.786	180	300	20	16	20	536	14	4.4	2.8	1	**116.9**

Notes:

1. Required flow and Vucuum rates were determined during the SVE pilot test.
2. Equivalent Length Values for Pipes from https://neutrium.net, accessed on 21JUL2020.

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - SA2-HSVE-1 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{45}{407} \cdot 1\ atm = 1.6\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 12.7\ psi$ SVE Applied Asolute Pressure

$L := 266\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{35\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0174\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 9.3644\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 26680$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0241$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 2.9188 \cdot 10^8\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 85705.8169\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 1686.2026\ Pa$

$dP = 0.2446\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 6.8\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - SA2-HSVE-1 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{45}{407} \cdot 1\ atm = 1.6\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 12.7\ psi$ SVE Applied Asolute Pressure

$L := 292\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{35\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0174\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 9.3644\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 26680$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0241$$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 3.2041 \cdot 10^8\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 85539.2168\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 1852.8026\ Pa$

$dP = 0.2687\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 7.4\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - Vertebrae Well SA2-01 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 111\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{13.33\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3125\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9438$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0315$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 1.9909 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 81045.3934\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 122.7317\ Pa$

$dP = 0.0178\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0.5\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - Vertebrae Well SA2-02 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 101\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{13.33\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3125\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9438$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log_{10}\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0315$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 1.8115 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 81056.4579\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 111.6672\ Pa$

$dP = 0.0162\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0.4\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - Vertebrae Well SA2-03 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 124\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 1.917\ in$ Blank SVE Screen Internal Diameter - Assume 2" DR11

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{13.33\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.02\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 3.3125\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 9438$ Reynold's Number

$er := \frac{e}{D} = 3.0806 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0315$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 2.224 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 81031.0073\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 137.1178\ Pa$

$dP = 0.0199\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0.6\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Savings Square - Vertebrae Well SA2-01 Conveyence Piping

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70.6}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 123.7\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 5.709\ in$ Pipe Diameter - Assume 6" Sch. 80 PVC

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{35\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.1777\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.0162\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 0.9789\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 8306$ Reynold's Number

$er := \frac{e}{D} = 1.0344 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0326$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 6.7344 \cdot 10^5\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 81014.5955\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 4.1562\ Pa$

$dP = 0.0006\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 0\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - Header to Blower

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70.6}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 61.79\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 3.786\ in$ Pipe Diameter - Assume 6" Sch. 80 PVC

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{230\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.0781\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.1062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 14.6264\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 82302$ Reynold's Number

$er := \frac{e}{D} = 1.5598 \cdot 10^{-5}$ Relative roughness

$$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0187$$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 6.4892 \cdot 10^7\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 80617.2841\ Pa$ Final pressure at discharge

$dP := p1 - p2 = 401.4676\ Pa$

$dP = 0.0582\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 1.6\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

OBJECTIVE: Estimate pipe friction loss in SVE wells
Pilgrim Cleaners - Blower to Atmosphere

REFERENCE: Environmental Engineering Reference Manual. M. Linderburg. 2001
Section 17. Fluid Dynamics. Friction Losses for Steam and Gases

INPUT:

$p0 := 14.3\ psi$ Pressure at approximately 650 ft msl

$vac := \frac{70.6}{407} \cdot 1\ atm = 2.5\ psi$ Anticipated vacuum at the branch

$p1 := p0 - vac = 11.8\ psi$ SVE Applied Asolute Pressure

$L := 536\ ft$ Conveyence Pipe Length

$R' := \frac{0.08206\ atm\ L}{mol\ K}$ Universal Constant

$T := 60\ °F$ Soil vapor average temperature

$D := 3.786\ in$ Pipe Diameter - Assume 4" Sch. 80 PVC

$MW := 28.98\ \frac{g}{mol}$ Air

$Q := \frac{230\ ft^3}{min}$ Design volumetric flowrate - branch

$d := 1.293\ \frac{kg}{m^3}$ Density of air at 0 degrees Celcius

$mu := 1.709 \cdot 10^{-5}\ Pa\ s$ Absolute viscosity of air at 0 degrees Celcius

$e := 1.5 \cdot 10^{-6}\ m$ Specific Roughness for Plastic Pipe

CALCULATIONS:

$Area := \frac{3.14 \cdot D^2}{4} = 0.0781\ ft^2$ Area of pipe

$m := Q \cdot d \cdot \frac{p1}{1\ atm} \cdot \frac{32\ °F}{T} = 0.1062\ \frac{kg}{s}$ Mass flowrate

$G := \frac{m}{Area} = 14.6264\ \frac{kg}{m^2\ s}$ Mass flowrate per area

$Re := \frac{D \cdot G}{mu} = 82302$ Reynold's Number

$er := \frac{e}{D} = 1.5598 \cdot 10^{-5}$ Relative roughness

$f := \frac{0.25}{\left(\log\left(\frac{er}{3.7} + \frac{5.74}{Re^{0.9}}\right)\right)^2} = 0.0187$

$B := \frac{f \cdot L \cdot G^2 \cdot R' \cdot T}{D \cdot MW} = 5.6291 \cdot 10^8\ \frac{kg\ Pa}{m\ s^2}$

$p2 := \sqrt{p1^2 - B} = 77466.9797\ Pa$ Final pressure at discharge

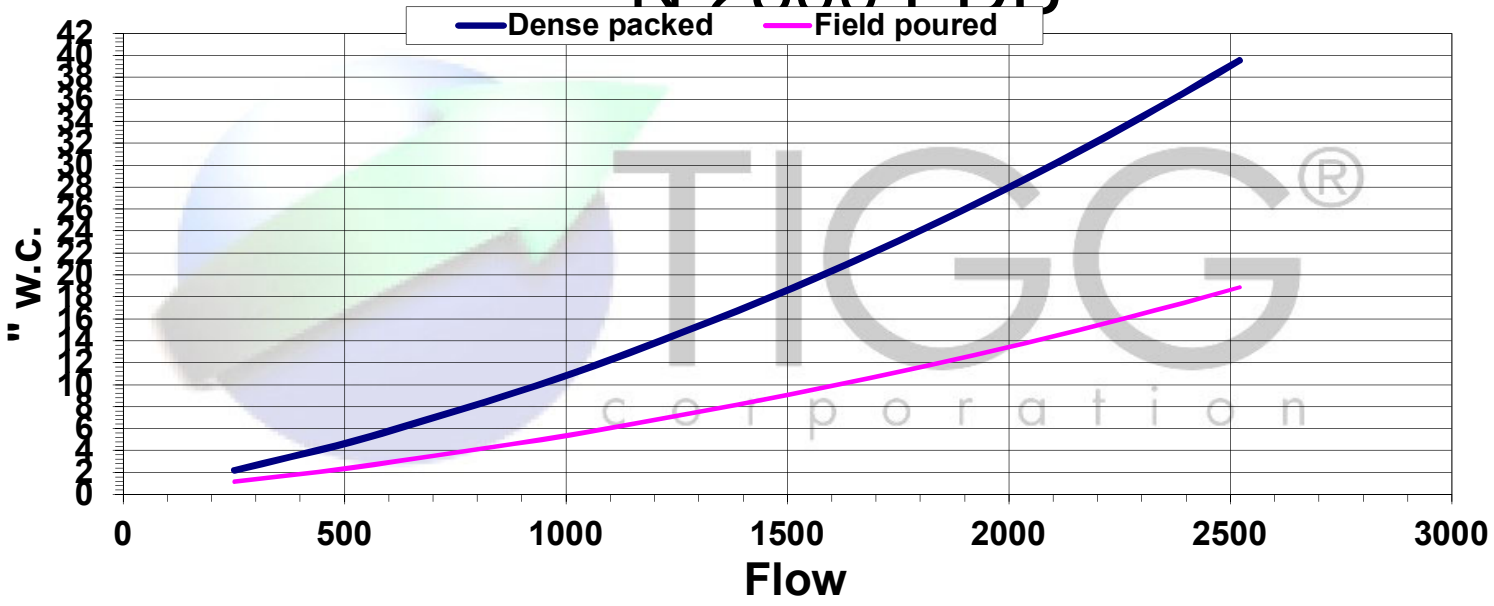
$dP := p1 - p2 = 3551.772\ Pa$

$dP = 0.5151\ psi$ Pressure loss in pipe

$inwc := 1 \cdot \frac{atm}{407} = 249\ Pa$

$dP = 14.3\ inwc$ Loss is acceptable, therefore, selected well diameter is appropriate

N 2500 PDB



Carbon	Type	Density	MPD	Bed Depth	Media
		(lbs/cuft)	(mm)	(in)	(lbs)
TIGG 5CC (0408)	408	26	3	68	3714

Appendix C-2

Carbon Adsorption Calculations

1 Willow Avenue
Oakdale, PA 15071
p. 724-703-3020
f. 724-703-3026

Title: EA Engineering Attn: Alexander Spiller AOI-1

Report Basis

Flow Rate	245 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	1,500.000 ug/l
trichloroethylene	74.000 ug/l
cisdichloroethylene	490.000 ug/l
transdichloroethylene	3.700 ug/l
benzene	7.800 ug/l
toluene	13.000 ug/l
ethyl benzene	5.900 ug/l
xylene	21.000 ug/l
cyclohexane	2.300 ug/l
heptane	3.200 ug/l
hexane	3.600 ug/l

Report: 150.94 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 30.983 lbs./100 lbs. Carbon

Note: Contact TIGG Corporation if comments are needed on preferential adsorption of contaminants above.

Run 1

Report Basis

Flow Rate	245 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	1,500.000 ug/l
trichloroethylene	74.000 ug/l
cisdichloroethylene	490.000 ug/l
transdichloroethylene	3.700 ug/l
benzene	7.800 ug/l
toluene	13.000 ug/l
ethyl benzene	5.900 ug/l
xylene	21.000 ug/l
cyclohexane	2.300 ug/l
heptane	3.200 ug/l
hexane	3.600 ug/l

Band	Chemicals	Y	LBS/100 LBS Carbon	Overall LBS/100 LBS Carbon
1	perchloroethylene	0.59	42.120	42.120
	trichloroethylene	0.04	0.178	0.178
	cisdichloroethylene	0.33	0.187	0.187
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.019	0.019
	toluene	0.01	0.251	0.251
	ethyl benzene	0.00	0.424	0.424
	xylene	0.01	2.585	2.585
	cyclohexane	0.00	0.005	0.005
	heptane	0.00	0.040	0.040
	hexane	0.00	0.007	0.007
	17.886 Pounds Carbon Per Day			
2	perchloroethylene	0.60	46.102	43.613
	trichloroethylene	0.04	0.188	0.182
	cisdichloroethylene	0.33	0.194	0.190
	transdichloroethylene	0.00	0.001	0.001

	benzene	0.01	0.020	0.019
	toluene	0.01	0.272	0.259
	ethyl benzene	0.00	0.504	0.454
	xylene	0.00	0.000	1.615
	cyclohexane	0.00	0.006	0.006
	heptane	0.00	0.043	0.041
	hexane	0.00	0.008	0.007
	28.615 Pounds Carbon Per Day			
3	perchloroethylene	0.61	46.844	45.568
	trichloroethylene	0.04	0.189	0.186
	cisdichloroethylene	0.33	0.195	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.020	0.020
	toluene	0.01	0.275	0.269
	ethyl benzene	0.00	0.000	0.179
	xylene	0.00	0.000	0.638
	cyclohexane	0.00	0.006	0.006
	heptane	0.00	0.043	0.042
	hexane	0.00	0.008	0.007
	72.461 Pounds Carbon Per Day			
4	perchloroethylene	0.00	0.000	45.339
	trichloroethylene	0.04	0.255	0.187
	cisdichloroethylene	0.34	0.236	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.028	0.020
	toluene	0.60	24.935	0.393
	ethyl benzene	0.00	0.000	0.178
	xylene	0.00	0.000	0.635
	cyclohexane	0.00	0.008	0.006
	heptane	0.00	0.099	0.043
	hexane	0.00	0.011	0.007
	72.827 Pounds Carbon Per Day			
5	perchloroethylene	0.00	0.000	45.217
	trichloroethylene	0.05	0.339	0.187
	cisdichloroethylene	0.40	0.264	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.039	0.020

	toluene	0.00	0.000	0.392
	ethyl benzene	0.00	0.000	0.178
	xylene	0.00	0.000	0.633
	cyclohexane	0.00	0.011	0.006
	heptane	0.53	20.116	0.096
	hexane	0.00	0.016	0.007
	73.022 Pounds Carbon Per Day			
6	perchloroethylene	0.00	0.000	43.995
	trichloroethylene	0.19	7.730	0.391
	cisdichloroethylene	0.41	1.008	0.215
	transdichloroethylene	0.00	0.004	0.001
	benzene	0.26	7.744	0.229
	toluene	0.00	0.000	0.381
	ethyl benzene	0.00	0.000	0.173
	xylene	0.00	0.000	0.616
	cyclohexane	0.03	0.990	0.032
	heptane	0.00	0.000	0.094
	hexane	0.10	3.406	0.099
	75.050 Pounds Carbon Per Day			
7	perchloroethylene	0.00	0.000	43.968
	trichloroethylene	0.19	6.886	0.395
	cisdichloroethylene	0.45	0.947	0.216
	transdichloroethylene	0.00	0.004	0.001
	benzene	0.00	0.000	0.229
	toluene	0.00	0.000	0.381
	ethyl benzene	0.00	0.000	0.173
	xylene	0.00	0.000	0.616
	cyclohexane	0.03	0.734	0.033
	heptane	0.00	0.000	0.094
	hexane	0.33	9.965	0.106
	75.098 Pounds Carbon Per Day			
8	perchloroethylene	0.00	0.000	43.836
	trichloroethylene	0.22	9.125	0.421
	cisdichloroethylene	0.41	1.026	0.218
	transdichloroethylene	0.00	0.005	0.001
	benzene	0.00	0.000	0.228
	toluene	0.00	0.000	0.380

	ethyl benzene	0.00	0.000	0.172
	xylene	0.00	0.000	0.614
	cyclohexane	0.36	11.488	0.067
	heptane	0.00	0.000	0.094
	hexane	0.00	0.000	0.105
	75.324 Pounds Carbon Per Day			
9	perchloroethylene	0.00	0.000	41.330
	trichloroethylene	0.59	28.718	2.039
	cisdichloroethylene	0.40	1.146	0.271
	transdichloroethylene	0.00	0.005	0.001
	benzene	0.00	0.000	0.215
	toluene	0.00	0.000	0.358
	ethyl benzene	0.00	0.000	0.163
	xylene	0.00	0.000	0.579
	cyclohexane	0.00	0.000	0.063
	heptane	0.00	0.000	0.088
	hexane	0.00	0.000	0.099
	79.891 Pounds Carbon Per Day			
10	perchloroethylene	0.00	0.000	21.932
	trichloroethylene	0.00	0.000	1.082
	cisdichloroethylene	0.99	14.958	7.164
	transdichloroethylene	0.01	0.046	0.022
	benzene	0.00	0.000	0.114
	toluene	0.00	0.000	0.190
	ethyl benzene	0.00	0.000	0.086
	xylene	0.00	0.000	0.307
	cyclohexane	0.00	0.000	0.034
	heptane	0.00	0.000	0.047
	hexane	0.00	0.000	0.053
	150.553 Pounds Carbon Per Day			
11	perchloroethylene	0.00	0.000	21.875
	trichloroethylene	0.00	0.000	1.079
	cisdichloroethylene	0.00	0.000	7.146
	transdichloroethylene	1.00	12.390	0.054
	benzene	0.00	0.000	0.114
	toluene	0.00	0.000	0.190
	ethyl benzene	0.00	0.000	0.086

xylene	0.00	0.000	0.306
cyclohexane	0.00	0.000	0.034
heptane	0.00	0.000	0.047
hexane	0.00	0.000	0.053

150.942 Pounds Carbon Per Day

Report: 150.94 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 30.983 lbs./100 lbs. Carbon

1 Willow Avenue
Oakdale, PA 15071
p. 724-703-3020
f. 724-703-3026

Title: EA Engineering ATTN: Alexander Spiller AOI-2

Report Basis

Flow Rate	230 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	160.000 ug/l
trichloroethylene	37.000 ug/l
cisdichloroethylene	210.000 ug/l
transdichloroethylene	19.000 ug/l

Report: 59.11 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 14.894 lbs./100 lbs. Carbon

Note: Contact TIGG Corporation if comments are needed on preferential adsorption of contaminants above.

Run 1

Report Basis

Flow Rate	230 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	160.000 ug/l
trichloroethylene	37.000 ug/l
cisdichloroethylene	210.000 ug/l
transdichloroethylene	19.000 ug/l

Band	Chemicals	Y	LBS/100 LBS Carbon	Overall LBS/100 LBS Carbon
1	perchloroethylene	0.27	35.765	35.765
	trichloroethylene	0.08	0.380	0.380
	cisdichloroethylene	0.60	0.219	0.219
	transdichloroethylene	0.05	0.012	0.012
	9.245 Pounds Carbon Per Day			
2	perchloroethylene	0.00	0.000	24.870
	trichloroethylene	0.27	18.012	5.751
	cisdichloroethylene	0.67	1.546	0.624
	transdichloroethylene	0.06	0.082	0.033
	13.294 Pounds Carbon Per Day			
3	perchloroethylene	0.00	0.000	5.816
	trichloroethylene	0.00	0.000	1.345
	cisdichloroethylene	0.93	9.773	7.633
	transdichloroethylene	0.07	0.458	0.359
	56.850 Pounds Carbon Per Day			
4	perchloroethylene	0.00	0.000	5.594
	trichloroethylene	0.00	0.000	1.294
	cisdichloroethylene	0.00	0.000	7.342
	transdichloroethylene	1.00	8.363	0.664
	59.105 Pounds Carbon Per Day			

Report: 59.11 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 14.894 lbs./100 lbs. Carbon

Appendix C-3

In Situ Bioremediation Dosage Calculations

SUBSTRATE ESTIMATING TOOL FOR ENHANCED ANAEROBIC BIOREMEDIATION OF CHLORINATED SOLVENTS

Version 1.2
November 2010

Site Data Input Table

TABLE S.1 - INPUT TABLE

Calculation Tables

Table S.2 - Substrate Calculations in Hydrogen Equivalents

Table S.3 - Hydrogen Produced by Common Substrates

Table S.4 - Estimated Substrate Requirements for Hydrogen Demand

Output Summary Table

TABLE S.5 - OUTPUT TABLE

PRINT SUMMARY TABLE

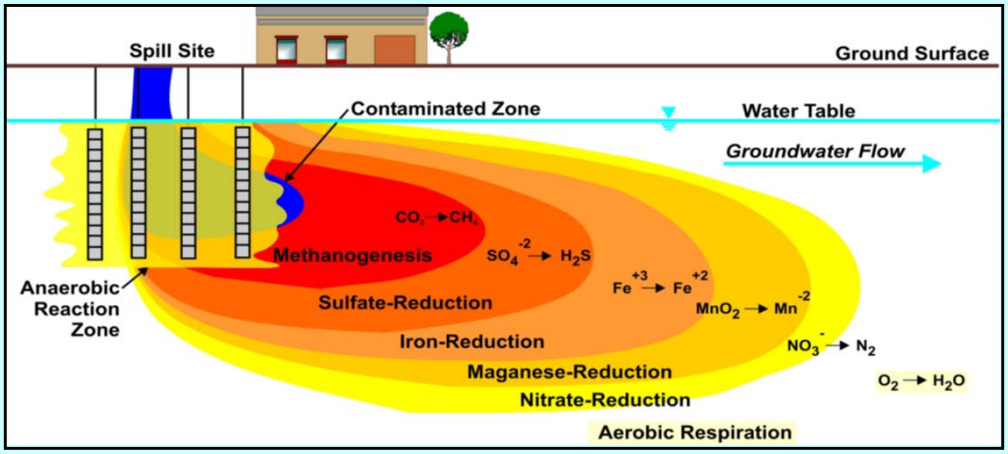


Table S.1 Input for Substrate Requirements in Hydrogen Equivalents

Site Name: Bandera Rd SF Site AOI 1 Savings Square

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NOTE: Unshaded boxes are user input.

1. Treatment Zone Physical Dimensions	Values	Range	Units	User Notes
Width (Perpendicular to predominant groundwater flow direction)	300	1-10,000	feet	
Length (Parallel to predominant groundwater flow)	20	1-1,000	feet	Please input your site data.
Saturated Thickness	20	1-100	feet	DTW 80.85 ft BTOC at usgs-42 measaured on 2OCT2019
Treatment Zone Cross Sectional Area	6000	--	ft^2	
Treatment Zone Volume	120,000	--	ft^3	
Treatment Zone Total Pore Volume (total volume x total porosity)	44,892	--	gallons	
Treatment Zone Effective Pore Volume (total volume x effective porosity)	17,957	--	gallons	
Design Period of Performance	3.0	.5 to 5	year	
Design Factor (times the electron acceptor hydrogen demand)	5.0	2 to 20	unitless	
2. Treatment Zone Hydrogeologic Properties				
Total Porosity	5%	.05-50	percent	Assumed: Not used for calculation
Effective Porosity	2%	.05-50	percent	SVE Pilot Test
Average Aquifer Hydraulic Conductivity	0.01	.01-1000	ft/day	Assumed
Average Hydraulic Gradient	0.014	0.0001-0.1	ft/ft	Assumed
Average Groundwater Seepage Velocity through the Treatment Zone	0.01	--	ft/day	
Average Groundwater Seepage Velocity through the Treatment Zone	2.6	--	ft/yr	
Average Groundwater Discharge through the Treatment Zone	2,294	--	gallons/year	
Soil Bulk Density	1.5	1.4-2.0	gm/cm^3	Assumed
Soil Fraction Organic Carbon (foc)	0.05%	0.01-10	percent	Assumed
3. Native Electron Acceptors				
A. Aqueous-Phase Native Electron Acceptors				
Oxygen	2.0	0.01 to 10	mg/L	31JAN2011 Data from DW404
Nitrate	1.69	0.1 to- 20	mg/L	Ave at DW404, FEB09, OCT09, & JUN10
Sulfate	46	10 to 5,000	mg/L	USGS-42 Results JUL2008
Carbon Dioxide (estimated as the amount of Methane produced)	0.4	0.1 to 20	mg/L	Ave at DW404, FEB09, OCT09, & JUN10
B. Solid-Phase Native Electron Acceptors				
Manganese (IV) (estimated as the amount of Mn (II) produced)	0	0.1 to 20	mg/L	DW404 Results 6JAN2011 - ISB Pilot Report
Iron (III) (estimated as the amount of Fe (II) produced)	9	0.1 to 20	mg/L	DW404 Results 6JAN2011 - ISB Pilot Report
4. Contaminant Electron Acceptors				
Tetrachloroethene (PCE)	2500.000	--	mg/L	DEC2016 Data from USGS-42
Trichloroethene (TCE)	180.000	--	mg/L	DEC2016 Data from USGS-42
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	660.000	--	mg/L	DEC2016 Data from USGS-42
Vinyl Chloride (VC)	0.000	--	mg/L	
Carbon Tetrachloride (CT)	0.000	--	mg/L	
Trichloromethane (or chloroform) (CF)	0.000	--	mg/L	
Dichloromethane (or methylene chloride) (MC)	0.000	--	mg/L	
Chloromethane	0.000	--	mg/L	
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	--	mg/L	
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	--	mg/L	
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	--	mg/L	
Chloroethane	0.000	--	mg/L	
Perchlorate	0.000	--	mg/L	
5. Aquifer Geochemistry (Optional Screening Parameters)				
A. Aqueous Geochemistry				
Oxidation-Reduction Potential (ORP)	43	-400 to +500	mV	6JAN2011 WQ Parameter at DW404 - ISB Pilot Report
Temperature	20	5.0 to 30	ºC	6JAN2011 WQ Parameter at DW404 - ISB Pilot Report
pH	6.8	4.0 to 10.0	su	6JAN2011 WQ Parameter at DW404 - ISB Pilot Report
Alkalinity	200	10 to 1,000	mg/L	
Total Dissolved Solids (TDS, or salinity)	1210	10 to 1,000	mg/L	31JAN2011 WQ Parameter at DW404 - ISB Pilot Report
Specific Conductivity	771	100 to 10,000	µs/cm	6JAN2011 WQ Parameter at DW404 - ISB Pilot Report
Chloride	260	10 to 10,000	mg/L	Estimated based on spec cond
Sulfide - Pre injection	0.0	0.1 to 100	mg/L	APR2008 at USGS-42
Sulfide - Post injection	0.0	0.1 to 100	mg/L	
B. Aquifer Matrix				
Total Iron	2000	200 to 20,000	mg/kg	Assumed
Cation Exchange Capacity	NA	1.0 to 10	meq/100 g	
Neutralization Potential	10.0%	1.0 to 100	Percent as $CaCO_3$	Assumed

NOTES:

Table S.2 Substrate Calculations in Hydrogen Equivalents

Site Name: Bandera Rd SF Site AOI 1 Savings Square

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NOTE: Open cells are user input.

1. Treatment Zone Physical Dimensions

	Values	Range	Units
Width (Perpendicular to predominant groundwater flow direction)	300	1-10,000	feet
Length (Parallel to predominant groundwater flow)	20	1-1,000	feet
Saturated Thickness	20	1-100	feet
Treatment Zone Cross Sectional Area	6000	--	ft^2
Treatment Zone Volume	120,000	--	ft^3
Treatment Zone Effective Pore Volume (total volume x effective porosity)	17,957	--	gallons
Design Period of Performance	3.0	.5 to 5	year

2. Treatment Zone Hydrogeologic Properties

Total Porosity	0.05	.05-50	
Effective Porosity	0.02	.05-50	
Average Aquifer Hydraulic Conductivity	0.01	.01-1000	ft/day
Average Hydraulic Gradient	0.014	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the Treatment Zone	0.01	--	ft/day
Average Groundwater Seepage Velocity through the Treatment Zone	2.6	--	ft/yr
Average Groundwater Flux through the Treatment Zon 0	2,294	--	gallons/year
Soil Bulk Density	1.5	1.4-2.0	gm/cm^3
Soil Fraction Organic Carbon (foc)	0.0005	0.0001-0.1	

3. Initial Treatment Cell Electron-Acceptor Demand (one total pore volume)

A. Aqueous-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	2.0	0.30	7.94	0.04	4
Nitrate (denitrification)	1.7	0.25	12.30	0.02	5
Sulfate	46	6.89	11.91	0.58	8
Carbon Dioxide (estimated as the amount of methane produced)	0.4	0.05	1.99	0.03	8
Soluble Competing Electron Acceptor Demand (lb.)				**0.66**	

B. Solid-Phase Native Electron Acceptors (Based on manganese and iron produced)	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Manganese (IV) (estimated as the amount of Mn (II) produced)	0.1	0.01	27.25	0.00	2
Iron (III) (estimated as the amount of Fe (II) produced)	9.1	1.88	55.41	0.03	1
Solid-Phase Competing Electron Acceptor Demand (lb.)				**0.03**	

C. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	2500.000	374.60	20.57	18.21	8
Trichloroethene (TCE)	180.000	26.97	21.73	1.24	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	660.000	98.90	24.05	4.11	4
Vinyl Chloride (VC)	0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.55	0.00	4
Chloroethane	0.000	0.00	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Soluble Contaminant Electron Acceptor Demand (lb.)				**23.56**	

D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	Soil Conc. (mg/kg)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	263	328.75	3694.89	20.57	179.63	8
Trichloroethene (TCE)	107	9.63	108.23	21.73	4.98	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	14.85	166.90	24.05	6.94	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	224	0.00	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	63	0.00	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	28	0.00	0.00	21.06	0.00	4
Chloromethane	25	0.00	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	117	0.00	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	105	0.00	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	30	0.00	0.00	24.55	0.00	4
Chloroethane	3	0.00	0.00	32.00	0.00	2
Perchlorate	0.0	0.00	0.00	12.33	0.00	6
Total Sorbed Contaminant Electron Acceptor Demand (lb.)					**191.55**	

(continued)

Table S.2 Substrate Calculations in Hydrogen Equivalents

4. Treatment Cell Electron-Acceptor Flux (per year)

A. Soluble Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	2.0	0.04	7.94	0.00	4
Nitrate (denitrification)	1.7	0.03	10.25	0.00	5
Sulfate	46	0.88	11.91	0.07	8
Carbon Dioxide (estimated as the amount of Methane produced)	0.36	0.01	1.99	0.00	8
Total Competing Electron Acceptor Demand Flux (lb/yr)				**0.1**	

B. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	2500.000	47.86	20.57	2.33	8
Trichloroethene (TCE)	180.000	3.45	21.73	0.16	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	660.000	12.63	24.05	0.53	4
Vinyl Chloride (VC)	0.000	0.00	31.00	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.08	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.74	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.06	0.00	4
Chloromethane	0.000	0.00	25.04	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.82	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.06	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.55	0.00	4
Chloroethane	0.000	0.00	32.00	0.00	2
Perchlorate	0.000	0.00	12.33	0.00	6
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr)				**3.01**	

Initial Hydrogen Requirement First Year (lb)	**218.9**
Total Life-Cycle Hydrogen Requirement (lb)	**225.1**

5. Design Factors

Microbial Efficiency Uncertainty Factor	2X - 4X
Methane and Solid-Phase Electron Acceptor Uncertainty	2X - 4X
Remedial Design Factor (e.g., Substrate Leaving Reaction Zone)	1X - 3X
Design Factor	**5.0**
Total Life-Cycle Hydrogen Requirement with Design Factor (lb)	**1,125.5**

6. Acronyns and Abbreviations

°C =degrees celsius
µs/cm = microsiemens per centimeter
cm/day = centimeters per day
cm/sec = centimeters per second
ft^2 = square feet
ft/day = feet per day
ft/ft = foot per foot
ft/yr = feet per year
gm/cm^3 = grams per cubic centimeter
kg of CaCO3 per mg = kilograms of calcium carbonate per milligram
lb = pounds
meq/100 g = milliequivalents per 100 grams
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
m/m = meters per meters
mV = millivolts
m/yr = meters per year
su = standard pH units
wt/wt H2 = concetration molecular hydrogen, weight per weight

Table S.3

Hydrogen Produced by Fermentation Reactions of Common Substrates

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Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	Range of Moles H_2/Mole Substrate
Lactic Acid	$C_3H_6O_3$	90.1	2	0.0448	**2 to 3**
Molasses (assuming 100% sucrose)	$C_{12}H_{22}O_{11}$	342	8	0.0471	**8 to 11**
High Fructose Corn Syrup (assuming 50% fructose and 50% glucose)	$C_6H_{12}O_6$	180	4	0.0448	**4 to 6**
Ethanol	C_2H_6O	46.1	2	0.0875	**2 to 6**
Whey (assuming 100% lactose)	$C_{12}H_{22}O_{11}$	342	11	0.0648	**11**
HRC® (assumes 40% lactic acid and 40% glycerol by weight)	$C_{39}H_{56}O_{39}$	956	28	0.0590	**28**
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	$C_{18}H_{32}O_2$	281	16	0.1150	**16**

Table S.4

Estimated Substrate Requirements for Hydrogen Demand in Table S.3

Design Life (years): 3

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	25,145	25,145	1.14E+10	121,308
Sodium Lactate Product (60 percent solution)	5.0	25,145	52,167	1.14E+10	121,308
Molasses (assuming 6 0	5.0	23,887	39,812	1.08E+10	115,241
HFCS (assuming 40% fructose and 40% glucose by weight)	5.0	25,150	31,438	1.14E+10	121,335
Ethanol Product (assuming 80% ethanol by weight)	5.0	12,860	16,075	5.83E+09	62,041
Whey (assuming 100% lactose)	5.0	17,357	24,796	7.87E+09	83,738
HRC® (assumes 40% lactic acid and 40% glycerol by weight)	5.0	19,061	19,061	8.65E+09	73,567
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	5.0	9,787	9,787	4.44E+09	47,218
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	5.0	9,787	16,312	4.44E+09	47,218

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.
2. Molecular weight of sodium lactate (CH_3-CHOH-COONa) = 112.06.
3. Molecular weight of lactic Acid ($C_6H_6O_3$) = 90.08 .
4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.
5. Weight of sodium lactate product = 11.0 pounds per gallon.
6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

NOTES: Standard HRC Product

1. Assumes HRC product is 40 percent lactic acid and 40 percent glycerol by weight.
2. HRC® weighs approximately 9.18 pounds per gallon.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.
2. Soybean oil is 7.8 pounds per gallon.
3. Assumes specific gravity of emulsion product is 0.96.

Table S.5 Output for Substrate Requirements in Hydrogen Equivalents

Site Name: Bandera Rd SF Site AOI 1 Savings Square

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1. Treatment Zone Physical Dimensions

	Values	Units	Values	Units
Width (perpendicular to groundwater flow)	300	feet	91	meters
Length (parallel to groundwater flow)	20	feet	6.1	meters
Saturated Thickness	20	feet	6.1	meters
Design Period of Performance	3	years	3	years

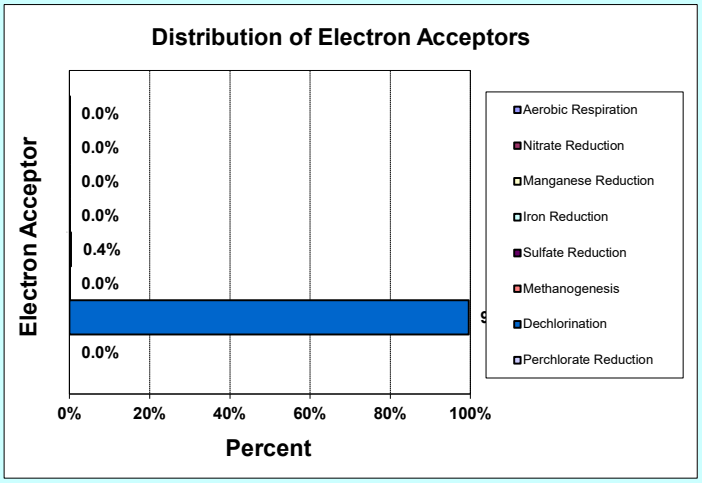
2. Treatment Zone Hydrogeologic Properties

	Values	Units	Values	Units
Total Porosity	0.05	percent	0.05	percent
Effective Porosity	0.02	percent	0.02	percent
Average Aquifer Hydraulic Conductivity	0.01	ft/day	3.5E-06	cm/sec
Average Hydraulic Gradient	0.014	ft/ft	0.014	m/m
Average Groundwater Seepage Velocity	0.01	ft/day	2.1E-01	cm/day
Average Groundwater Seepage Velocity	3	ft/yr	0.8	m/yr
Effective Treatment Zone Pore Volume	17,957	gallons	67,972	liters
Groundwater Flux (per year)	2,294	gallons/year	8,683	liters/year
Total Groundwater Volume Treated (over entire design period)	24,839	gallons total	94,022	liters total

3. Distribution of Electron Acceptor Demand

	Percent of Total	Hydrogen Demand (lb)
Aerobic Respiration	0.0%	0.053
Nitrate Reduction	0.0%	0.030
Sulfate Reduction	0.4%	0.801
Manganese Reduction	0.0%	0.001
Iron Reduction	0.0%	0.034
Methanogenesis	0.0%	0.037
Dechlorination	99.6%	224.141
Perchlorate Reduction	0.0%	0.000
Totals:	**100.00%**	**225.10**

Hydrogen demand in pounds/gallon:	9.06E-03
Hydrogen demand in grams per liter:	1.09E+00



4. Substrate Equivalents: Design Factor = 5.0

Product	Quantity (lb)	Quantity (gallons)	Effective Concentration (mg/L)	Effective concentration is for total volume of groundwater treated.
1. Sodium Lactate Product	52,167	4,742	121,308	as lactic acid
2. Molasses Product	39,812	3,318	115,241	as sucrose
3. Fructose Product	31,438	2,807	121,335	as fructose
4. Ethanol Product	16,075	2,330	62,041	as ethanol
5. Sweet Dry Whey (lactose)	24,796	sold by pound	83,738	as lactose
6. HRC®	19,061	sold by pound	73,567	as 40% lactic acid/40% glycerol
7. Linoleic Acid (Soybean Oil)	9,787	1,255	47,218	as soybean oil
8. Emulsified Vegetable Oil	16,312	2,091	47,218	as soybean oil

Notes:
1. Quantity assumes product is 60% sodium lactate by weight.
2. Quantity assumes product is 60% sucrose by weight and weighs 12 pounds per gallon.
3. Quantity assumes product is 80% fructose by weight and weighs 11.2 pounds per gallon.
4. Quantity assumes product is 80% ethanol by weight and weighs 6.9 pounds per gallon.
5. Quantity assumes product is 70% lactose by weight.
6. Quantity assumes HRC® is 40% lactic acid and 40% glycerol by weight.
7. Quantity of neat soybean oil, corn oil, or canola oil.
8. Quantity assumes commercial product is 60% soybean oil by weight.

Appendix D

Construction Cost Estimate

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$6,245,000
Soil Vapor Extraction *In-Situ* **Bioremediation**	**Bandera Road Bexar County, TX**	**Soil Vapor Groundwater**	**Construction Time:**	**2 months**
			Operation Time:	**2 years**
			Post Remediation Monitoring	**- years**

Description	Data Source (Means[1] or Other)	Quantities: Quantity Amount	Quantities: Quantity Unit	Cost Breakdown (if available): Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Combined Unit Costs: Unit Cost	Option Total Cost
REMEDIAL ACTION		**TOTAL CAPITAL COST (totals rounded to nearest thousand)**									**$2,229,000**
											$1,580,979
Mobilization	**Professional Estimate**	**1**	**LS**							**10% of Direct Cost**	$158,098
Temporary Facilities, Staging Areas, Site Access		**1**	**LS**								
Toilet, portable chemical (2 toilets)	RS Means - 3105 3340 6410	3	month							$ 391.46	$1,476
Silt Fence	RS Means - 3125 1416 1000	350	LF	$ 0.79	$ 276.50	$ 0.19	$ 66.50	$ 0.50	$ 175.00	$ 1.48	$651
Trash Dumpster, 10 CY	RS Means - 0241 1919 0700	8	Weeks					$ 565.00	$ 4,520.00	$ 565.00	$6,391
SVE Treatment System - Savings Square		**1**	**LS**								
550 Gal double-wall Poly Water Storage Tank w/ Level Indicator and U-vent	Vendor Quote	1	each							$ 8,334.00	$10,474
SVE Blower/Motor and Moisture Seperator System and Appurtenances	Vendor Quote	1	each							$ 27,800.00	$34,939
Heat Exchanger	Vendor Quote	1	each							$ 6,300.00	$7,918
1/2 hp Transfer Pump (liquid, MS to GAC)	Vendor Quote	1	each							$ 458.00	$576
Vapor Phase GAC Units and Initial Carbon, 7,400 lb each	Vendor Quote	2	each							$ 42,472.00	$106,758
20 ft Sea Box with Fire and Sound Proofing	Vendor Quote/Professional Estima	1	lump sum							$ 10,632.25	$13,363
Piping Manifold	Vendor Quote	1	lump sum							$ 9,277.57	$11,660
GAC Duct Rack	Vendor Quote	1	lump sum							$ 13,850.00	$17,407
1 hp Air Compressor	Vendor Quote	1	lump sum							$ 200.00	$251
18,500 Btu AC Window Unit Installed	Vendor Quote/Professional Estima	1	each							$ 1,000.00	$1,257
Exhaust Fan Installed	Vendor Quote/Professional Estima	1	each							$ 400.00	$503
Control System	Professional Estimate	1	lump sum							$ 50,000.00	$62,840
Bird Proof Louvres Installed	Vendor Quote/Professional Estima	2	each							$ 300.00	$754
Air Intake Silencer and Filter	Vendor Quote/Professional Estima	1	each							$ 585.00	$735
Orifice Plates - Sized	Vendor Quote/Professional Estima	2	each							$ 533.90	$1,342
Start-up Assistance, Equipment Testing, Operator Training	Vendor Quote	1	lump sum							$ 4,774.05	$6,000
SVE Treatment System - Pilgrim Cleaners		**1**	**LS**								
550 Gal double-wall Poly Water Storage Tank	Vendor Quote	1	each							$ 8,334.00	$11,752
SVE Blower/Motor and Moisture Seperator System and Appurtenances	Vendor Quote	1	each							$ 16,460.00	$23,210
Heat Exchanger	Vendor Quote	1	each							$ 3,680.00	$5,189
1/2 hp Transfer Pump (liquid, MS to GAC)	Vendor Quote	1	each							$ 458.00	$613
Vapor Phase GAC Units and Initial Carbon 2,300 lb each	Vendor Quote	2	each							$ 24,197.00	$68,240
20 ft Sea Box with Fire and Sound Proofing	Vendor Quote/Professional Estima	1	lump sum							$ 10,632.25	$13,363
Piping Manifold	Vendor Quote	1	lump sum							$ 9,277.57	$11,660
GAC Duct Rack	Vendor Quote	1	lump sum							$ 13,850.00	$17,407
1 hp Air Compressor	Vendor Quote	1	lump sum							$ 200.00	$251
18,500 Btu AC Window Unit Installed	Vendor Quote/Professional Estima	1	each							$ 1,000.00	$1,257
Exhaust Fan Installed	Vendor Quote/Professional Estima	1	each							$ 400.00	$503
Control System	Professional Estimate	1	lump sum							$ 50,000.00	$62,840
Bird Proof Louvres Installed	Vendor Quote/Professional Estima	2	each							$ 300.00	$754
Start-up Assistance, Equipment Testing, Operator Training	Vendor Quote	1	lump sum							$ 4,500.00	$5,656
Deep Horizontal SVE Well Installation		**2**	**EA**								
Drill and Install Deep Horizontal SVE Wells	Professional Estimate	3	each							$ 49,470.00	$186,522
Wellhead Installation		**21**	**EA**								
Well Head Materials Installation	Vendor Quote	8	each							$ 900.40	$9,644
SVE Piping Trenching		**800**	**LF**								
Saw Cut Asphaltic Concrete	RS Means - 0381 1350 0300	1,025	LF	$ 0.89	$ 912.25	$ 0.86	$ 876.99	$ 0.23	$ 235.75	$ 2.03	$2,621
Excavation	RS Means - 3123 1614 3100	700	LF	$ 0.57	$ 399.00	$ 0.54	$ 378.00			$ 1.11	$874
Sand Bedding	RS Means - 3123 2316 0200	80	CY							$ 33.82	$3,400
Tracer Wire	RS Means - 3305 2610 0500	500	LF							$ 0.15	$94
Base Layer Backfill and Compaction	RS Means - 3123 2313 0010	20	CY							$ 43.29	$1,115
Pavement Restoration	RS Means - 3206 1010 0140	3,120	SF	$ 0.24	$ 748.80	$ 0.04	$ 124.80	$ 0.69	$ 2,152.80	$ 0.97	$3,804
Piping, 2" HDPE DR 11	**RS Means - 3314 1335 0100**	**1,320**	**LF**	**$ 2.76**	**$ 3,643.20**	**$ 1.89**	**$ 2,494.80**	**$ 2.71**	**$ 3,577.20**	**$ 9.21**	**$15,279**
Injection Well Installation		**1**	**EA**								
Drill and Construct Injection Wells	Vendor Quote	13	each							$ 25,675.76	$419,501
Logging and Reporting	Professional Estimate	13	each							$ 824.00	$13,463
Amendment Injection		**2**	**EA**								
Inject Emulsified Vegetable Oil	Vendor Quote	16	well							$ 9,978.00	$200,646
SVE Compound		**1**	**LS**								
Plumbing and Wiring to the Enclosure	Professional Estimate	2	lump sum							$ 10,000.00	$22,886
Fencing	RS Means - 3231 1320 0200	250	LF	$ 4.09	$ 1,022.50	$ 0.98	$ 245.00	$ 19.49	$ 4,872.50	$ 24.56	$7,717
Fencing Fabric	RS Means - 3231 1320 0248	1,750	SF					$ 0.66	$ 1,155.00	$ 0.76	$1,522
Swing Gate	RS Means - 3231 1320 5070	2	each	$ 377.87	$ 755.74	$ 90.34	$ 180.68	$ 693.67	$ 1,387.34	$ 1,161.88	$2,921
Electricity Connections	Professional Estimate	2	lump sum							$ 10,000.00	$22,886
Indirect Construction Cost											**$648,201**
System Contingency											
25% of Direct Cost										$ 395,244.67	$395,245
Professional/Technical Services[2]											
6% Project Management, Startup Sampling, Reporting										$ 94,858.72	$94,859
10% Construction Management, Oversight, Reporting										$ 158,097.87	$158,098
OPERATIONAL AND FUNCTIONAL									**ANNUAL O&F COST**		**$ 1,928,600**
Yearly											**$414,738**
AOI 1 Vapor Phase GAC Changout and Oversight (7 Changes	Vendor Quote/Professional Estima	7	Changeout							$ 24,800.00	$218,180
AOI 2 Vapor Phase GAC Changout and Oversight (9 Changes	Vendor Quote/Professional Estima	9	Changeout							$ 14,600.00	$165,144
Replacement Air Filters (4 changes per year)	Vendor Quote/Professional Estima	4	Changeout							$ 150.00	$754
Sampling - Water (analytical)	Vendor Quote/Professional Estima	12	months							$ 55.00	$660
Annual O&M Report	Professional Estimate	2	lump sum							$ 15,000.00	$30,000
Monthly											**$101,385**
Reporting	Professional Estimate	64	hour	$ 100.00	$ 6,400.00						$7,324
Maintenance	Professional Estimate	80	hour	$ 140.00	$ 11,200.00	$50.00	$ 4,000.00				$17,393
Electricity	Professional Estimate	1	year							$ 67,000.00	$76,668
Weekly											**$4,119**
Operations	Professional Estimate	30	hour	$ 120.00	$ 3,600.00					$ 120.00	$4,119
Ongoing Sampling (after 8 Weeks)											**$5,453**
Monthly Sampling - Air (analytical)	Vendor Quote/Professional Estima	32	each							$ 110.00	$4,028
Monthly Sampling (labor and equpiment - 1 employee)	Professional Estimate	10	months	$ 100.00	$ 1,000.00	$ 45.00	$ 45.00	$20.00	$200.00	$165.00	$1,425
Startup Weekly Sampling (8 Weeks)											**$4,926**
Weekly Sampling - Air (analytical)	Vendor Quote/Professional Estima	30	each							$ 110.00	$3,776
Weekly Sampling (labor and equpiment - 1 employee)	Professional Estimate	8	hour	$ 100.00	$ 800.00	$ 45.00	$ 45.00	$20.00	$160.00	$165.00	$1,150
SITEWIDE MONITORING									**ANNUAL MONITORING COST**		**$ 159,100**
Yearly - Site monitoring											
Annual Indoor Air Sampling	Professional Estimate	2	lump sum	$ 17,424.48	$ 34,848.96	$2,000.00	$4,000.00	$4,140.00	$8,280.00	$ 23,564.48	$47,129
Annual Indoor Air Sampling Report	Professional Estimate	2	lump sum	$ 15,000.00						$ 15,000.00	$30,000
Annual Sitewide GW Sampling	Professional Estimate	2	lump sum	$ 22,508.64	$ 45,017.28	$2,500.00	$5,000.00	$1,000.00	$2,000.00	$ 26,008.64	$52,017

EA Engineering, Science, and Technology, Inc., PBC

TECHNOLOGY	LOCATION	MEDIUM	Estimated Cost to Implement	$6,245,000
Soil Vapor Extraction *In-Situ* **Bioremediation**	**Bandera Road Bexar County, TX**	**Soil Vapor Groundwater**	**Construction Time:**	**2 months**
			Operation Time:	**2 years**
			Post Remediation Monitoring	**- years**

		Quantities		Cost Breakdown (if available)						Combined Unit Costs	
Description	Data Source (Means[1] or Other)	Quantity Amount	Quantity Unit	Labor Unit Cost	Labor Total Cost	Equipment Unit Cost	Equipment Total Cost	Material Unit Cost	Material Total Cost	Unit Cost	Option Total Cost
Annual Sitewide GW Sampling Report	Professional Estimate	2	lump sum	$ 15,000.00						$ 15,000.00	$30,000
TOTAL ESTIMATED NPV TECHNOLOGY COST (Capital + Lifetime O&F)											**$6,245,000**
										+15%	**$7,181,750**
										-5%	**$5,932,750**

Assumptions:

General

Working condition is Safety Level	**D**		(Labor productivity:	**82%**	;	Equipment productivity:	**100%**		
Weighted Average of city cost index	**100.0%**	(not applicable for vendor quotes).							
Costs are loaded with mark-up	**14%**								
Inflation	**3%**	per year	**6%**	for 2 years	**13%**	for 4 years	**34%**	for 10 years	
Sales Tax	**8.25%**								
Standard work day	**10**	hrs							

Notes

CY	Cubic yard	HP	Horse power	NPV	Net present value
ft	Foot	H&S	Health and safety	O&M	Operation and maintenance
gal	Gallon	lb	Pound	SF	Square foot
GSA	U.S. General Services Administration	LF	Linear foot		

1 Source is The Gordian Group, RS Means Online (2017), Houston, TX

Appendix E

Equipment Data

Appendix E-1

AOI 1 Equipment Data

Tuthill
PUMP YOUR HEART INTO IT

M-D Pneumatics™
Compact Rotary Blower Packages

PneuPak

Based on the dependable CP Series rotary positive blowers, PneuPak rotary blower packages are a dependable and economical low pressure (up to 15 PSIG or 16" Hg vacuum) air source for many industrial and municipal applications such as pneumatic conveying of bulk powder or seed, fluidization/agitation of bulk powders, wastewater aeration, milking of dairy cattle and motive force for vacuum exhausting and cleaning systems.
In addition to dependability and economy, PneuPak rotary blower packages offer many distinct advantages:

Maintenance Friendly
Designed for easy access to vital areas for maintenance, PneuPak provides easy access to grease fittings and the oil reservoir.

Factory Built and Factory Warranted
PneuPak compact rotary blower packages are built in the Tuthill Springfield manufacturing facility under our ISO 9001 registered quality assurance system to assure you that your PneuPak is of the highest quality.
All PneuPak rotary blower packages are covered by a factory warranty of 18 months after installation, not to exceed 24 months after shipment.

Mounting Base with Integral Silencer
PneuPak utilizes an integrated silencer/base to provide a wide variety of blower-motor combinations.

Multiple Configurations
Whatever your air handling needs, there is a PneuPak available for your application. Automated configuration optimizes your PneuPak to afford you the best value for your investment.

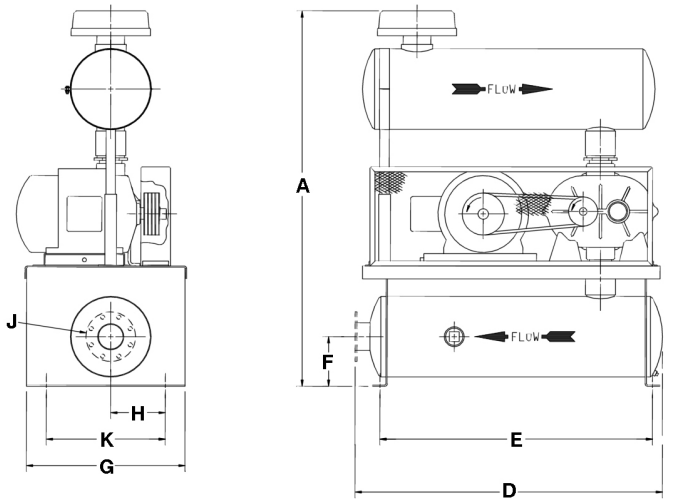
Accessory Kits
Available for your PneuPak, accessory kits provide you the ability to customize your PneuPak for your particular needs. Available accessory kits include:
- Pressure or vacuum relief valve kit with fittings required for installation
- Instrumentation kit including inlet filter restriction indicator and 0-15 PSIG discharge pressure gauge
- NEMA 4/12 control panel for wall mounting including:
  - Powder coated and gasketed steel enclosure
  - Circuit breaker disconnect with through-the-door operator
  - Control circuit transformer with fused windings
  - Magnetic motor starter with overloads and manual reset
  - Run light
  - On-Off-Auto selector switch

Quality Features
PneuPak rotary blower packages include the following quality features:
- CP Series rotary blower that includes features normally found only on premium design blowers such as:
  - Helical timing gears for quiet operation
  - Double row ball bearings on gear end of all models increases overall design bearing life by up to 50% versus other makes
  - Rotors with integrally cast shafts that allow larger shaft diameters and greater strength as compared to the competition
  - Every CP Series blower is factory tested to assure of the highest quality. While other manufacturers only perform sample testing, Tuthill Vacuum & Blower Systems goes the distance to make sure that your blower meets our rigid ISO 9001 registered quality standards.
- TEFC motor standard with 1.15 service factor
- Welded steel motor slide base
- Matched V-belt drive with 1.4 service factor
- OSHA belt guard with flow-through ventilation keeps belts running cool
- Integral mounting base with discharge silencer
- Low pressure drop inlet filter
- Easy and convenient maintenance
- Suitable for indoor or outdoor installation
- Shipped completely assembled for convenient installation*

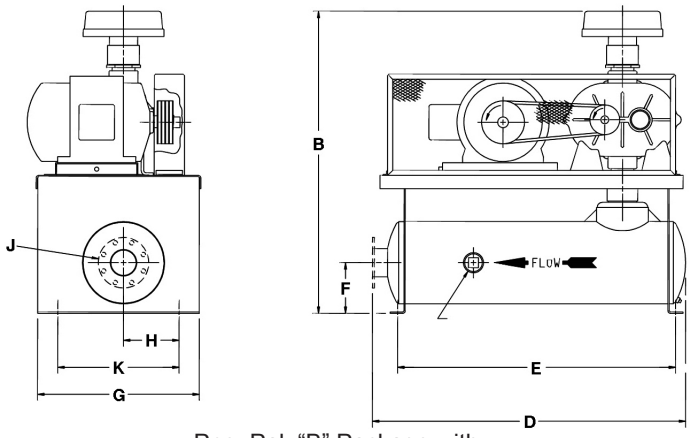
* Height consideration may require partial disassembly for shipment

Dimensions

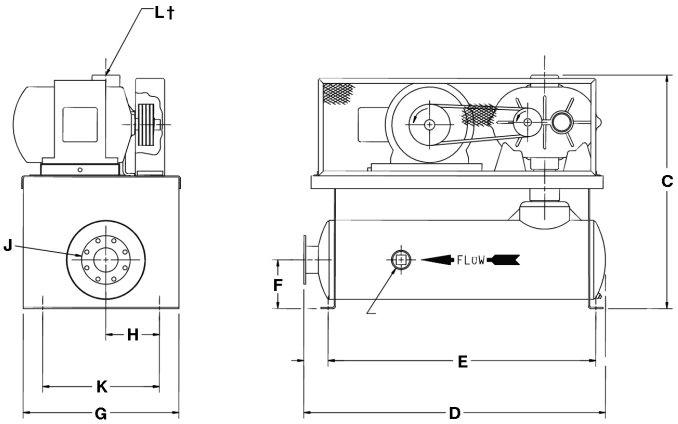
Values shown are approximate and should not be used for construction.
Certified drawings are available through your local Tuthill Springfield Sales Professional.



PneuPak "A" Package with
inlet filter/silencer, inlet silencer and discharge silencer



PneuPak "B" Package with
inlet filter/silencer and discharge silencer



PneuPak "C" Package with discharge silencer

Dimension Table

All dimensions are shown in inches

PneuPak Size	A*	B*	C*	D	E	F	G	H	J	K
13-20	45.13	35	24.75	30	25	5	19	4.50	2" NPT	12
33-20	49.13	37	26.75							
13-25	49.44	37.63	27.75	31	25.50	6	26	6	2½"NPT	18
33-25	53.44	39.63	29.75							
13-30	55.69	43.94	32.19	49.50	44	7	27	7.50	3" NPT	18
33-30	61.38	48.19	36.19							
13-40	71.13	52.94	41.94	50.38	44	8	30.50	8.56	4" NPT	20.50
33-40	75.75	55.94	44.94							
13-50	75.69	56.69	44.94	62	55	10	32	11	5" FLG	24
33-50	81.19	59.69	47.94							
13-60	84.44	57.94	48	69	62	12	33	12.50	6" FLG	24
33-60	91.44	60.94	51							
13-80	101.50	69	51.88	89	65.75	15	42	12	8" FLG	24
33-80	116.25	81.75	64.63							

* "A", "B" and "C" height dimensions shown are "not to exceed" values. Actual height may be lower, depending on blower model incorporated in your package. Certified prints are available from your local Tuthill Springfield Sales Professional.

† "L" dimension is blower inlet connection size. Please refer to COMPETITOR PLUS specification sheet for applicable blower inlet connection size.

PneuPak Sizes Available for Each Blower

Blowers that can be mounted in each PneuPak are shown to the right of the applicable PneuPak.

PneuPak Size	Blower Model	PneuPak Size	Blower Model	PneuPak Size	Blower Model	PneuPak Size	Blower Model
13-20 33-20	2002 2004 3003 3006 4002	13-30 33-30	3006 4005 4007 5003 6005	13-50 33-50	5009 6005 6008 7006	13-80 33-80	7011 7018
13-25 33-25	3003 3006 4002 4005 5003	13-40 33-40	4007 5006 5009 6005 7006	13-60 33-60	6008 6015 7006 7011		

Your Local Tuthill Vacuum Blower Systems Sales Professional:

Tuthill
PUMP YOUR HEART INTO IT

Tuthill Springfield
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
o 417.865.8715 800.825.6937 **f** 417.865.2950
tuthillvacuumblower.com

ISO 9001

Tuthill

M-D Pneumatics™
Rotary Positive Displacement Blowers

CP Series

CP Series rotary blowers are designed to be interchangeable with equivalent sizes of Roots Universal RAI®, and many Sutorbilt® Legend® blowers. CP Series models are rated up to 15 PSIG discharge pressure or 16" Hg dry vacuum. All models have sight glasses and triple lip seals as standard features.

Reduced Noise Versions Available

CP Series standard models feature a bi-lobe design. Many models are available with tri-lobe rotors and a specially tuned housing to reduce blower noise.

Triple Lip Seals

Standard on all models, triple lip seals provide improved lubrication to extend the life of the seal up to 50% also resulting in longer bearing life.

Helical Gearing

CP Series blowers are timed with precision helical gears, keyed to the rotor shafts, not taper fit spur gears as offered by other manufacturers, which have greater backlash, can slip and lose timing. Helical gears are also quieter, reducing mechanical noise.

Stronger Bearings

All CP Series blowers include double-row ball bearings at the gear end, stronger than single row ball bearings offered by other manufacturers. Drive shaft bearing is cylindrical roller type for additional strength against side loading from V-belt drives. As a result of this superior design, CP Series blowers offer design bearing life as much as 50% greater than models offered by other manufacturers.

Rotors with Integral Shafts

CP Series blowers include precision machined ductile iron rotors with large, integrally cast shafts, not press fit and/or pinned shafts offered by other manufacturers, which can loosen over time and cause rotor clash.

Versatility

CP Series blowers can be field converted from horizontal to vertical flow, or vice versa, without any special tools or additional components.

Metric Availability

CP Series blowers are available with metric drive shaft and process connections.

Lubrication

Many CP Series models include dual oil splash lubrication at both the gear end and drive end of the blower. Splash lubrication provides for longer bearing and seal life through improved heat dissipation versus grease lubrication.

Material Specifications:

Housing: Cast iron
End Plates: Cast iron
End Cover: Cast iron
Rotors: Ductile iron
Shafts: Ductile iron, cast integrally with rotors
Bearings: Gear end - Double row ball, both rotors
Drive end - Cylindrical roller on drive rotor
Single row ball on driven rotor
Drive Shaft: Ductile iron, cast integrally with drive rotor
Gears: Heat treated alloy steel, helical cut
Seals: Lip seals on rotor shafts and drive shaft
Lubrication: Oil splash on gear end, grease on drive end
Models available with dual oil splash lubrication

All blowers are factory tested to meet ISO 9001 registered quality standards. Rotors are dynamically balanced to meet ISO1940 Grade 6.3 specifications.

Performance

P PSIA C C PSIA
specifications are subject to change without notice. All data are approximate. Request a quotation for your specific application.

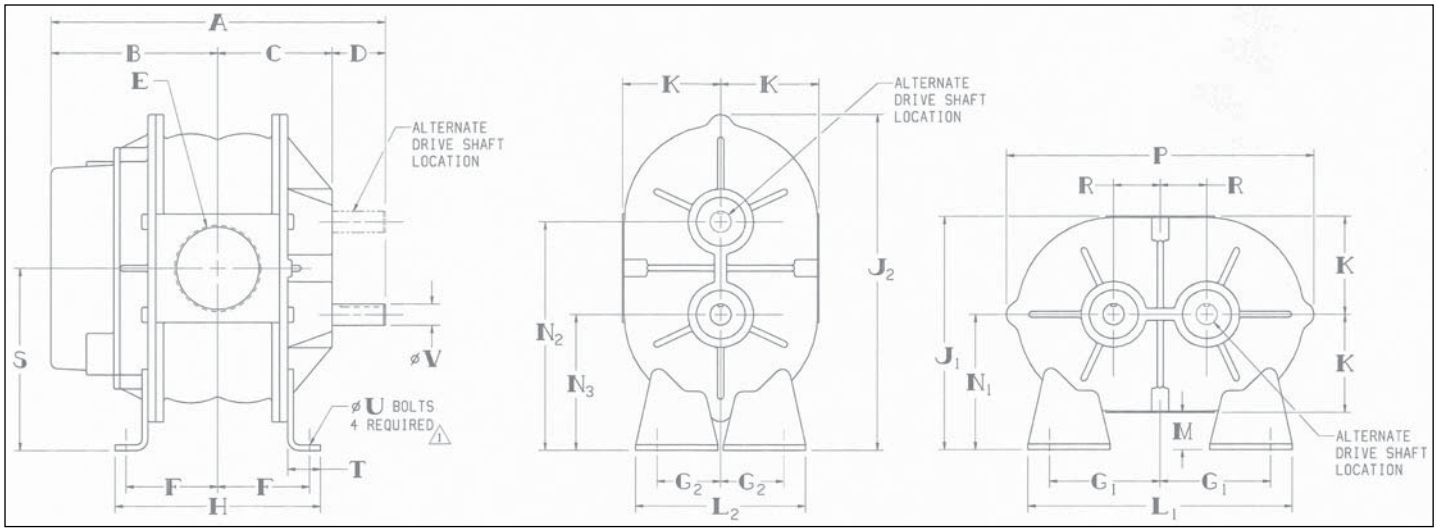
Model	Lobe	RPM	6 psig		7 psig		8 psig		10 psig		12 psig		13 psig		14 psig		15 psig		16 psig		17 psig		18 psig		Max. Vacuum		
			CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	" Hg	CFM	BHP
2002	2-lobe	1750	8	0.9	6	1.0	5	1.1	2	1.4															9	7	0.7
2002	2-lobe	3600	38	1.8	36	2.1	35	2.3	32	2.8	29	3.3													14	28	2.1
2002	2-lobe	5275	64	2.7	63	3.1	61	3.4	59	4.2	56	4.9													15	53	3.2
2004	2-lobe	1750	24	1.6	21	1.9																			10	20	1.4
2004	2-lobe	3600	83	3.3	80	3.8																			15	65	4.0
2004	2-lobe	5275	137	4.9	134	5.6																			15	118	5.9
3002	2-lobe	1150	22	1.6	19	1.8	17	2.1																	10	18	1.3
3002	2-lobe	2700	94	3.8	92	4.3	89	4.9	85	6.0	81	7.1													16	72	4.8
3002	2-lobe	3600	136	5.0	134	5.7	131	6.5	127	7.9	123	9.4	121	10.1	119	10.9	118	11.6							16	114	6.4
3003	2-lobe	1150	30	2.0	27	2.4																			10	26	1.7
3003	2-lobe	2700	126	4.8	122	5.5	119	6.3	114	7.7	109	9.2													14	107	5.4
3003	2-lobe	3600	181	6.4	178	7.4	175	8.3	169	10.3	164	12.2													15	158	7.7
3003	3-lobe	1150	32	2.1	28	2.5																			10	27	1.8
3003	3-lobe	2700	132	5.0	129	5.8	126	6.6																	14	112	5.7
3003	3-lobe	3600	191	6.7	187	7.7	184	8.8	178	10.8	173	12.8													15	166	8.1
3006	2-lobe	1150	60	4.8	55	5.3																			11	49	4.5
3006	2-lobe	2700	218	11.3	213	12.5																			15	185	12.9
3006	2-lobe	3600	310	15.0	305	16.6																			15	277	17.2
3006	3-lobe	1150	58	6.0	53	6.5																			11	46	5.7
3006	3-lobe	2700	218	14.0	213	15.2																			15	183	15.7
3006	3-lobe	3600	310	18.7	305	20.3																			15	276	20.9
4002	2-lobe	850	18	1.5	15	1.7																			10	14	1.3
4002	2-lobe	1760	73	3.1	70	3.6	68	4.1	63	5.0	59	5.9	57	6.4											14	58	3.5
4002	2-lobe	3600	184	6.4	182	7.4	179	8.3	175	10.2	171	12.1	169	13.1	167	14.0	165	15.0							16	162	8.2
4005	2-lobe	850	40	2.9	35	3.3	30	3.8																	9	38	2.2
4005	2-lobe	1760	150	5.9	145	6.9	140	7.8	132	9.6															14	121	6.7
4005	2-lobe	3600	373	12.1	368	14.0	363	15.9	354	19.7															16	330	15.7
4005	3-lobe	850	44	3.5	40	3.9	36	4.3																	9	43	2.8
4005	3-lobe	1760	149	7.2	145	8.1	141	9.0	133	10.8															14	124	8.0
4005	3-lobe	3600	360	14.8	356	16.6	352	18.4	345	22.0															16	324	18.1
4007	2-lobe	850	54	3.7	47	4.3																			10	45	3.1
4007	2-lobe	1760	199	7.7	192	8.9																			14	160	8.8
4007	2-lobe	3600	492	15.8	486	18.3																			16	437	20.4
4007	3-lobe	850	59	4.2	53	4.8																			10	51	3.6
4007	3-lobe	1760	193	8.8	188	9.9																			14	162	9.7
4007	3-lobe	3600	466	17.9	460	20.2																			15	428	21.1
5003	2-lobe	700	41	2.6	36	3.0	33	3.4																	10	35	2.2
5003	2-lobe	1760	180	6.6	176	7.6	172	8.6	165	10.7	159	12.7	156	13.7	153	14.7	150	15.7							14	156	7.5
5003	2-lobe	2850	324	10.7	320	12.3	316	14.0	309	17.2	303	20.5	300	22.2	297	23.8	294	25.4							16	289	13.7
5006	2-lobe	700	68	4.3	61	4.9	55	5.6																	10	59	3.5
5006	2-lobe	1760	302	10.7	295	12.4	289	14.1	277	17.5	266	20.9	261	22.6											14	262	12.2
5006	2-lobe	2850	543	17.3	536	20.1	530	22.8	518	28.3	507	33.8	502	36.6											16	485	22.5
5006	3-lobe	700	65	4.6	57	5.3	51	6.0																	10	55	3.9
5006	3-lobe	1760	300	11.7	293	13.4	286	15.1	273	18.5	262	21.9	257	23.6											14	257	13.2
5006	3-lobe	2850	542	18.9	535	21.7	528	24.4	515	30.0	504	35.5	499	38.2											16	480	24.1
5009	2-lobe	700	130	6.1	122	7.1																			11	111	5.5
5009	2-lobe	1760	472	15.4	464	17.9																			14	427	17.6
5009	2-lobe	2850	824	25.0	816	29.0																			15	769	30.4
5009	3-lobe	700	116	6.8	107	7.8	98	8.8																	11	93	6.1
5009	3-lobe	1760	473	17.0	464	19.6	455	22.2																	14	417	19.2
5009	3-lobe	2850	841	27.5	831	31.7	822	35.9																	15	773	33.2
6005	2-lobe	700	91	4.9	84	5.6	78	6.4	67	7.9															12	68	4.8
6005	2-lobe	1760	352	12.3	345	14.2	339	16.1	328	19.9	318	23.6	313	25.5	309	27.4	304	29.3							16	296	15.8
6005	2-lobe	2350	497	16.4	490	19.0	484	21.5	473	26.5	463	31.6	458	34.1	454	36.6	449	39.1							16	442	21.1
6008	2-lobe	700	146	7.6	135	8.8	126	10.0	108	12.4															12	109	7.5
6008	2-lobe	1760	565	19.2	554	22.2	544	25.2	527	31.3	510	37.4	503	40.4	496	43.4									15	490	23.3
6008	2-lobe	2350	798	25.6	787	29.6	777	33.7	760	41.8	744	49.9	736	53.9	729	58.0									16	709	33.1

Performance continued

Model	Lobe	RPM	6 psig		7 psig		8 psig		10 psig		12 psig		13 psig		14 psig		15 psig		16 psig		17 psig		18 psig		Max. Vacuum		
			CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	" Hg	CFM	BHP
6015	2-lobe	700	273	13.9	254	16.2																			10	247	11.5
6015	2-lobe	1760	1058	35.0	1038	40.7																			14	943	40.0
6015	2-lobe	2350	1494	46.8	1475	54.4																			14	1380	53.4
7006	2-lobe	650	171	7.2	163	8.3	157	9.5	144	11.8	133	14.0	128	15.2											13	137	7.6
7006	2-lobe	1760	617	19.5	610	22.6	603	25.7	591	31.8	579	38.0	574	41.1	569	44.2	564	47.3							16	556	25.2
7006	2-lobe	2050	734	22.7	726	26.3	719	29.9	707	37.1	696	44.3	691	47.8	686	51.4	681	55.0							16	672	29.4
7011	2-lobe	650	322	12.9	310	15.0	298	17.1	277	21.3															13	264	13.7
7011	2-lobe	1760	1142	35.0	1129	40.6	1117	46.3	1096	57.6															16	1035	45.5
7011	2-lobe	2050	1356	40.7	1343	47.3	1331	53.9	1310	67.1															16	1249	53.0
7018	2-lobe	650	560	20.8																					10	536	17.1
7018	2-lobe	1760	1892	56.2																					12	1830	55.3
7018	2-lobe	2050	2240	65.5																					12	2178	64.4

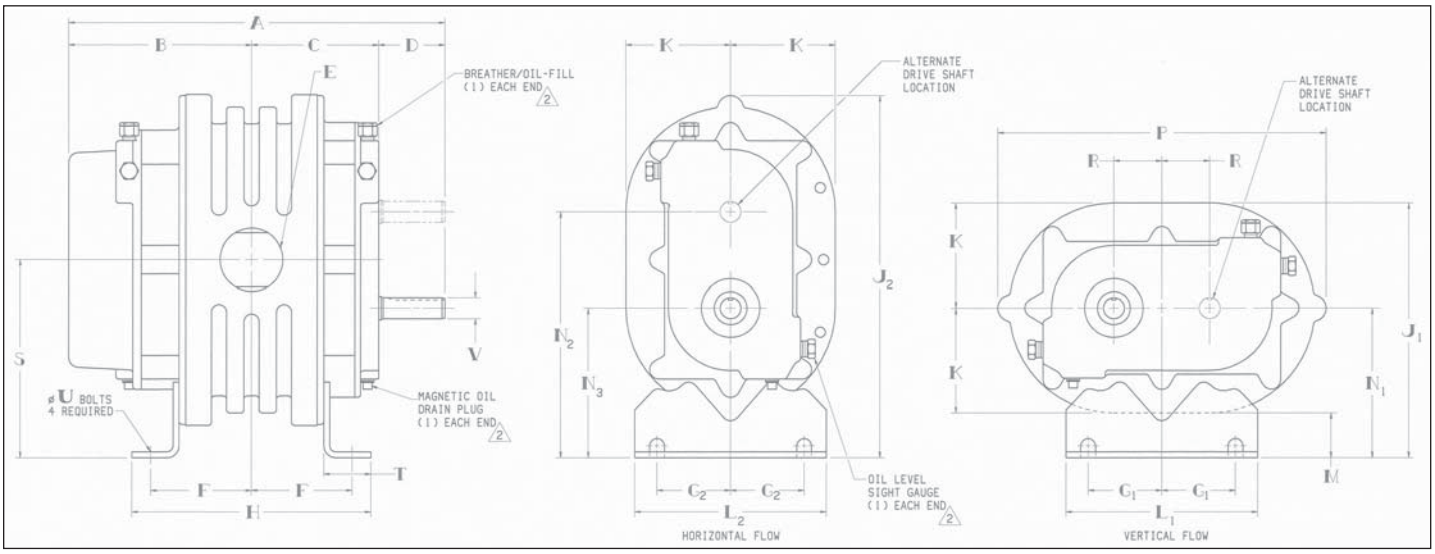
Dimensions: Standard Models/6

Model Size	A	B	C	D	E	F	G1	G2	H	J1	J2	K	L1	L2	M	N1	N2	N3	P	R	S	T	U	V	Weight (lbs.)
2002					NPT																		⅜		
2004					NPT																				
3002					NPT																				
3003					NPT																		¾		
3006					NPT																				
4002					NPT																				
4005					NPT																		½		
4007					NPT																				
5003					NPT																				
5006					NPT																		⅝		
5009					NPT																				
6005					NPT																				
6008					NPT																		¾		
6015					L																				
7006					NPT																				
7011					L																		¾		
7018					L																				



Dimensions: Splash Lube Models/7

Model Size	A	B	C	D	E	F	G1	G2	H	J1	J2	K	L1	L2	M	N1	N2	N3	P	R	S	T	U	V	Weight (lbs.)
3002 3003 3006	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□ □NPT □□NPT □□ □NPT	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□ □	□□□□	□□ □□ □□□
4002 4005 4007	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□ □NPT □□ □NPT □□NPT	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□ □	□□□□	□□□ □□□ □□□
5003 5006 5009	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□ □NPT □□NPT □□NPT	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	5/8□	□□□□	□□□ □□□ □□□
6005 6008 6015	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□NPT □□NPT □□□L□	□□□□ □□□□ □□□□	□□□□ □□□□	□□□□	□□□□ □□□□ □□□□	□□□□ □□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□ □	□□□□	□□□ □□□ □□□



Values shown are approximate and should not be used for construction. Certified drawings are available through your local Tuthill Vacuum & Blower Systems Sales Professional.

The tri-lobe CP Series units have a cast-in noise reduction on the discharge port. This will reduce the sound level of the blower 3-5dB, or by half.

Your Local Tuthill Vacuum Blower Systems Sales Professional:

Tuthill
PUMP YOUR HEART INTO IT

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
o 417.865.8715 800.825.6937 **f** 417.865.2950
tuthillvacuumblower.com

ISO 9001

		No.:
		Date: 15-JUN-2018

Customer :

TECHNICAL PROPOSAL

Three-phase induction motor - Squirrel cage rotor

Product line	: W22 NEMA Premium - Ball Bearings
Catalog Number	: 04018ET3E324T-W22
List Price	: $4,178

Notes:
04018ET3E324T-W22

Performed by:	Checked:

No.:

Date: 15-JUN-2018

DATA SHEET

Three-phase induction motor - Squirrel cage rotor

Customer	:	
Product line	:	W22 NEMA Premium - Ball Bearings

Frame	:	324/6T
Output	:	40 HP
Frequency	:	60 Hz
Poles	:	4
Full load speed	:	1775 rpm
Slip	:	1.39 %
Voltage	:	208-230/460 V
Rated current	:	104-94.2/47.1 A
Locked rotor current	:	575/287 A
Locked rotor current (Il/In)	:	6.1
No-load current	:	32.0/16.0 A
Full load torque	:	117 lb.ft
Locked rotor torque	:	220 %
Breakdown torque	:	240 %
Design	:	B
Insulation class	:	F
Temperature rise	:	80 K
Locked rotor time	:	20 s (hot)
Service factor	:	1.25
Duty cycle	:	S1
Ambient temperature	:	-20°C - +40°C
Altitude	:	1000 m
Degree of Protection	:	IP55
Approximate weight	:	492 lb
Moment of inertia	:	9.1624 sq.ft.lb
Noise level	:	66 dB(A)

	D.E.	N.D.E.
Bearings	6312 C3	6212 C3
Regreasing interval	20000 h	20000 h
Grease amount	21 g	13 g

Load	Power factor	Efficiency (%)
100%	0.85	94.1
75%	0.80	94.1
50%	0.72	93.6

Notes:

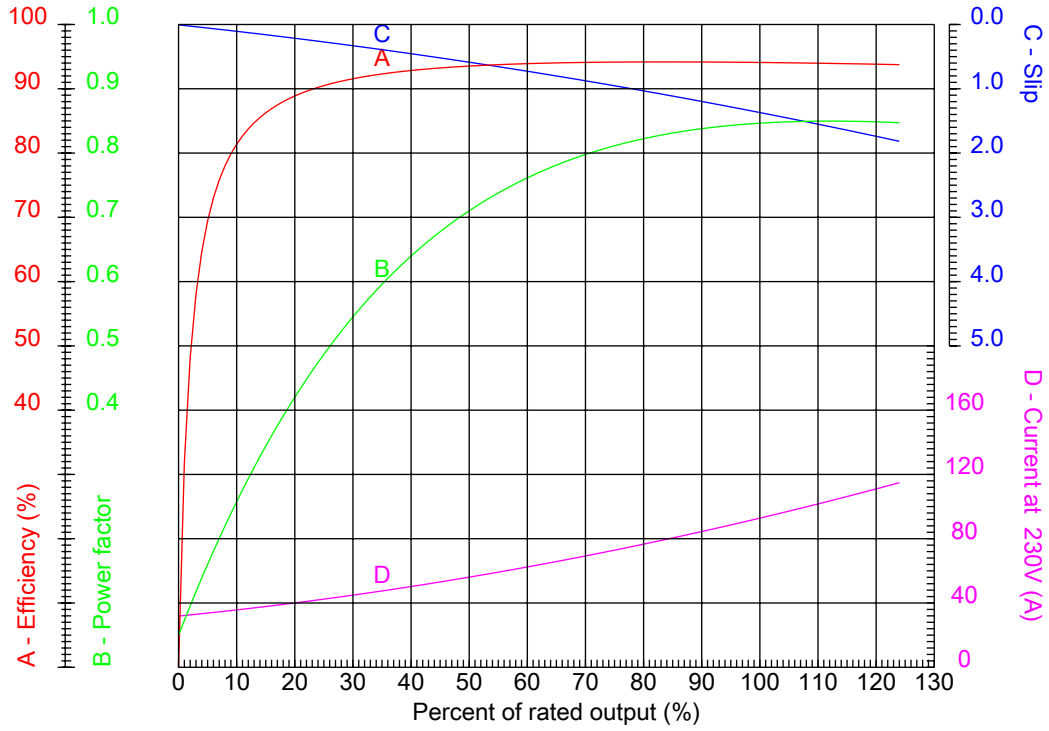
04018ET3E324T-W22

Performed by	Checked

	No.:
	Date: 15-JUN-2018

PERFORMANCE CURVES RELATED TO RATED OUTPUT

Three-phase induction motor - Squirrel cage rotor



Customer	:
Product line	: W22 NEMA Premium - Ball Bearings

Frame	: 324/6T	Locked rotor current (Il/In)	: 6.1
Output	: 40 HP	Duty cycle	: S1
Frequency	: 60 Hz	Service factor	: 1.25
Full load speed	: 1775 rpm	Design	: B
Voltage	: 208-230/460 V	Locked rotor torque	: 220 %
Rated current	: 104-94.2/47.1 A	Breakdown torque	: 240 %
Insulation class	: F		

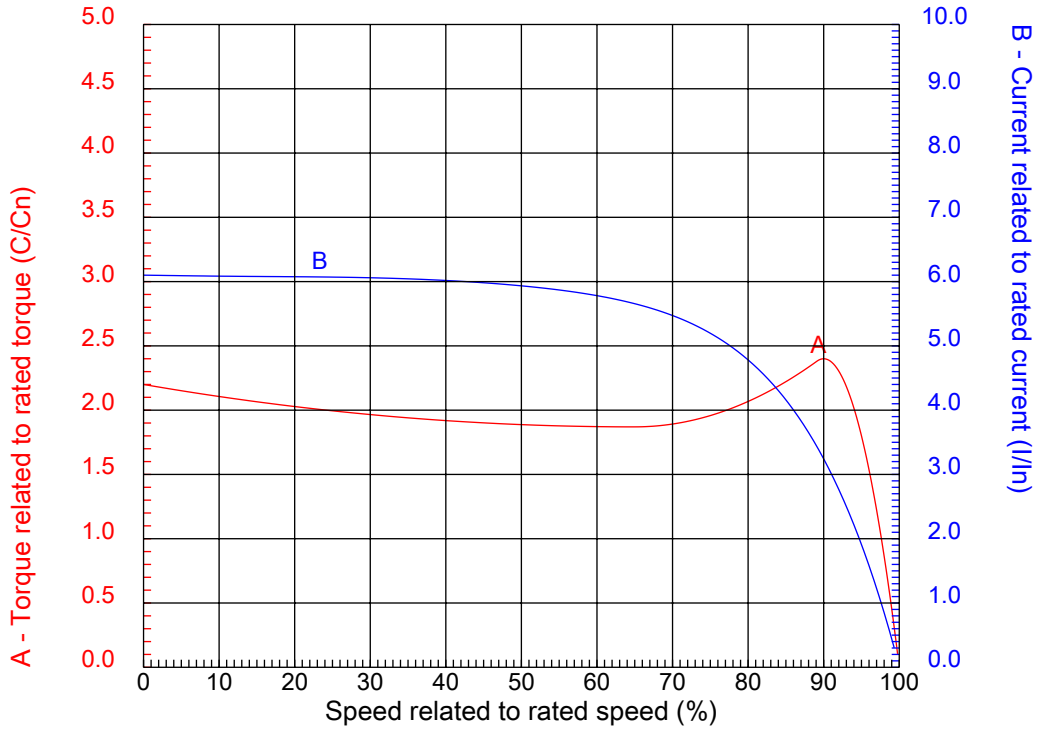
Notes:
04018ET3E324T-W22

Performed by	Checked

	No.:
	Date: 15-JUN-2018

CHARACTERISTIC CURVES RELATED TO SPEED

Three-phase induction motor - Squirrel cage rotor



Customer	:
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Output	: 40 HP	Duty cycle	: S1
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Full load speed	: 1775 rpm	Design	: B
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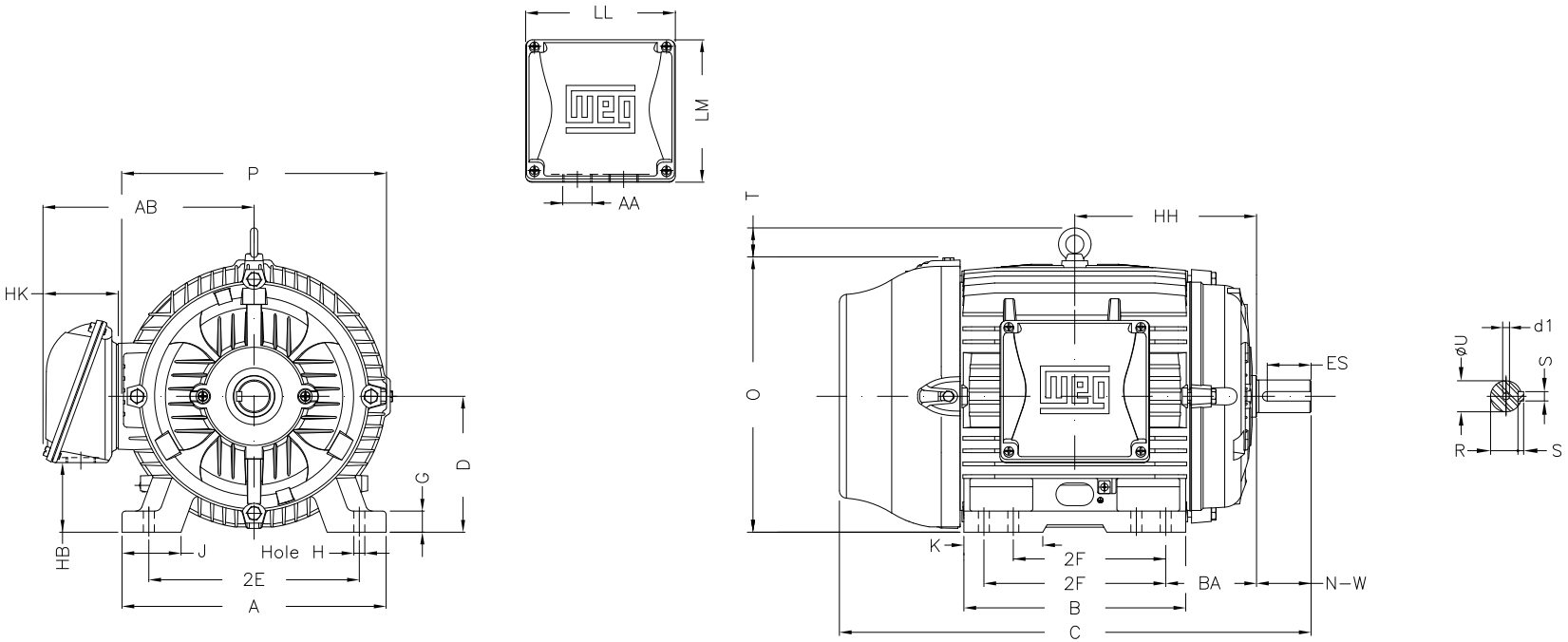
Rated current	: 104-94.2/47.1 A	Breakdown torque	: 240 %
Insulation class	: F		

Notes:
04018ET3E324T-W22

Performed by	Checked



Notes: 04018ET3E324T-W22

2E 12.500	J 3.189	A 15.157	P 15.827	AB 12.575
2F 10.500/12.000	K 4.055	B 14.567	BA 5.250	FBA 8.738
U 2.125	N-W 5.250	ES 3.937	S 0.500	R 1.844
depth 0.500	D 8.000	G 1.300	HB 4.811	O 15.953
T 2.441	HF 8.708	HH 11.250	HK 4.705	H 0.657
C 31.116	FC 35.860	LL 9.055	LM 8.661	AA NPT 2"
d1 A 4				

Performed by:

Checked:

Customer:

W22 NEMA Premium - Ball Bearings

Three-phase induction motor

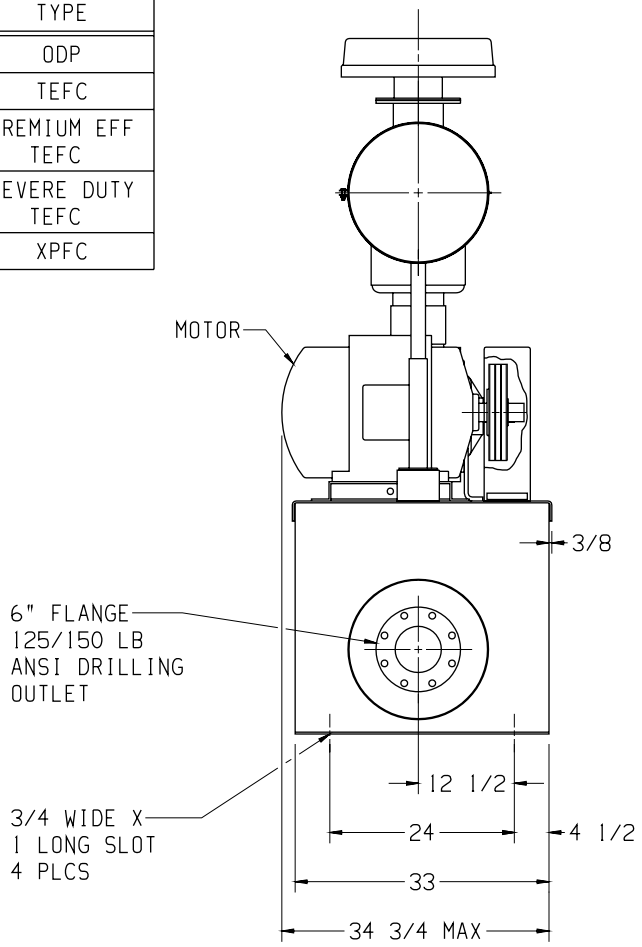
Frame 324/6T - IP55

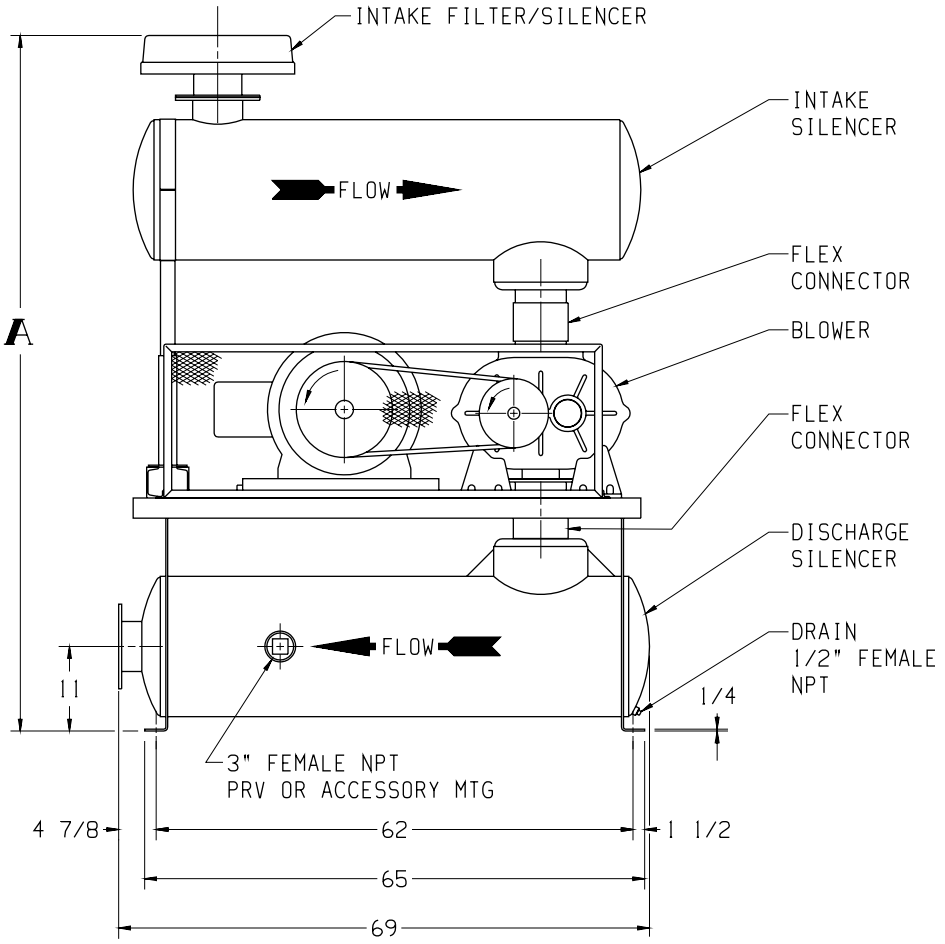
15-JUN-2018

LTR	REVISION	DATE	DR	CH

MOTOR W/SLIDE BASE 1800 RPM, 230/460 V, 3 PH, 60 HZ		
HP	FRAME	TYPE
20	256T	ODP
25	284T	TEFC
30	286T	PREMIUM EFF TEFC
40	324T	SEVERE DUTY TEFC
50	326T	XPFC
60	364T	
75	365T	

BLOWER	A
6008	87 5/16
6015	87 5/16
7006	91 7/16
7011	90 7/16





SERIAL NUMBER(S)_____

_____

F.O._____

APPROXIMATE WEIGHT

BASE, SILENCERS, FILTER, DRIVE, & GUARD	950 LBS
BLOWER	___ LBS
MOTOR & SLIDE BASE	___ LBS
TOTAL WEIGHT	___ LBS

Tuthill 800.825.6937

BASE MOUNTED OUTLINE PNEU-PAK-33-60-A

SIZE: C2

DR BD 5-31-02 CH _____

Tuthill

Performance Datasheet

Customer	: SVE #1	Quote number	: 1179721
Customer reference	:	Size	: 33-60-A-7011 CP Series (2-lobe) PneuPak
Item	: 001		
Application	:	Based on curve number	: 0-7011
Material	: Cast Iron	Date last saved	: 09 Jun 2020 4:19 PM

Operating Conditions

Standard conditions :

(14.70 psi.a , 70.00 deg F , 0.00 %)

Condition	1	
System inlet volume flow	792.1	CFM
Flow at standard conditions , dry	490.0	SCFM
Mass flow	0.61	lbm/s
System inlet temperature	68.00	deg F
System inlet pressure	154.0	in H2O vac
Inlet pressure loss	0.18	psi
Product inlet pressure	158.9	in H2O vac
Product discharge pressure	1.55	psi.g
Discharge pressure loss	0.05	psi
System discharge pressure [p2]	1.50	psi.g
Product differential pressure	7.29	psi
System differential pressure [dp]	7.06	psi
Vacuum Relief Setting	182.0	in H2O vac
Actual system discharge volume	572.7	CFM

Site Conditions

Atmospheric pressure	14.70	psi.a
Elevation above sea level	0.00	ft
Ambient temperature	68.00	deg F
Relative humidity	36.00	%
Frequency	60	Hz
Set inlet to ambient site conditions	No	

Gas Data

Type of gas	Air	
Molecular weight (MW)	28.82	
Specific gravity	0.995	
Specific heat (Cp)	0.2424	Btu/(lb.deg F)
Ratio of specific heat (k)	1.40	

Performance

Actual inlet volumetric flow	807.9	CFM
Power, shaft [Ps] *	35.44	hp
Inertial power	15.00	hp
Torque	2.52	hp/100 rpm
% of max torque	76.36	%
Quantity of units operating	1	
Speed	1404	rpm
% of max speed	68.48	%
Noise (with inlet and discharge silencers)	90	dB
Efficiency, volumetric [#,v]	77.98	%
Temperature rise	148.9	deg F
Discharge temperature	216.9	deg F
% of max temperature rise	70.90	%
% of max pressure rise	48.63	%

Vacuum Relief Condition

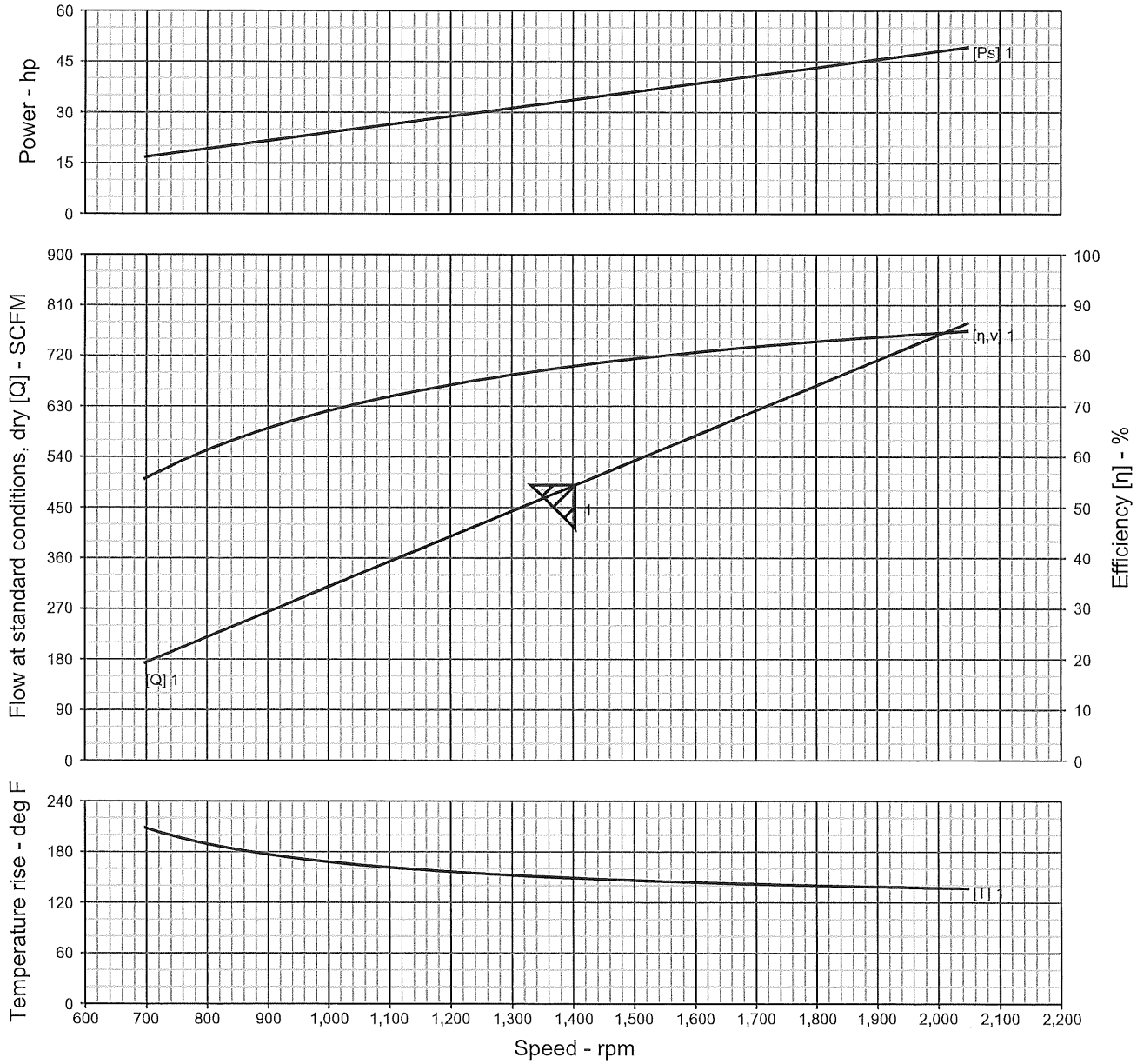
Power, shaft @ Vacuum Relief *	40.24	hp
Temperature rise @ Vacuum relief	194.3	deg F
Discharge temperature @ Vacuum Relief	262.3	deg F
% of max temperature rise @ Vacuum Relief	92.54	%
% of max pressure rise @ Vacuum Relief	55.37	%

**Power includes 5% loss for belt drive*

Tuthill

Performance Datasheet

Customer	:	Quote number	: 1179721
Customer reference	:	Size	: 33-60-A-7011 CP Series (2-lobe) PneuPak
Item	: 001		
Application	:	Based on curve number	: 0-7011
Material	: Cast Iron	Date last saved	: 09 Jun 2020 4:19 PM



JE Gasho · 460 West Gay Street · West Chester, PA 19380-2851
phone: (610) 692-5650 · fax: (610) 692-5837 · gasho.org

Electric Actuated Butterfly Valves

Ductile Iron Wafer Body ASME 150#
2" to 12" Pipe with EPS Positioner

SERIES
5671

Features

- EPS - Electronic Positioning System with 4-20mA input
- Wafer body valve with ISO5211 direct mount actuator
- 3-layer epoxy coated ductile iron body with 316 SS disc
- Unique wave line seat reduces torque and extends seal life
- Visual valve position indicator
- Rugged aluminum Type 4X weatherproof enclosure
- Heavy duty motors with overload protection
- Thermostatically controlled anti-condensation heater
- Manual override with end of travel mechanical stops
- Actuators CSA Listed per UL429 and CSA C22.2

Applications

EPDM seals typically used for on-off control of water and other media compatible with the materials of construction. NBR (Buna-N) seals typically used for air, oil, vacuum and other media compatible with the materials of construction. Multi-standard alignment holes, suitable for flanges: ANSI/ASME B16.5 Class 150/125, EN1092 PN10,PN16, BS10 Table D, E and JIS B2239 10K,16K. Actuators designed for 70% duty cycle.

Operation

Electric actuated valves with EPS- Electronic Positioning System provide an accurate valve positioning function whereby the movement of the actuator is controlled by either a field selectable 4-20mA input control signal. Any change in the control input signal results in a corresponding and proportional change in the position of the actuator (valve disc). Flow is adjustable anywhere between 0-100%. Unique electronic positioning module is fully potted to help protect the electronics from vibration/moisture resistance.

Construction

Valve Body	3-layer Epoxy/Epoxy/PUR coated ductile iron
Disc	316 stainless steel CF8M
Disc Seat/Liner	EPDM or NBR (Buna-N)
Stem/Stem Seals	420 SS / (2) v-rings same material as seat
Gear Drive	Heavy duty alloy steel/aluminum bronze, self locking
Actuator Enclosure	Aluminum, polyester powder painted, Type 4X, IP67
Visual Valve Position Indicator	Clear ABS cover with red/yellow open-closed indicator
Fasteners	Stainless Steel
EPS Module	Electronics mounted in potted ABS module

Description

Electric operated direct mount butterfly valves with epoxy- coated ductile iron wafer body are designed for commercial and industrial applications. Valve mounts between two standard ANSI/ASME Class 150 flanges and includes integral molded flange gaskets. Disc is precision machined 316SS. Two piece stem and disc design enhances the flow capacity and reduces turbulence. Rugged corrosion resistant electric actuator includes a manual override, auto calibration positioner module, thermostatically controlled anti-condensation heater, and over-torque protection.

Approvals

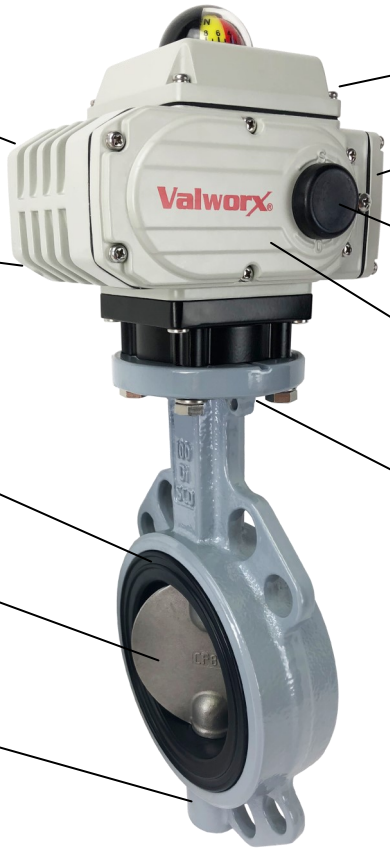
Actuators

- CSA Listed to:
  - UL429 and CSA C22.2 no 139
  - Type 4X, IP67 weatherproof enclosure
- CE conformance
  - ISO5211 Mounting

Valves

- Design complies with API-609, MSS SP-67
- Tests per API-598, AWWA C502-87
- CE according to PED 97/23/EC, ISO5208

Construction Features



Heavy duty integral motor design significantly reduces physical size of actuator

Rugged polyester powder coated aluminum corrosion resistant Type 4X weather-proof enclosure

Unique wave line seat reduces torque and extends seal life

316SS disc with 2-piece stem design enhances flow capacity, reduces pressure drop

Ductile iron body with 3-layer epoxy/epoxy/PUR coating

Anti-Condensation Heater

Terminal Box, wire directly to terminal strip, or via optional 1/2" NPT conduit adapters

Manual Override with protective cover

Self-locking all metal gear train, no additional brake required

Direct mount wafer butterfly valve with standard ISO5211 mount, no brackets required

Visual Valve Position Indicator

Pressure-Temperature Rating

Pressure Rating: 230 PSI (16 Bar), Vacuum 29in Hg, 145 PSI (10 Bar) 12" Size

Actuator Temperature Rating: -22 to +140° F (-30 to 60° C)

Valve Temperature Rating: EPDM seals 0 to 248° F (-18 to 120°C)

NBR (Buna-N) seals 5 to 185° F (-15 to 85°C)

EPS - Electronic Positioning System

Valve positioning and how it works?
Valworx electric actuators with EPS - Electronic Positioning System provide an accurate valve positioning function whereby the movement of the actuator is controlled by a 4-20mA input control signal. Any change in the control input signal results in a corresponding and proportional change in the position of the actuator (valve).

Unique electronic positioning module is fully potted to help protect the electronics from vibration/moisture resistance.

An internal microprocessor on the EPS circuit board continuously monitors the analog input and output signals and compares them to the physical position via a precision potentiometer feedback system, moving the actuator as required to balance the signals.

The EPS system is self-calibrating which virtually eliminates "hunting". The following functions are standard:

- Position monitoring output signal in same format as input. Ex: 4-20mA input, 4-20mA output
- Adjustable forward or reversing action.
- Sensitivity, Zero and Span adjustments
- Selectable fail mode: fail closed, fail open or stop in place (for loss of input command signal).
- Electric manual control with onboard selector switches
- Fault LED lights indicate valve jam or signal loss
- Electronic brake function

Specifications (English units)

Stock Number	Pipe Size (inch)	Orifice Size (inch)	Cv Flow Factor	Pressure Max.(PSI)	Cycle Time/90° (seconds)	Voltage	Current (amps)	Duty Cycle	Electrical Dwg.
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567102A	2	2.00	124	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567103A	2-1/2	2.50	247	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567104A	3	3.00	470	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567105A	4	4.00	929	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567107A	6	6.00	2243	230	30/25	110 VAC, 50/60Hz	0.73	70%	E
567008A	8	8.00	3584	230	45/37	110 VAC, 50/60Hz	1.27	70%	E
567009A	12	12.00	8498	145	45/37	110 VAC, 50/60Hz	1.27	70%	E
24 VDC ELECTRIC WAFER ACTUATED BUTTERLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567127A	2	2.00	124	230	30	DC24	1.0	70%	GE
567128A	2-1/2	2.50	247	230	30	DC24	1.0	70%	GE
567129A	3	3.00	470	230	30	DC24	1.0	70%	GE
567130A	4	4.00	929	230	30	DC24	1.0	70%	GE
567132A	6	6.00	2243	230	30	DC24	1.7	70%	GE
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, NBR (BUNA-N) SEALS EPS POSITIONER 4-20mA input									
567136A	2	2.00	124	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567137A	2-1/2	2.50	247	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567138A	3	3.00	470	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567139A	4	4.00	929	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567141A	6	6.00	2243	230	30/25	110 VAC, 50/60Hz	0.73	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, NBR (BUNA-N) SEALS EPS POSITIONER 4-20mA input									
567146A	2	2.00	124	230	30	DC24	1.0	70%	GE
567147A	2-1/2	2.50	247	230	30	DC24	1.0	70%	GE
567148A	3	3.00	470	230	30	DC24	1.0	70%	GE
567149A	4	4.00	929	230	30	DC24	1.0	70%	GE
567150A	6	6.00	2243	230	30	DC24	1.7	70%	GE

• Cv is the GPM of water at 60° F that will pass through the valve with 1 PSI pressure drop

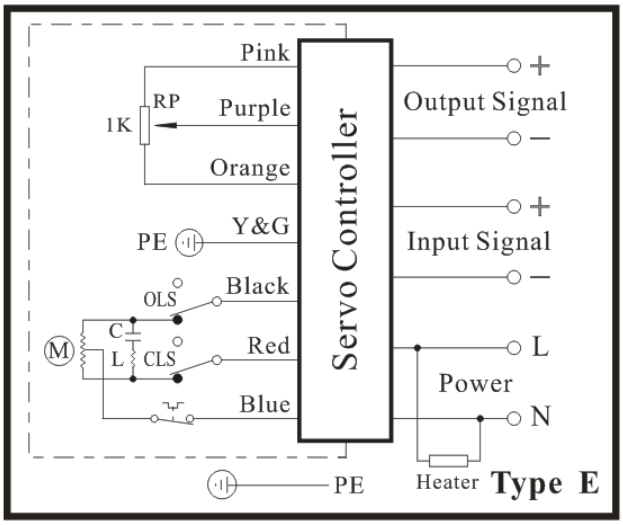
Specifications (Metric units)

Stock Number	Pipe Size (inch)	Orifice Size (mm)	Kv Flow Factor	Pressure Max.(Bar)	Cycle Time/90° (seconds)	Voltage	Current (amps)	Duty Cycle	Electrical Dwg.
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567102A	2	50	107	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567103A	2-1/2	65	212	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567104A	3	80	404	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567105A	4	100	799	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567107A	6	150	1929	16	30/25	110 VAC, 50/60Hz	0.73	70%	E
567008A	8	200	3100	16	45/37	110 VAC, 50/60Hz	1.27	70%	E
567009A	12	300	7350	10	45/37	110 VAC, 50/60Hz	1.27	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567127A	2	50	107	16	30	DC24	1.0	70%	GE
567128A	2-1/2	65	212	16	30	DC24	1.0	70%	GE
567129A	3	80	404	16	30	DC24	1.0	70%	GE
567130A	4	100	799	16	30	DC24	1.0	70%	GE
567132A	6	150	1929	16	30	DC24	1.7	70%	GE
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, NBR SEALS EPS POSITIONER 4-20mA input									
567136A	2	50	107	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567137A	2-1/2	65	212	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567138A	3	80	404	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567139A	4	100	799	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567141A	6	150	1929	16	30/25	110 VAC, 50/60Hz	0.73	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, NBR SEALS EPS POSITIONER 4-20mA input									
567146A	2	50	107	16	30	DC24	1.0	70%	GE
567147A	2-1/2	65	212	16	30	DC24	1.0	70%	GE
567148A	3	80	404	16	30	DC24	1.0	70%	GE
567149A	4	100	799	16	30	DC24	1.0	70%	GE
567150A	6	150	1929	16	30	DC24	1.7	70%	GE

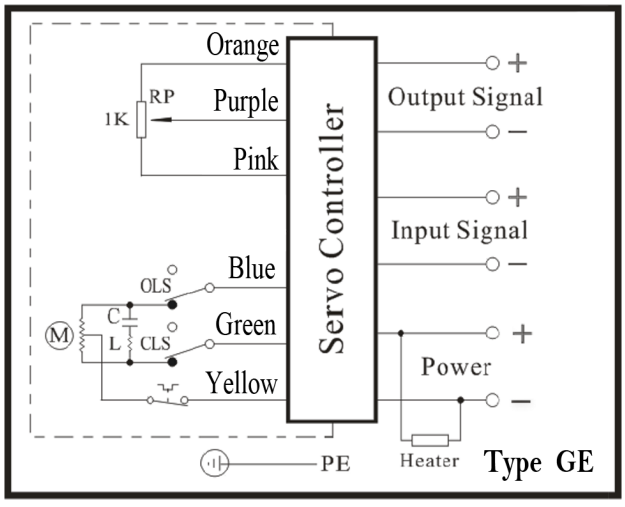
• Kv = The number of m^3 per hour of 20° C water at 1 bar pressure drop

Electrical Wiring

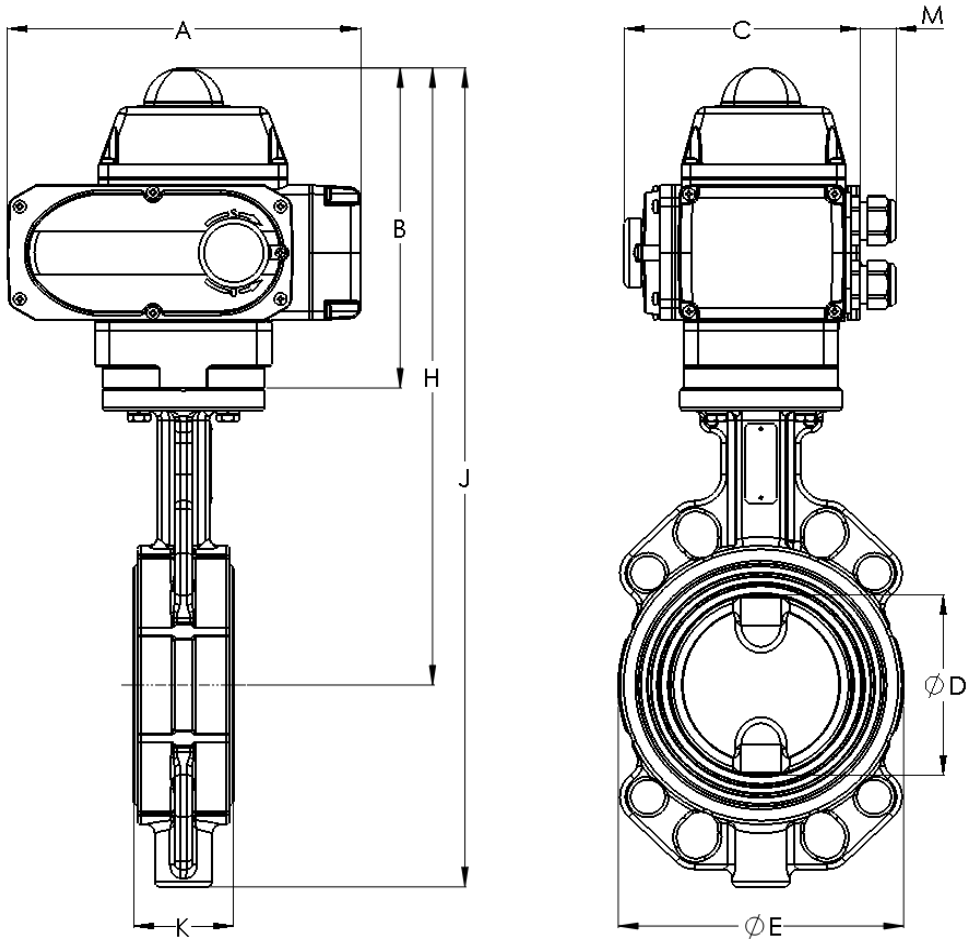
Valves with EPS Positioners
AC Voltages



Valves with EPS Positioners
DC Voltages



Dimensions:



Suitable between flanges:

- ANSI/ASME B16.5 CLASS150
- ANSI/ASME B16.1 CLASS125
- EN1092 PN10, PN16
- JIS B 2239 10K, 16K
- BS 10 Table D, Table E

Pipe Size		A	B	C	D	E	H	J	K	M	Weight (AC/DC)
2	inch	6.34	7.09	4.65	1.97	3.90	12.05	15.04	1.81	0.98	10.8 / 13.3 lb
DN50	mm	161	180	118	50	99	306	382	46	25	4.9 / 6.0 kg
2-1/2	inch	6.34	7.09	4.65	2.56	4.46	12.36	15.59	1.93	0.98	11.8 / 14.3 lb
DN65	mm	161	180	118	65	113	314	396	49	25	5.4 / 6.4 kg
3	inch	6.34	7.09	4.65	3.15	5.07	13.27	17.03	1.93	0.98	13.7 / 16.2 lb
DN80	mm	161	180	118	80	129	337	432.5	49	25	6.2 / 7.3 kg
4	inch	6.34	7.09	4.65	3.94	6.17	13.66	18.54	2.20	0.98	17.3 / 19.8 lb
DN100	mm	161	180	118	100	157	347	471	56	25	7.8 / 9.0 kg
6	inch	10.08	8.50	6.30	5.91	8.39	16.50	22.24	2.32	0.98	37.2 / 37.2 lb
DN150	mm	256	216	160	150	213	419	565	59	25	16.9 / 16.9 kg
8	inch	10.08	8.50	6.30	7.87	10.67	17.48	24.25	2.36	0.98	48.9 lb
DN200	mm	256	216	160	200	271	444	616	60	25	22.2 kg
12	inch	10.08	8.50	6.30	11.81	15.0	19.9	29.4	3.07	0.98	79.4 lb
DN300	mm	256	216	160	300	381	505	747	78	25	36 kg

SOLBERG®
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Miniature Filter Silencers

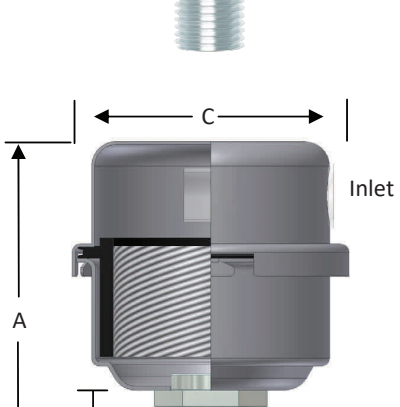
FS Series 1/4" - 1"

Features

- High grade filter element with integrated gasket seal
- Fully drawn weatherhood
- Tubular silencing design: tube maximizes attenuation and air flow while minimizing pressure drop
- Corrosive resistant black powder coat carbon steel
- Ability to mount vertically and horizontally

Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20" H_2O over initial Δ P
- Polyester: 99%+ removal efficiency standard to 10 micron
- Paper: 99%+ removal efficiency standard to 2 micron
- Pressure drop graphs available upon request



Options

- Various media for different environments
- Straight through configuration
- Various nonstandard finishes and connection styles

MPT Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches			Suggested Service Ht. inches	No. of Silencing Tubes	Approx. Weight lbs	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C				Polyester	Paper	
¼"	4	FS-05-025	FS-04-025	2 ¾	11/16	2 ½	1	1	0.25	05	04	8
⅜"	8	FS-05-038	FS-04-038	2 ¾	11/16	2 ½	1	1	0.25	05	04	8
⅜"	8	FS-07-038	FS-06-038	3 9/16	11/16	3 ¼	2	1	0.50	07	06	12
½"	8	FS-05-050	FS-04-050	3	⅞	2 ½	1	1	0.25	05	04	8
½"	12	FS-07-050	FS-06-050	3 ¾	⅞	3 ¼	2	1	0.50	07	06	12
½"	12	FS-11-050	FS-10-050	4 3/16	⅞	4 ¼	2	1	1	11	10	35
¾"	12	FS-07-075	FS-06-075	4 ⅛	1 ¼	3 ¼	2	1	0.50	07	06	12
¾"	25	FS-11-075	FS-10-075	4 ½	1 ¼	4 3/16	2	1	1	11	10	35
1"	35	FS-11-100	FS-10-100	4 ½	1 ¼	4 3/16	2	1	1	11	10	35

See Filter Silencer Technical Data for sizing guidelines.

Rev: FS .25-US1905K

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www.solbergmfg.com

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Compact Filter Silencers

FS Series 1/2” - 6”

Features

- Fully drawn weatherhood
- Tubular silencing design - tubes are positioned to maximize attenuation and air flow while minimizing pressure drop
- Corrosive resistant gray powder coat carbon steel

Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20” H_2O over initial Δ P
- Pressure drop graphs available upon request
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

ATEX Available

- Tap holes available
- Pressure drop indicator
- Various media for different environments
- Stainless steel construction
- Various nonstandard finishes and connection styles
- Side Access Silencer Filters (LQB Series) for space restricted enclosures (select models)

Threaded Outlet Assembly

Flange Outlet Assembly

Rev: FS .5-6-US1903K

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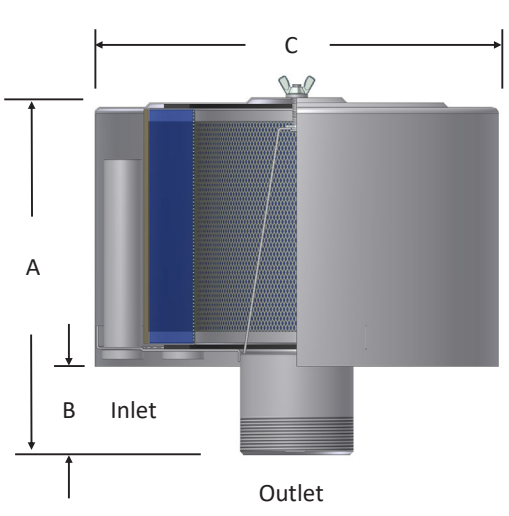
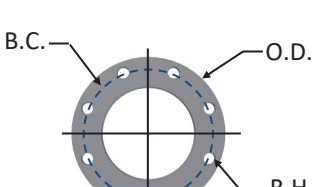
FS Series 1/2” - 6”





O.D.: Outside Diameter
B.C.: Bolt Circle
B.H.: Bolt Hole

125/150# Pattern Flange	Dimensions - inches			No. of Holes	Flange Thickness
	O.D.	B.C.	B.H.		
4”	9	7 ½	0.75	8	0.5
5”	10	8 ½	0.88	8	0.5
6”	11	9 ½	0.88	8	0.5

MPT Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches			Suggested Service ht. inches	No. of Silencing Tubes	Approx. Weight lbs.	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C				Polyester	Paper	
½”	10	FS-15-050	FS-14-050	3 7/16	1	6	3	1	2	15	14	35
¾”	25	FS-15-075	FS-14-075	4	1 ¼	6	3	2	2	15	14	35
1”	35	FS-15-100	FS-14-100	4	1 5/16	6	3	3	2	15	14	35
1”	55	FS-19P-100	FS-18P-100	6 ⅜	1 4/16	6	5	3	3	19P	18P	100
1 ¼”	70	FS-19P-125	FS-18P-125	6 ¾	1 ⅝	6	5	5	3	19P	18P	100
1 ½”	85	FS-19P-150	FS-18P-150	6 ¾	1 ⅝	6	5	5	4	19P	18P	100
2”	135	FS-31P-200	FS-30P-200	7 ½	2 ¼	10	5	5	8	31P	30P	195
2”	135	FS-231P-200	FS-230P-200	12	2 ⅜	10	10	5	14	231P	230P	300
2 ½”	195	FS-31P-250	FS-30P-250	7 ½	2 ½	10	5	5	8	31P	30P	195
2 ½”	195	FS-231P-250	FS-230P-250	12 ⅜	2 ⅝	10	10	9	15	231P	230P	300
3”	300	FS-231P-300	FS-230P-300	12 ¾	3 ⅛	10 ¼	10	9	15	231P	230P	300
3”	300	FS(12)-235P-300	FS(12)-234P-300	12 ⅞	2 11/16	12 ¼	10	3	29	235P	234P	570
3”	300	FS-275P-300	FS-274P-300	13	3	16	10	9	33	275P	274P	1100
4”	520	FS(12)-235P-400	FS(12)-234P-400	13 ⅞	3 11/16	12 ¼	10	6	29	235P	234P	570
4”	520	FS-275P-400	FS-274P-400	14	4	16	10	9	34	275P	274P	1100
5”	800	FS-245P-500	FS-244P-500	14	4 ⅛	16	10	14	33	245P	244P	880
5”	800	FS-275P-500	FS-274P-500	14	4 ⅛	16	10	14	36	275P	274P	1100
6”	1100	FS-275P-600	FS-274P-600	15	5 ⅛	16	10	18	38	275P	274P	1100

Flange Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches			Suggested Service ht. inches	No. of Silencing Tubes	Approx. Weight lbs.	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C				Polyester	Paper	
4”	520	FS(12)-235P-400F	FS(12)-234P-400F	13 ⅞	3 11/16	12 ¼	10	6	32	235P	234P	570
4”	520	FS-275P-400F	FS-274P-400F	14	4	16	10	9	39	275P	274P	1100
5”	800	FS-245P-500F	FS-244P-500F	14	4 ⅛	16	10	14	38	245P	244P	880
5”	800	FS-275P-500F	FS-274P-500F	14	4 ⅛	16	10	14	41	275P	274P	1100
6”	1100	FS-275P-600F	FS-274P-600F	15	5 ⅛	16	10	18	42	275P	274P	1100

See Filter Silencer Technical Data for sizing guidelines.

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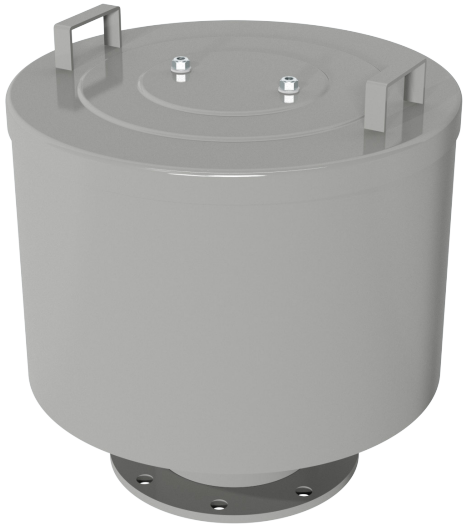
Big Boy Filter Silencers

FS Series 6” - 14”

Features

- Tubular silencing design - tubes are positioned to maximize attenuation and air flow while minimizing pressure drop
- Corrosive resistant gray powder coat carbon steel
- Low pressure drop center bracket & outlet pipe design



Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20” H_2O over initial Δ P
- Pressure drop graphs available upon request
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

ATEX Available

- Tap holes available
- Pressure drop indicator
- Various media for different environments
- Stainless steel construction
- Various nonstandard finishes and connection styles
- Side Access Silencer Filters (LQB Series) for space restricted enclosures (select models)

Sumo Class Features

- Single barrel filter design allows for large airflows in space restricted work areas
- 16” to 24” flange connections available
- Designed for airflows up to 8000 SCFM

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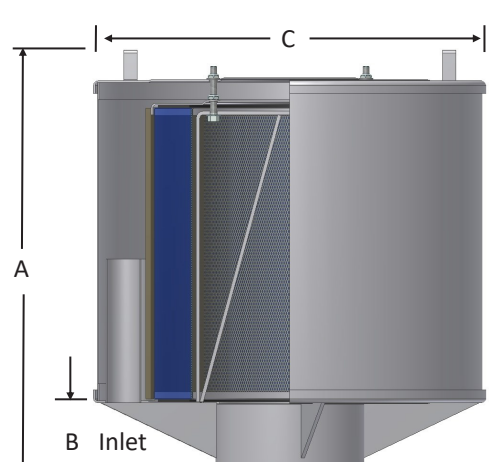
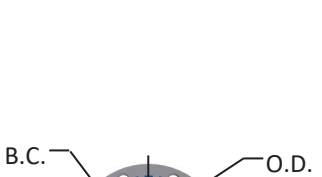
FS Series 6” - 14”



Flange Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches			Suggested Service ht. inches	No. of Silencing Tubes	Approx. Weight lbs	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C				Polyester	Paper	
6"	1100	**FS-377P-600F**	**FS-376P-600F**	22 11/16	5 1/4	21 7/8	15	6	95	377P	376P	1825
8"	1800	**FS-377P-800F**	**FS-376P-800F**	23 1/2	6	21 7/8	15	12	105	377P	376P	1825
8"	1800	**FS-385P-800F**	**FS-384P-800F**	24	6	28 5/16	15	12	125	385P	384P	3295
10"	3300	**FS-385P-1000F**	**FS-384P-1000F**	23 1/2	6	28 5/16	15	16	130	385P	384P	3295
10"	3300	**FS-485P-1000F**	**FS-484P-1000F**	31 1/2	6	28 5/16	22	16	143	485P	484P	4705
12"	4700	**FS-485P-1200F**	**FS-484P-1200F**	31 1/2	6	28 5/16	22	24	155	485P	484P	4705
12"	4700	**FS-685P-1200F**	**FS-384P(2)-1200F**	38 1/2	6	28 5/16	29	24	175	685P	384P (2)	6600
14"	6000	**FS-485P(2)-1400F**	**FS-484P(2)-1400F**	53 5/16	6	28 5/16	22	18	245	485P (2)	484P (2)	9410

Flange Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches			Suggested Service ht. inches	Replacement Element Part No.	
		Polyester	Paper	A	B	C		Polyester	Paper
18"	5500	**FS-391-1800F**	**FS-390-1800F**	23 1/2	6	44	15	391	390
18"	8000	**FS-491-1800F**	**FS-490-1800F**	30 1/2	6	44	22	491	490
20"	8000	**FS-491-2000F**	**FS-490-2000F**	30 1/2	6	44	22	491	490
24"	8000	**FS-491-2400F**	**FS-490-2400F**	30 1/2	6	44	22	491	490

125/150# Pattern Flange	Dimensions - inches			No. of Holes	Flange Thickness
	O.D.	B.C.	B.H.		
6"	11	9 1/2	0.88	8	0.5
8"	13 1/2	11 3/4	0.88	8	0.5
10"	16	14 1/4	1	12	0.5
12"	19	17	1	12	0.5
14"	21	18 3/4	1 1/8	12	0.5
18"	25	22 3/4	1 1/4	16	0.5
20"	27 1/2	25	1 1/4	20	0.5
24"	32	29 1/2	1 3/8	20	1.18



O.D.: Outside Diameter
B.C.: Bolt Circle
B.H.: Bolt Hole

See Filter Silencer Technical Data section for sizing guidelines.

SOLBERG®
Filtration • Separation• Silencing

Technical Data

Inlet Filter Silencers, Silencers

Applications & Equipment

- Industrial & Severe Duty
- Blowers - Side Channel & P.D.
- Breathers
- Fuel Cells
- Piston Compressors
- Screw Compressors
- Centrifugal Compressors
- Hydraulic Breathers – fine filtration
- Engines
- Fans
- Vacuum Pumps & Systems
- Construction\Contractor Industry
- Medical
- Pneumatic Conveying
- Waste Water Aeration
- Sparging
- Factory Air
- Vacuum Vent Breathers
- Cement Processing
- Power Plants
- Centralized Air Intakes

Identification

Standard Solberg assemblies should have an identification label/nameplate that gives the following information:

- Assembly Model #
- Replacement Element #

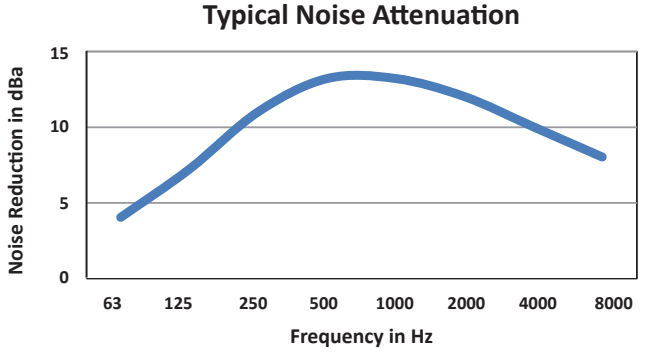
The part number designates the filter type, the element configuration and housing connection size. For example, the following part number identifies the filter as being an “FS” design filter with a “275” element, “P” prefilter and 3” MPT connection size.

FS-275P-300

- Connection Size and Type
- Replacement Element Part Number
- Filter Type

Typical Noise Attenuation

See chart for typical noise attenuation for filter silencers. It may vary due to the wide range of applications, installations, and machines.



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Choosing the Best Filter for Your Equipment

A. When the connection & airflow is known:

1. select the appropriate connection style. (i.e.: MPT, Flange, NPSC, etc.)
2. check assembly SCFM (flow) rating. Compare with your required airflow.

(Note: Assembly flow ratings are based on 6,000 FPM or 30m/sec for a given connection size to achieve low pressure drop performance. When required flow exceeds assembly flow rating, the pressure drop through the outlet connection will increase. In such cases select by element SCFM (flow) rating.)

3. when required flow rating matches connection size; skip to "C. Selecting Elements".

B. When the connection size is unknown, flexible, or the required flow rating exceeds assembly flow rating:

1. match required flow rating with the element flow rating.
2. choose related connection size.

C. Selecting Elements: The filter performance is influenced by the actual application duty and the equipment it is installed on. Regular maintenance checks and proper servicing is required.

Application Duty Descriptions:

Industrial Duty: clean workshop or clean outdoor environment - small element sizing is sufficient.

Severe Duty: dirty workshop, wastewater – medium to large element is recommended.

Extreme Duty: cement, steel making, plastics or dusty material conveying – largest element sizing is recommended.

1. Select media required by your application. Options include:
    a. Standard media
        1. Polyester: all purpose; withstands pulses, moisture, and oily air
        2. Paper: mostly dry, smooth flow applications
    b. Special media: for a variety of micron levels and media types, see the "Filter Media Specifications" in the Replacement Element Section or contact Solberg.
2. Select element size by matching the element with the anticipated duty and upsize accordingly.

Filter Assembly Maintenance

Request the appropriate maintenance manual for more in-depth information from your Solberg representative or on our website www.solbergmfg.com.

Element Maintenance

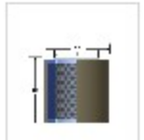
Solberg elements should be replaced once the pressure drop reaches 15-20" H_2O above the initial pressure drop of the installation. Cleaning the element is also an option.

Solberg recommends replacing dirty elements for optimal performance. Any damage which results from by-pass or additional pressure drop created by element cleaning is the sole responsibility of the operator.

Note: The overall performance of a filter element is altered once cleaned. The initial pressure drop after subsequent cleanings will be greater than the original, clean pressure drop of the element. After each cleaning, the pressure drop will continue to increase. Under all circumstances, the initial pressure drop of the element needs to be maintained at less than 15" H_2O.

If the pressure drop exceeds 20" H_2O at start-up; it should be replaced with a new element. With many types of equipment, the maximum pressure drop allowed will be dictated by the ability of the equipment to perform to its rated capacity. Under all circumstances, the operator should avoid exceeding the manufacturer's recommended maximum pressure drop for their specific equipment.




SOLBERG®

MODEL #

275P™

$133.00 / each

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A $100.00 net minimum order is required. Thank you.

1 + —

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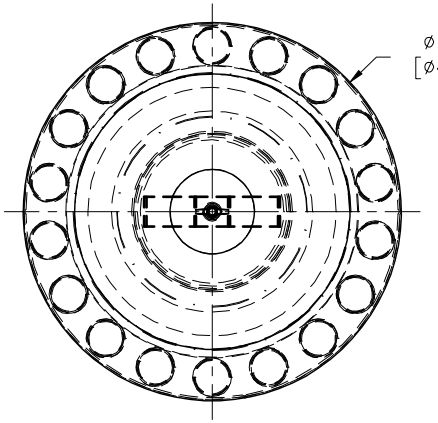
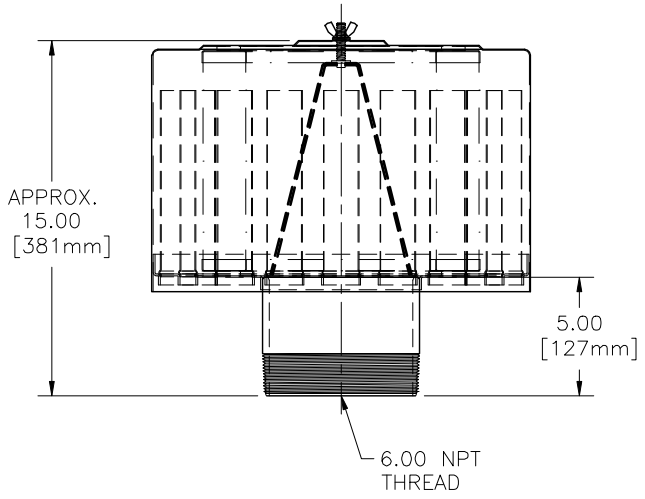
ZONE	REV	DESCRIPTION	ECN #	CHG BY	DATE	APP'D





REPLACEMENT ELEMENT# 275P	
MATERIAL	POLYESTER
CFM FLOW	1100
SURFACE AREA	19 SQ. FT.
I.D.	8.00
O.D.	11.75
HEIGHT	9.63

MODEL#	HOUSING MATERIAL	FINISH
FS-275P-600	CARBON STEEL	BAKED ENAMEL GREY

UNLESS OTHERWISE SPECIFIED:
-DIMENSIONS ARE IN INCHES
-REF: APPROXIMATE DIMENSIONS, NO TOLERANCES APPLY
-TOLERANCES ARE:
DECIMALS: .XX ±.25, .XXX ±.125
ANGLES ±2°

CUSTOMER APPROVAL:

SALES REP.:

APPROVALS	DATE
DRAWN: ABL	07/17/07
APPROVED:	

SOLBERG MANUFACTURING INC.
1151 W. ARDMORE AVE.
ITASCA, IL 60143
630/773-1363

DESCRIPTION:
FS-275P-600

SHEET: 1 of 1 | SHEET SIZE: C | SCALE: NTS

DRAWING NUMBER: SD12984 | REV: —

PROCO

The Expansion Joint and Check Valve People

Molded Spherical Joints Style 240/242

Proco Style 240/242 Molded Spherical Joints

Proco Style 240/242 Spherical Molded Expansion Joints are designed for piping systems to absorb pipe movements, relieve stress, reduce system noise/vibration, compensate for misalignment/offset and to protect rotating mechanical equipment against start-up surge forces.

The molded style 240 single sphere and 242 twin sphere designed bellows are inherently stronger than the conventional hand-built style spool arch type. Internal pressure within a "sphere" is exerted in all directions, distributing forces evenly over a larger area. The spherical design "flowing arch" reduces turbulence and sediment buildup.

Features and Benefits:

Absorbs Directional Movement

Thermal movements appear in any rigid pipe system due to temperature changes. The Style 240 and Style 242 spherical arch expansion joints allow for axial compression or axial extension, lateral deflection as well as angular movement. (Note: Rated movements in this publication are based on single plane movements. Multiple movement conditions are based on a multiple movement calculation. Contact Proco for information when designing multiple pipe movements.)

Easy Installation with Rotating Metallic Flanges

The floating metallic flanges freely rotate on the bellows, compensating for mating flange misalignment, thus speeding up installation time. Gaskets are not required with the Style 240 or Style 242, provided the expansion joints are mated against a flat face flange as required in the installation instructions.

Flange Materials/Drilling

The Proco Style 240 and Style 242 molded expansion joints are furnished complete with plated carbon steel flanges for corrosion protection. 304 or 316 stainless steel flanges are available upon request as well as ANSI 250/300 lb., BS-10, DIN PN10 & PN16 and JIS-10K drilling.

Absorbs Vibration, Noise and Shock

The Proco Style 240 and Style 242 molded expansion joints effectively dampen and insulate downstream piping against the transmission of noise and vibration generated by mechanical equipment. Noise and vibration caused by equipment can cause stress in pipe, pipe guides, anchors and other equipment downstream. Water hammer and pumping impulses can also cause strain, stress or shock to a piping system. Install the Style 240 or Style 242 molded expansion joints to help compensate for these system pressure spikes.

Wide Service Range with Low Cost

Engineered to operate up to 300 PSIG or 265°F, the Proco Style 240 and Style 242 can be specified for a wide range of piping requirements. Compared to conventional hand-built spool type joints, you will invest less money when specifying the mass-produced, consistent high quality, molded single or twin sphere expansion joints.

Material Identification

All Style 240 or Style 242 molded expansion joints have branded elastomer designations. Neoprene Tube/Neoprene Cover (NN) and Nitrile Tube/Neoprene Cover (NP) elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F1123-87. 240C/NP-9 joints have ABS certification.

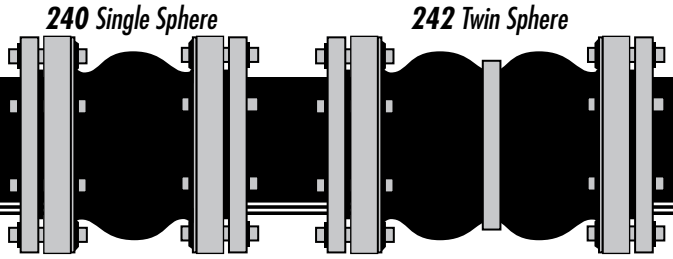
Large Inventory

Proco Products, Inc. maintains one of the largest inventories of rubber expansion joints in the world. Please contact us for price and availability.

Table 1: Available Styles • Materials

For Specific Elastomer Recommendations, See: **PROCO** "Chemical To Elastomer Guide"

240-A	240-C	240-AV,D,E,M [11]	242-A,B,C	PROCO Material Code	Cover Elastomer [1]	Tube Elastomer [2]	Max-imum Operating Temp. °F	Identifying Color Band/Label
		X	X	/BB[3]	Chlorobutyl	Chlorobutyl	250°	Black
		X	X	/EE[2,3,7]	EPDM	EPDM	250°	Red
X	X			/EE[2,3,4]	EPDM	FDA-EPDM	250°	Red
		X		/EQ[2,3]	EPDM	FDA-EPDM	250°	Red
X	X			/EE-9[3,5]	EPDM	EPDM	265°	DBL Red
	X			/HH	CSM	CSM	212°	Green
		X	X	/NH	Neoprene	CSM	212°	Green
	X			/NJ[2]	Neoprene	FDA-Nitrile	212°	White
	X	X	X	/NN[7]	Neoprene	Neoprene	225°	Blue
X	X	X	X	/NP	Neoprene	Nitrile	212°	Yellow
X	X			/NP-9[6]	Neoprene	Nitrile-ABS	212°	DBL Yellow



Protecting Piping and Equipment Systems from Stress/Motion

Notes: All Products are reinforced with Nylon Tire Cord, except 240-A and 240-C which are reinforced with Polyester.

1. *All NN & NP elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F 1123-87 and are marked accordingly.*
2. *Branding Label will be marked as "Food Grade".*
3. *BB, EE or EE-9 are good for 300°F blower service at 20 PSI or less.*
4. *240-A & 240-C expansion joints have black EPDM tube, but are FDA compliant.*
5. *EE-9 joints are peroxide cured.*
6. *NP-9 joints have ABS certification.*
7. *Elastomers are in accordance with NSF/ANSI 372, File MH47689 Und. Lab. Classified.*
8. *All elastomers above are not intended for steam service.*
9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*
10. *For 240A & 240C Rubber Joints, Vacuum Support devices are available. Published movements will be reduced by approximately 50% for this option.*
11. *Series 240AV,D,E&M + 242A,B&C In Elastomers EPDM & Neoprene are all listed for low lead content in accordance with NSF/ANSI 372*

Information subject to change without notice.

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	5.00	240-C	1.063	1.250	1.188	45	4.43	225	26	4.25	3.13	4	0.625	1/2-13 UNC	3.8	3.3
	6.00	240-AV	0.500	0.375	0.500	37										
1.25 (32)	3.74	240-D	0.312	0.188	0.312	45	6.34	225	26	4.63	3.5	4	0.625	—	4.6	3.3
	5.00	240-C	1.063	1.250	1.188	17		235	21				0.625	—	5.0	
	5.00	240-E	0.500	0.375	0.500	31		225	26				0.625	—	5.0	
	6.00	**240-AV**	0.500	0.375	0.500	31		225	26				0.625	1/2-13 UNC	5.0	
1.5 (40)	3.74	240-D	0.375	0.188	0.312	14	6.49	225	26	5.0	3.88	4	0.625	—	5.4	4.6
	4.00	240-M	0.375	0.188	0.312	14		225	26				0.625	—	5.5	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.625	—	5.1	
	5.00	240-E	0.500	0.375	0.500	27		225	26				0.625	—	6.0	
	6.00	**240-AV**	0.500	0.375	0.500	27		225	26				0.625	1/2-13 UNC	6.1	
2 (50)	4.00	240-M	0.375	0.188	0.312	11	7.07	225	26	6.0	4.75	4	0.750	—	8.3	6.3
	4.13	240-D	0.375	0.188	0.312	11		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	5.00	240-C	1.063	1.250	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	5.00	240-E	0.375	0.375	0.500	20		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	6.00	240-A	1.188	1.188	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	6.00	**240-AV**	0.500	0.375	0.500	20		225	26	6.0	4.75	4	0.750	5/8-11 UNC	12.3	7.6
	6.00	Q-240-HW	0.500	0.375	0.500	20		300	26	6.5	5.0	8	0.750	—	11.0	7.6
2.5 (65)	4.00	240-M	0.375	0.188	0.375	8	11.05	225	26	7.0	5.5	4	0.750	—	12.0	7.6
	4.53	240-D	0.500	0.188	0.375	11		225	26				0.750	—	12.3	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.750	—	10.6	
	5.00	240-E	0.500	0.375	0.500	17		225	26				0.750	—	12.0	
	6.00	240-A	1.188	1.188	1.188	43		235	18				0.750	—	12.0	
	6.00	**240-AV**	0.500	0.375	0.500	17		225	26				0.750	5/8-11 UNC	12.3	
3 (80)	5.00	240-C	1.063	1.250	1.188	40	13.36	235	15	7.5	6.0	4	0.750	—	13.3	8.3
	5.00	240-E	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	5.12	240-D	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	6.00	240-A	1.188	1.188	1.188	38		235	15	7.5	6.0	4	0.750	—	13.8	8.3
	6.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.0	8.3
	8.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	15.0	8.7
	6.00	Q-240-HW	0.500	0.375	0.500	14		300	26	8.25	6.62	8	0.875	—	17.5	8.3
3.5 (90)	6.00	240-AV	0.500	0.375	0.500	12	18.67	225	26	8.5	7.0	8	0.750	5/8-11 UNC	17.6	7.4
4 (100)	5.00	240-C	1.063	1.250	1.188	32	22.69	235	15	9.0	7.5	8	0.750	—	16.5	7.4
	5.00	240-E	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.0	7.4
	5.32	240-D	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.1	7.4
	6.00	240-A	1.188	1.188	1.188	30		235	15	9.0	7.5	8	0.750	—	17.5	7.4
	6.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	18.3	7.4
	8.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	19.3	7.8
	6.00	Q-240-HW	0.750	0.500	0.500	14		300	26	10.0	7.88	8	0.750	—	26.0	7.4
5 (125)	5.00	240-C	1.063	1.250	1.188	27	30.02	235	10	10.0	8.5	8	0.875	—	20.3	8.3
	5.00	240-E	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	—	22.0	8.3
	6.00	240-A	1.188	1.188	1.188	25		235	10	10.0	8.5	8	0.875	—	21.8	8.3
	6.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	22.8	8.3
	6.69	240-D	0.750	0.500	0.500	11		225	10	10.0	8.5	8	0.875	—	23.6	8.5
	8.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	25.0	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	11		300	26	11.0	9.25	8	0.875	—	28.0	14.0

See Notes Page 4

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
6 (150)	5.00	240-C	1.063	1.250	1.188	23	41.28	225	8	11.0	9.5	8	0.875	—	22.6	10.4
	5.00	240-E	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	26.0	10.4
	6.00	240-A	1.188	1.188	1.188	21		235	10	11.0	9.5	8	0.875	—	24.0	10.4
	6.00	**240-AV**	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	3/4-10 UNC	26.8	10.4
	7.09	240-D	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	29.0	10.6
	8.00	**240-AV**	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.1	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	9		300	26	12.5	10.62	12	0.875	—	39.0	10.4
8 (200)	5.00	240-C	1.063	1.188	1.188	17	63.62	235	8	13.5	11.75	8	0.875	—	35.5	13.4
	5.00	240-E	0.750	0.500	0.500	7		225	26	13.5	11.75	8	0.875	—	40.0	13.4
	6.00	240-A	1.188	1.188	1.188	16		235	8	13.5	11.75	8	0.875	—	38.5	13.4
	6.00	**240-AV**	0.750	0.500	0.500	7		225	26	13.5	11.75	8	0.875	3/4-10 UNC	40.6	13.4
	8.07	240-D	1.000	0.563	0.875	8		225	26	13.5	11.75	8	0.875	—	41.3	14.0
	6.00	Q-240-HW	0.750	0.500	0.500	7		300	26	15.0	13.00	12	1.000	—	70.0	13.4
10 (250)	5.00	240-C	1.063	1.188	1.188	14	103.87	235	6	16.0	14.25	12	1.000	—	49.3	21.0
	5.00	240-E	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	56.0	21.0
	8.00	240-A	1.188	1.188	1.188	13		145	6	16.0	14.25	12	1.000	—	53.6	21.3
	8.00	**240-AV**	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	56.6	21.3
	9.00	**240-AV**	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	57.0	22.0
	9.45	240-D	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	58.5	22.0
	10.00	**240-AV**	1.000	0.625	0.875	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	60.5	26.5
	8.00	Q-240-HW	1.000	0.625	0.750	7		275	26	17.5	15.25	16	1.125	—	56.0	22.0
12 (300)	5.00	240-C	1.063	1.250	1.188	12	137.89	235	6	19.0	17.0	12	1.000	—	73.4	26.5
	5.00	240-E	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	—	74.0	26.5
	8.00	240-A	1.188	1.188	1.188	11		145	6	19.0	17.0	12	1.000	—	80.0	27.0
	8.00	**240-AV**	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	7/8-9 UNC	83.0	27.0
	9.00	**240-AV**	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	7/8-9 UNC	88.0	27.0
	10.24	240-D	1.000	0.625	0.875	6		225	26	19.0	17.0	12	1.000	—	89.0	28.0
	8.00	Q-240-HW	1.000	0.625	0.750	6		275	26	20.5	17.75	16	1.250	—	100.0	27.0
14 (350)	8.00	240-C	1.000	1.063	1.188	8	182.65	232	6	21.0	18.75	12	1.125	—	112.0	28.0
	8.00	**240-AV**	1.000	0.625	0.750	6		150	26				1.125	—	115.0	28.0
16 (400)	8.00	240-C	1.000	1.063	1.188	8	240.53	232	6	23.5	21.25	16	1.125	—	136.0	26.8
	8.00	240-HW	1.000	0.625	0.750	4		175	26				1.125	—	186.0	26.8
	8.00	**240-AV**	1.000	0.625	0.750	4		125	26				1.125	—	165.0	26.8
	9.00	240-M	1.000	0.625	0.750	4		125	26				1.125	—	168.0	27.0
	10.43	240-D	1.000	0.625	0.875	4		125	26				1.125	—	170.0	27.0
18 (450)	8.00	240-HW	1.000	0.625	0.750	4	298.65	175	26	25.0	22.75	16	1.250	—	209.0	31.4
	8.00	**240-AV**	1.000	0.625	0.750			125	26				1.250	—	168.0	31.4
	9.00	240-M	1.000	0.625	0.750			125	26				1.250	—	169.0	33.1
	10.43	240-D	1.000	0.625	0.875			125	26				1.250	—	170.0	33.1
20 (500)	8.00	240-C	1.000	1.063	1.188	6	363.05	145	6	27.5	25.00	20	1.250	—	154.0	32.4
	8.00	240-HW	1.000	0.625	0.750	3		175	26				1.250	—	234.0	32.4
	8.00	**240-AV**	1.000	0.625	0.750	3		125	26				1.250	—	170.0	32.4
	9.00	240-M	1.000	0.625	0.750	3		125	26				1.250	—	173.0	34.1
	10.43	240-D	1.000	0.625	0.875	3		125	26				1.250	—	175.0	34.1
24 (600)	8.00	240-C	1.000	1.063	1.188	5	510.70	145	6	32.5	29.5	20	1.375	—	214.0	44.0
	10.00	**240-AV**	1.000	0.625	0.750	3		110	26				1.375	—	255.0	45.5
	10.00	240-HW	1.000	0.625	0.750	3		160	26				1.375	—	297.0	45.5
	10.47	240-D	1.000	0.625	0.875	3		110	26				1.375	—	265.0	46.0
30 (750)	10.00	**240-AV**	1.000	0.625	0.750	2	779.31	110	26	38.75	36.0	28	1.375	—	295.0	57.0

See Notes Page 4

NOTES:

Standard Proco Style 240-AV Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-240-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 240AV/NN and 240-D/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expasion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*

"Effective Area"

Thrust Factor=

$$T = \frac{\pi}{4}(D)^2 (P)$$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

Style 242 Twin Sphere Performance Data

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	10.00	242-C	2.000	1.188	1.750	45	4.43	225	26	4.25	3.13	4	0.625	—	5.2	3.6
1.25 (32)	7.0	**242-A**	2.000	1.188	1.750	45	6.34	225	26	4.63	3.5	4	0.625	1/2-13 UNC	5.3	3.5
	7.0	242-HA						300					0.625	—	6.5	3.5
	10.00	242-C						225					0.625	—	6.2	3.6
1.5 (40)	6.00	242-B	2.000	1.188	1.750	45	6.49	225	26	5.0	3.88	4	0.625	—	6.1	4.6
	6.00	242-HB						300					0.625	—	7.6	4.6
	7.00	**242-A**						225					0.625	1/2-13 UNC	6.8	4.8
	7.00	242-HA						300					0.625	—	8.3	4.8
	10.00	242-C						225					0.625	—	7.7	5.1
2 (50)	6.00	242-B	2.000	1.188	1.750	45	7.07	225	26	6.0	4.75	4	0.750	—	9.0	6.6
	7.00	**242-A**						225		6.0	4.75	4	0.750	—	9.0	7.0
	10.00	242-C						235		6.0	4.75	4	0.750	5/8-11 UNC	10.2	7.3
	6.00	Q-242-HB						300		6.0	4.75	4	0.750	—	10.5	6.6
	7.00	Q-242-HA						300		6.5	5.00	8	0.750	—	10.5	7.0
2.5 (65)	6.00	242-B	2.000	1.188	1.750	43	11.05	225	26	7.0	5.5	4	0.750	—	12.9	7.6
	7.00	**242-A**						225					0.750	—	13.3	8.0
	10.00	242-C						225					0.750	5/8-11 UNC	14.5	8.4
	6.00	Q-242-HB						300					0.750	—	15.3	7.6
	7.00	Q-242-HA						300					0.750	—	15.8	8.0
3 (80)	7.00	**242-A**	2.000	1.188	1.750	38	13.36	225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.3	8.6
	9.00	242-B						225		7.5	6.0	4	0.750	—	15.2	9.0
	10.00	242-C						225		7.5	6.0	4	0.750	—	15.8	9.1
	12.00	242-C						225		7.5	6.0	4	0.750	—	16.0	9.9
	7.00	Q-242-HA						300		8.25	6.62	8	0.875	—	18.2	8.6
4 (100)	9.00	**242-A**	2.000	1.375	1.562	34	22.69	225	26	9.0	7.5	8	0.750	5/8-11 UNC	20.3	8.0
	10.00	242-C						225		9.0	7.5	8	0.750	—	21.3	8.2
	12.00	242-C						225		9.0	7.5	8	0.750	—	22.0	8.2
	9.00	Q-242-HA						300		10.0	7.88	8	0.750	3/4-10 UNC	26.4	8.0
5 (125)	9.00	**242-A**	2.000	1.375	1.562	29	30.02	225	26	10.0	8.5	8	0.875	—	24.5	8.3
	10.00	242-C						225		10.0	8.5	8	0.875	—	25.5	9.1
	12.00	242-C						225		10.0	8.5	8	0.875	—	26.0	9.1
	9.00	Q-242-HA						300		11.0	9.25	8	0.875	—	31.4	8.3
6 (150)	9.00	**242-A**	2.000	1.375	1.562	25	41.28	225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.5	11.7
	10.00	242-C						225		11.0	9.5	8	0.875	—	30.5	11.9
	12.00	242-C						225		11.0	9.5	8	0.875	—	31.0	12.0
	14.00	242-C						225		11.0	9.5	8	0.875	—	32.0	12.0
	9.00	Q-242-HA						300		12.5	10.62	12	0.875	—	38.6	11.7
8 (200)	9.00	242-B	2.375	1.375	1.375	19	63.62	225	26	13.5	11.75	8	0.875	—	42.3	14.5
	10.00	242-C						225		13.5	11.75	8	0.875	—	43.4	15.0
	12.00	242-C						225		13.5	11.75	8	0.875	—	44.0	15.2
	13.00	**242-A**						225		13.5	11.75	8	0.875	—	43.8	15.4
	14.00	242-C						225		13.5	11.75	8	0.875	3/4-10 UNC	46.0	16.0
	9.00	Q-242-HB						300		15.0	13.0	12	1.000	—	55.4	14.5
	13.00	Q-242-HA						300		15.0	13.0	12	1.000	—	57.5	15.4
10 (250)	12.00	242-B	2.375	1.375	1.375	15	103.87	225	26	16.0	14.25	12	1.000	—	64.1	23.5
	13.00	**242-A**						225		16.0	14.25	12	1.000	—	65.5	24.5
	14.00	242-C						225		16.0	14.25	12	1.000	7/8-9 UNC	66.7	24.5
	12.00	Q-242-HB						275		17.5	15.25	16	1.125	—	86.5	23.5
	13.00	Q-242-HA						275		17.5	15.25	16	1.125	—	88.4	24.5

See Notes Page 6

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
12 (300)	12.00	242-B	2.375	1.375	1.375	13	137.89	225	26	19.0	17.00	12	1.000	—	94.0	30.0
	13.00	**242-A**						225		19.0	17.00	12	1.000	—	95.0	31.0
	14.00	242-C						225		19.0	17.00	12	1.000	7/8-9 UNC	99.1	31.0
	12.00	Q-242-HB						275		20.5	17.75	16	1.250	—	110.0	30.0
	13.00	Q-242-HA						275		20.5	17.75	16	1.250	—	110.0	31.0
14 (350)	13.75	**242-A**	1.750	1.118	1.118	9	182.65	150	26	21.0	18.75	12	1.125	—	142.0	32.0
16 (400)	12.00	242-C	1.750	1.118	1.118	8	240.53	125	26	23.5	21.25	16	1.125	—	154.0	28.8
	12.00	242-HC						175					1.125	—	190.0	28.8
	13.75	**242-A**						125					1.125	—	162.0	30.8
	13.75	242-HA						175					1.125	—	200.2	30.8
18 (450)	12.00	242-C	1.750	1.118	1.118	7	298.65	125	26	25.0	22.75	16	1.250	—	168.0	35.1
	13.75	**242-A**						125					1.250	—	176.0	36.1
	13.75	242-HA						175					1.250	—	211.2	36.1
20 (500)	12.00	242-C	1.750	1.118	1.118	7	363.05	125	26	27.5	25.0	20	1.250	—	202.0	35.0
	13.75	**242-A**						125					1.250	—	212.0	35.5
	13.75	242-HA						175					1.250	—	212.0	35.5
24 (600)	12.00	242-C	1.750	1.118	1.118	5	510.70	110	26	32.5	29.5	20	1.375	—	220.0	47.0
	13.75	**242-A**						110					1.375	—	250.0	48.0
	13.75	242-HA						160					1.375	—	296.2	48.0
30 (750)	12.00	242-C	1.750	1.118	1.118	4	779.31	110	26	38.75	36.0	28	1.375	—	300.0	62.0

NOTES:

Standard Proco Style 242-A Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-242-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$T = \frac{\pi}{4} (D)^2 (P)$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 242A/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expansion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

Style 240/242 Drilling Chart

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	American 125/150# Conforms to ANSI B16.1 and B16.5						American 250/300# Conforms to ANSI B16.1 and B16.5					British Standard 10:1962 Conforms to BS 10 Table E				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Drilled Hole Size	Threaded Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.55 (14.0)	4.25 (108.0)	3.13 (79.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	4.88 (124.0)	3.5 (88.9)	4	0.75 (19.1)	0.59 (15.0)	4.5 (114.0)	3.25 (82.6)	4	0.62 (15.9)
1.25 (32)	0.55 (14.0)	4.63 (118.0)	3.5 (88.9)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	5.25 (133.0)	3.88 (98.4)	4	0.75 (19.1)	0.59 (15.0)	4.75 (121.0)	3.44 (87.3)	4	0.62 (15.9)
1.5 (40)	0.55 (14.0)	5.0 (127.0)	3.88 (98.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	6.12 (156.0)	4.50 (114.3)	4	0.88 (22.2)	0.59 (15.0)	5.25 (133.0)	3.88 (98.4)	4	0.62 (15.9)
2 (50)	0.63 (16.0)	6.0 (152.0)	4.75 (120.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	6.50 (165.0)	5.00 (127.0)	8	0.75 (19.1)	0.63 (16.0)	6.0 (152.0)	4.5 (114.3)	4	0.75 (19.1)
2.5 (65)	0.71 (18.0)	7.0 (178.0)	5.5 (139.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	7.5 (191.0)	5.88 (149.2)	8	0.88 (22.2)	0.71 (18.0)	6.5 (165.0)	5.0 (127.0)	4	0.75 (19.1)
3 (80)	0.71 (18.0)	7.5 (191.0)	6.0 (152.4)	4	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	8.25 (210.0)	6.62 (168.2)	8	0.88 (22.2)	0.71 (18.0)	7.25 (184.0)	5.75 (146.1)	4	0.75 (19.1)
3.5 (90)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	9.0 (229.0)	7.25 (184.2)	8	0.88 (22.2)	0.71 (18.0)	8.0 (203.0)	6.5 (165.1)	8	0.75 (19.1)
4 (100)	0.71 (18.0)	9.0 (229.0)	7.5 (190.5)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	10.0 (254.0)	7.88 (200.0)	8	0.88 (22.2)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)
5 (125)	0.79 (20.0)	10.0 (254.0)	8.5 (215.9)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.0)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)	0.79 (20.0)	10.0 (254.0)	8.25 (209.6)	8	0.75 (19.1)
6 (150)	0.87 (22.0)	11.0 (279.0)	9.5 (241.3)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.2)	12.5 (318.0)	10.62 (269.9)	12	0.88 (22.2)	0.87 (22.2)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)
8 (200)	0.87 (22.0)	13.5 (343.0)	11.75 (298.5)	8	0.88 (22.2)	3/4 - 10 UNC	0.95 (24.0)	15.0 (381.0)	13.0 (330.2)	12	1.00 (25.4)	0.87 (22.2)	13.25 (337.0)	11.5 (292.1)	8	0.88 (22.2)
10 (250)	0.95 (24.0)	16.0 (406.0)	14.25 (362.0)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	17.5 (445.0)	15.25 (387.4)	16	1.13 (28.6)	0.95 (24.0)	16.0 (406.0)	14.0 (355.6)	12	0.88 (22.2)
12 (300)	0.95 (24.0)	19.0 (483.0)	17.0 (431.8)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	20.5 (521.0)	17.75 (450.9)	16	1.25 (31.8)	0.95 (24.0)	18.0 (457.0)	16.0 (406.4)	12	1.00 (25.4)
14 (350)	1.02 (26.0)	21.0 (533.0)	18.75 (476.3)	12	1.13 (28.6)	1 - 8 UNC	1.10 (28.0)	23.0 (584.0)	20.25 (514.4)	20	1.25 (31.8)	1.02 (26.0)	20.75 (527.0)	18.5 (469.9)	12	1.00 (25.4)
16 (400)	1.10 (28.0)	23.5 (597.0)	21.25 (539.8)	16	1.13 (28.6)	1 - 8 UNC	1.18 (30.0)	25.5 (648.0)	22.5 (571.5)	20	1.38 (34.9)	1.10 (28.0)	22.75 (578.0)	20.5 (520.7)	12	1.00 (25.4)
18 (450)	1.18 (30.0)	25.0 (635.0)	22.75 (577.9)	16	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	28.0 (711.0)	24.75 (628.7)	24	1.38 (34.9)	1.18 (30.0)	25.25 (641.0)	23.0 (584.2)	16	1.00 (25.4)
20 (500)	1.18 (30.0)	27.5 (699.0)	25.0 (635.0)	20	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	30.5 (775.0)	27.0 (685.8)	24	1.38 (34.9)	1.18 (30.0)	27.75 (705.0)	25.25 (641.4)	16	1.00 (25.4)
24 (600)	1.18 (30.0)	32.06 (813.0)	29.5 (749.3)	20	1.38 (34.9)	1 1/4 - 7 UNC	1.18 (30.0)	36.0 (914.0)	32.0 (812.8)	24	1.62 (41.3)	1.18 (30.0)	32.5 (826.0)	29.75 (755.7)	16	1.25 (31.8)
30 (750)	1.26 (32.0)	38.75 (984.0)	36.0 (914.4)	28	1.38 (34.9)	1 1/4 - 7 UNC	1.26 (32.0)	43.0 (1092.0)	39.25 (997.0)	28	2.00 (50.8)	1.26 (32.0)	39.25 (997.0)	36.5 (927.1)	20	1.38 (34.9)

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	Metric Series Conforms to I.S.O. 2084-1974 Table PN10 Holes to I.S.O. /R-273					Metric Series Conforms to I.S.O. 2084-1974 Table PN16 Holes to I.S.O. /R-273					J.I.S. Standard B-2212 Conforms to J.I.S. 10Kg/cm				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.59 (15.0)	4.92 (125.0)	3.54 (90.0)	4	0.75 (19.0)
1.25 (32)	0.63 (16.0)	5.51 (140.0)	3.94 (85.0)	4	0.71 (18.0)	0.63 (16.0)	5.51 (140.0)	3.94 (100.0)	4	0.71 (18.0)	0.59 (15.0)	5.31 (135.0)	3.94 (100.0)	4	0.75 (19.0)
1.5 (40)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.59 (15.0)	5.51 (140.0)	4.13 (105.0)	4	0.75 (19.0)
2 (50)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.63 (16.0)	6.10 (155.0)	4.72 (120.0)	4	0.75 (19.0)
2.5 (65)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	6.89 (175.0)	5.51 (140.0)	4	0.75 (19.0)
3 (80)	0.79 (20.0)	7.87 (200.0)	6.3 (160.0)	8	0.71 (18.0)	0.79 (20.0)	7.87 (200.0)	6.30 (160.0)	8	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.91 (150.0)	8	0.75 (19.0)
3.5 (90)	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	0.71 (18.0)	7.68 (195.0)	6.30 (160.0)	8	0.75 (19.0)
4 (100)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.71 (18.0)	8.27 (210.0)	6.89 (175.0)	8	0.75 (19.0)
5 (125)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.79 (20.0)	9.84 (250.0)	8.27 (210.0)	8	0.91 (23.0)
6 (150)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.02 (280.0)	9.45 (240.0)	8	0.91 (23.0)
8 (200)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	8	0.87 (22.0)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	12	0.87 (22.0)	0.87 (22.0)	12.99 (330.0)	11.42 (290.0)	12	0.91 (23.0)
10 (250)	1.02 (26.0)	15.55 (395.0)	13.78 (350.0)	12	0.87 (22.0)	1.02 (26.0)	15.94 (405.0)	13.98 (355.0)	12	1.02 (26.0)	0.95 (24.0)	15.75 (400.0)	13.98 (355.0)	12	0.98 (25.0)
12 (300)	1.02 (26.0)	17.52 (445.0)	15.75 (400.0)	12	0.87 (22.0)	1.02 (26.0)	18.11 (460.0)	16.14 (410.0)	12	1.02 (26.0)	0.95 (24.0)	17.52 (445.0)	15.75 (400.0)	16	0.98 (25.0)
14 (350)	1.10 (28.0)	19.88 (505.0)	18.11 (460.0)	16	0.87 (22.0)	1.10 (28.0)	20.47 (520.0)	18.50 (470.0)	16	1.02 (26.0)	1.02 (26.0)	19.29 (490.0)	17.52 (445.0)	16	0.98 (25.0)
16 (400)	1.18 (30.0)	22.24 (565.0)	20.28 (515.0)	16	1.02 (26.0)	1.18 (30.0)	22.83 (580.0)	20.67 (525.0)	16	1.18 (30.0)	1.10 (28.0)	22.05 (560.0)	20.08 (510.0)	16	1.06 (27.0)
18 (450)	1.18 (30.0)	24.21 (615.0)	22.24 (565.0)	20	1.02 (26.0)	1.18 (30.0)	25.20 (640.0)	23.03 (585.0)	20	1.18 (30.0)	1.18 (30.0)	24.41 (620.0)	22.24 (565.0)	20	1.06 (27.0)
20 (500)	1.18 (30.0)	26.38 (670.0)	24.41 (620.0)	20	1.02 (26.0)	1.18 (30.0)	28.15 (715.0)	25.59 (650.0)	20	1.30 (33.0)	1.18 (30.0)	26.57 (675.0)	24.41 (620.0)	20	1.06 (27.0)
24 (600)	1.18 (30.0)	30.71 (780.0)	28.54 (725.0)	20	1.18 (30.0)	1.18 (30.0)	33.07 (840.0)	30.31 (770.0)	20	1.42 (36.0)	1.18 (30.0)	31.30 (795.0)	28.74 (730.0)	24	1.30 (33.0)
30 (750)	1.26 (32.0)	37.99 (965.0)	35.43 (900.0)	24	1.30 (33.0)	1.26 (32.0)	38.19 (970.0)	35.43 (900.0)	24	1.42 (36.0)	1.26 (32.0)	38.19 (970.0)	35.07 (900.0)	24	1.30 (33.0)

Drilling Chart for Bolting Requirements

Table 5:	Standard Drilling for PROCO Rubber Expansion Joints					Thickness of Materials for PROCO Rubber Expansion Joints			Control Unit Plate Detail	
	Flange Dimensions [2]					Material Thickness [1] for Bolt Length Requirements				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Flange O.D. Inch / (mm)	Bolt Circle Inch / (mm)	Number Of Holes	Size Of Holes Inch / (mm)	Bolt Hole Thread	Nominal Flange/ Beaded End Thickness Inch / (mm) (Approx. Value)	Adjacent Mating [3] Flange Thickness	Max. Control [4] Rod Plate Thickness Inch / (mm)	Control Rod [6] Plate O.D. Inch / (mm)	Maxi-mum [7] Rod Diameter Inch / (mm)
1 (25)	**4.25 (108.0)**	**3.13** (79.50)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)	CUSTOMER TO SPECIFY MATING FLANGE THICKNESS	**0.375** (9.53)	**8.375** (215.9)	**0.625** (15.9)
1.25 (32)	**4.63** (118.0)	**3.5** (88.90)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)		**0.375** (9.53)	**8.750** (222.3)	**0.625** (15.9)
1.5 (40)	**5.0** (127.0)	**3.88** (98.55)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)		**0.375** (9.53)	**9.125** (231.8)	**0.625** (15.9)
2 (50)	**6.00** (152.00)	**4.75** (120.65)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**10.125** (257.2)	**0.625** (15.9)
2.5 (65)	**7.00** (178.00)	**5.50** (139.70)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**11.125** (282.6)	**0.625** (15.9)
3 (80)	**7.50** (191.00)	**6.00** (152.40)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**11.625** (295.3)	**0.625** (15.9)
3.5 (90)	**8.5** (216.0)	**7.0** (177.80)	**8**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**12.625** (320.7)	**0.625** (15.9)
4 (100)	**9.00** (229.00)	**7.50** (190.50)	**8**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**13.125** (333.4)	**0.625** (15.9)
5 (125)	**10.00** (254.00)	**8.50** (215.90)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.500** (12.70)	**14.125** (358.8)	**0.625** (15.9)
6 (150)	**11.00** (279.00)	**9.50** (241.30)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.500** (12.70)	**15.125** (384.2)	**0.625** (15.9)
8 (200)	**13.50** (343.00)	**11.75** (298.45)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.750** (19.05)	**19.125** (485.8)	**1.000** (25.4)
10 (250)	**16.00 (406.00)**	**14.25** (361.95)	**12**	**1.000** (25.40)	**7/8-9 UNC**	**1.50** (38.10)		**0.750** (19.05)	**21.625** (549.3)	**1.000** (25.4)
12 (300)	**19.00** (483.00)	**17.00** (431.80)	**12**	**1.000** (25.40)	**7/8-9 UNC**	**1.50** (38.10)		**0.750** (19.05)	**24.625** (625.5)	**1.000** (25.4)
14 (350)	**21.00** (533.00)	**18.75** (476.25)	**12**	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**26.625** (676.3)	**1.000** (25.4)
16 (400)	**23.50** (597.00)	**21.25** (539.75)	**16**	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**30.125** (765.2)	**1.250** (31.8)
18 (450)	**25.00** (635.00)	**22.75** (577.85)	**16**	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**31.625** (803.3)	**1.250** (31.8)
20 (500)	**27.50** (699.00)	**25.00** (635.00)	**20**	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**34.125** (866.8)	**1.250** (31.8)
24 (600)	**32.00** (813.00)	**29.50** (749.30)	**20**	**1.375** (34.93)	—	**2.00** (50.80)		**1.000** (25.40)	**38.625** (981.1)	**1.250** (31.8)
30 (750)	**38.75** (984.00)	**36.00** (914.40)	**28**	**1.375** (34.93)	—	**2.00** (50.80)		**1.250** (31.75)	**46.375** (1177.9)	**1.500** (38.1)

Metric Conversion Formula: Nominal I.D.: in. x 25 = mm; Dimensions/ Thickness': in. x 25.4 = mm.

Notes:

1. *Limit/Control Rod length is determined by neutral length of rubber expansion joint, rated extension, control rod plate thickness, mating flange thickness and number of nuts. Consult PROCO for rod lengths.*
2. *Flange Dimensions shown are in accordance with ANSI B16.1 and ANSI B16.5 Class 125/150, AWWA C-207-07, Tbl 2 and 3 - Class D, Table 4 - Class E. Hole size shown is 1/8" larger than AWWA Standard.*
3. *Adjacent mating flange thickness is required to determine overall rod length and compression sleeve length (if required).*
4. *Plate thickness is based on a maximum width PROCO would use to design a Limit/Control Rod plate.*
5. *Flat Washers required at ring splits and are supplied by others.*
6. *Control rod plate O.D. installed dimension is based on a maximum O.D. Proco would supply.*
7. *Control rod diameter is based on a maximum diameter Proco would use to design a control rod.*

A - Flange/Beaded End Thickness (Approximated Figure)
B - Adjacent Mating Flange Thickness (By Others)
C - Control Unit Plate Thickness
D - Double Nut Thickness is determined by Control Rod Diameter
E - Control Rod Bolt Length is determined by A through E + OAL [1]
F - Control Rod Control Rod Plate O.D.
G - Maximum Rod Diameter

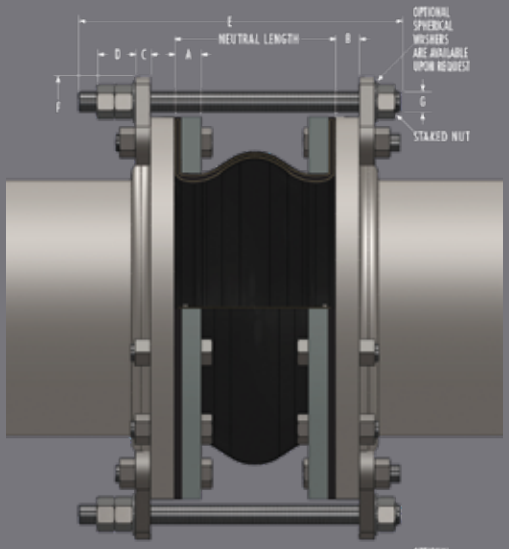


Figure 1
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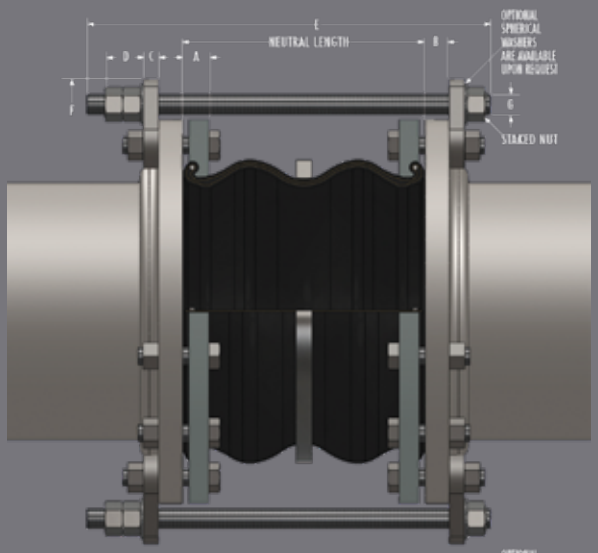

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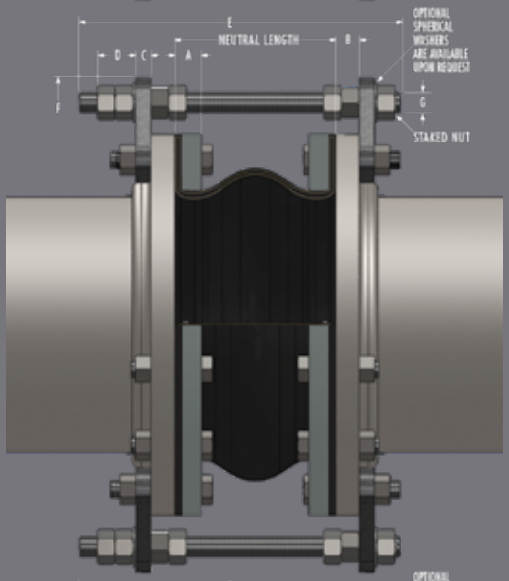

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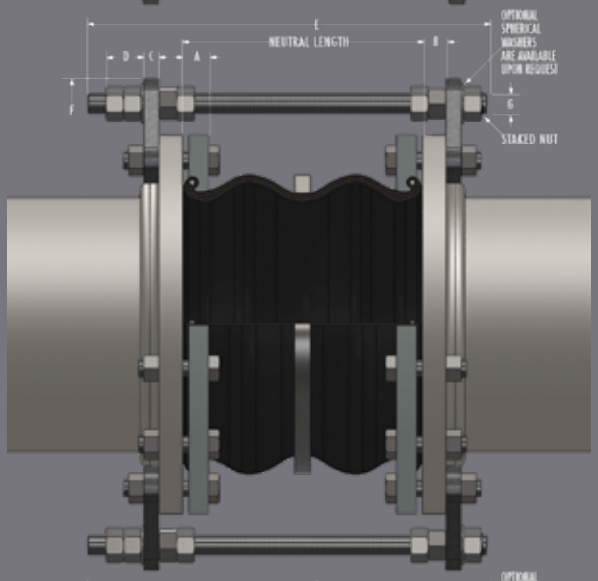

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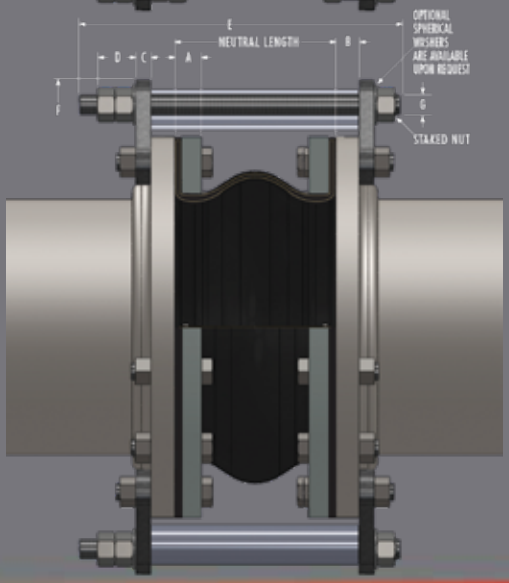

Figure 3
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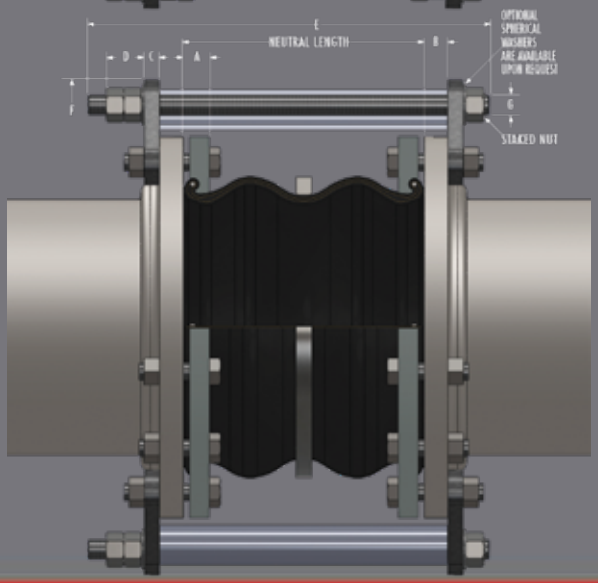

Figure 3
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Use of Control Units with Rubber Expansion Joints

Definition

A control unit assembly is a system of two or more control rod units (limit rods, tie rods or compression sleeves) placed across an expansion joint from flange to flange to minimize possible damage caused by excessive motion of a pipeline. The control unit assemblies can be set at the maximum allowable expansion and/or contraction of the rubber expansion joint. When used in this manner, control units are an additional safety factor and can minimize possible damage to adjacent equipment.

Rubber expansion joints should be installed between two fixed anchor points in a piping system. The pipe system must be rigidly anchored on both sides of the expansion joint to control expansion or contraction of the line. Piping anchors must be capable of withstanding the line thrusts generated by internal pressure or wide temperature fluctuations.

When proper anchoring cannot be provided, **CONTROL UNITS ARE REQUIRED.** For un-anchored piping systems nuts shall be tightened snug against rod plate to prevent over-extension due to pressure thrust created by expansion joint. Refer to "Thrust Factor" in Table 2, note 5 in this manual. Please also see Table 7 for number of control rods recommended based on maximum serge for test pressure of the system

Listed below are three (3) control unit configurations supplied by PROCO and are commonly used with rubber expansion joints in piping systems.

Figure 1

Known as a **LIMIT ROD**, this control unit configuration will allow an expansion joint to extend to a predetermined extension setting. Nuts shall be field-set to no more than the maximum allowable extension movement of a rubber expansion joint (unless used in an un-anchored system). Refer to Table 2 in this manual for allowable movement capabilities. Spherical washers can also be furnished (upon request) to combat any "nut-to-plate" binding during offset. ***Consult the systems engineer for proper nut settings prior to system operation.***

Figure 2

Known as a **LIMIT/CONTROL ROD**, this control unit configuration is used to allow specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint axial extension) movements. Nuts shall be field set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) or compression of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. Internal and external nuts can also be field-set to allow for no movement in the horizontal plane. This setting will allow the rubber to move laterally while keeping expansion joint thrust forces low on adjacent equipment. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Limit/Control rods with internal nuts must be specified at the time of inquiry. Consult the systems engineer for proper nut settings prior to system operation.***

Figure 3

Known as a **COMPRESSION SLEEVE**, this configuration is used to allow for specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint extension) movements. Nuts shall be field-set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. PROCO will manufacture each compression sleeve to allow for no axial movement unless otherwise specified by the purchaser. Compression sleeves shall be field-trimmed to meet required allowable axial movement as set forth by system requirements. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Consult the systems engineer for proper sleeve lengths prior to system operation.***

Important Control Unit Considerations

The number of rods, control rod diameters and control rod plate thicknesses are important considerations when specifying control units for an application. As a minimum, specifying engineers or purchasers shall follow the guidelines as set forth in Appendix C of the Fluid Sealing Association's Technical Handbook, Seventh Edition. PROCO engineers its control unit assemblies to system requirements. Our designs incorporate an allowable stress of 65% of material yield for each rod and plate (rod and plate material to be specified by purchaser). Therefore, it is important to provide pressure and temperature ratings to PROCO when requesting control units for rubber expansion joints. It is also important to provide adjacent mating flange thickness or mating specifications to ensure correct rod lengths are provided.

Installation Instructions for Limit Rods

1. Assemble expansion joint between pipe flanges in its manufactured face-to-face length.

2. Assemble control rod plates behind pipe flanges as shown. Flange bolts or all-thread studs through the control rod plate must be longer to accommodate the plate thickness. Control rod plates should be equally spaced around the flange. Depending upon the size and pressure rating of the system, 2, 3, 4, or more control/limit rods may be required. Refer to Table 4 in this manual or to the Fluid Sealing Association's Technical Handbook, Seventh Edition, for control rod pressure ratings.

3. Insert control/limit rods through top plate holes. Steel flat washers are to be positioned at outer plate surface.

4. If a single nut per unit is furnished, position this nut so that there is a gap between the nut and the steel flat washer. This gap is equal to the joint's maximum extension (commencing with the nominal face-to-face length). To lock this nut in position, either "stake" the thread in two places or tack weld the nut to the rod. If two nuts are supplied, the nuts will create a "jamming" effect to prevent loosening. (Nuts should be snug against the flat washer and control rod plate when piping system is un-anchored.)

Note: Consult the manufacturer if there are any questions as to the rated compression and elongation. These two dimensions are critical in setting the nuts and sizing the compression pipe sleeve (if supplied).

5. If there is a requirement for compression pipe sleeves, an ordinary pipe may be used, sized in length to allow the joint to be compressed to its normal limit.

6. If there is a requirement for optional spherical washers, these washers are to be positioned at the inner and/or outer plate surface and backed up by movable double nuts.

Figure 1
Style 240

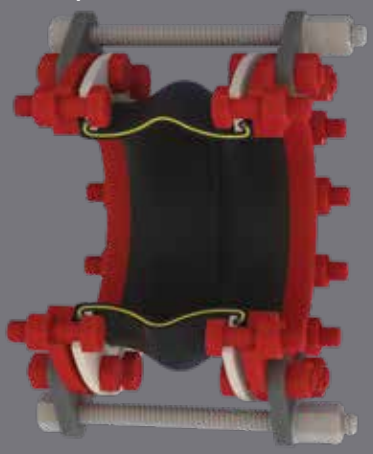

Figure 1
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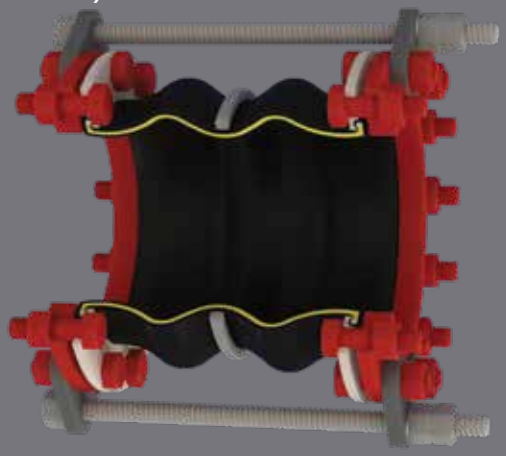

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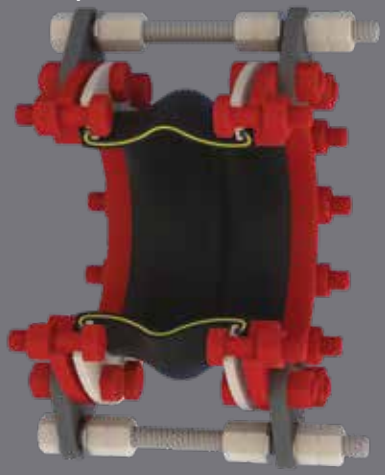

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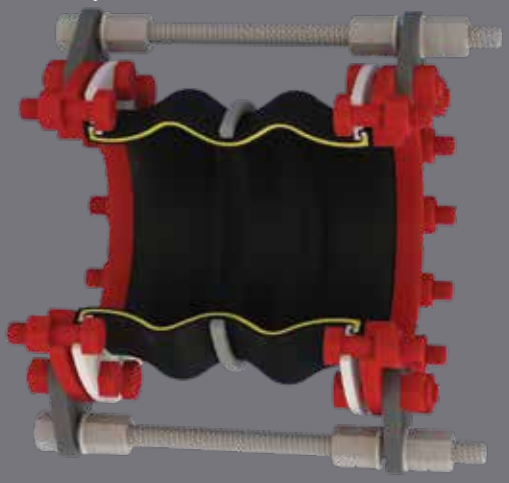

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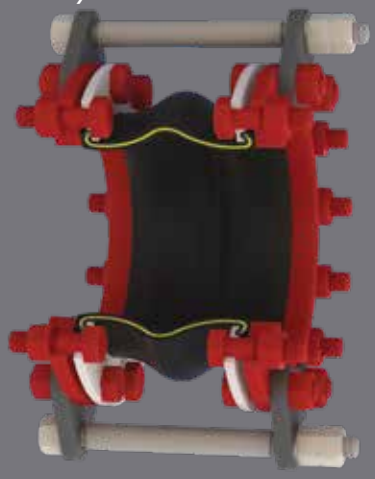

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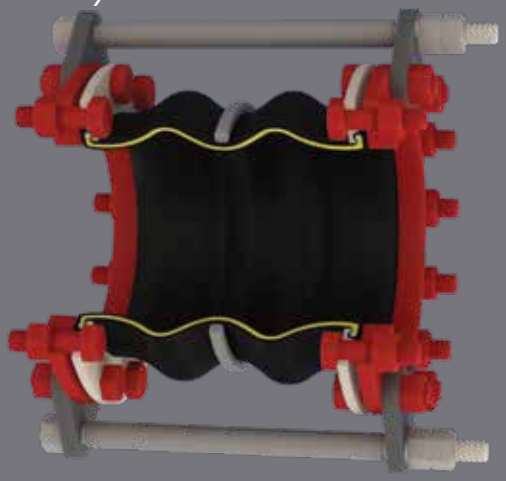


Table 6: Control Units/Anchored

Control Units must be installed when pressures (test • design • surge • operating) exceed rating below:

Pipe Size	Series 240 P.S.I.G.	Series 242 P.S.I.G.
1″ thru 4″	180	135
5″ thru 10″	135	135
12″ thru 14″	90	90
16″ thru 24″	45	45
30″	35	35

Table 7:

Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Maximum Surge or Test Pressure of the System — Number of Control Rods Recommended			
		2	4	6	8
1	(25)	949	•	•	•
1.25	(32)	830	•	•	•
1.5	(40)	510	•	•	•
2	(50)	661	•	•	•
2.5	(65)	529	•	•	•
3	(75)	441	•	•	•
4	(100)	311	622	•	•
5	(125)	235	470	•	•
6	(150)	186	371	•	•
8	(200)	163	326	•	•
10	(250)	163	325	488	•
12	(300)	160	320	481	•
14	(350)	112	223	335	•
16	(400)	113	227	340	453
18	(450)	94	187	281	375
20	(500)	79	158	236	315
24	(600)	74	147	221	294
30	(750)	70	141	211	281

Note:
Pressures listed above do not relate to the actual design pressure of the expansion joint products, but are the maximum surge or pressure for a specific control rod nominal pipe size.

Installation Instructions for Non-Metallic Expansion

1. Service Conditions:

Make sure the expansion joint rating for temperature, pressure, vacuum*, movements and selection of elastomeric materials match the system requirements. Contact the manufacturer if the system requirements exceed those of the expansion joint selected. (*Vacuum service for spherical rubber connectors: Vacuum rating is based on neutral installed length. These products should not be installed "extended" on vacuum applications.)

2. Alignment:

Expansion joints are not designed to make up for piping misalignment errors. Piping misalignment should be no more than 1/8" in any direction. Misalignment of an expansion joint will reduce the rated movements and can induce severe stress of the material properties, thus causing reduced service life or premature failure.

3. Anchoring:

Expansion joints should be located as close as possible to anchor points with proper pipe guides. Install expansion joints only on straight runs between anchors. It is recommended that control rods be installed on the expansion joint to prevent excessive movements from occurring due to pressure thrust of the line.

4. Pipe Support:

Piping must be supported so expansion joints do not carry any pipe weight.

5. Mating Flanges:

Install the expansion joint against the mating pipe flanges and install bolts so that the bolt head is against the expansion joint flange. Flange-to-flange dimension of the expansion joint must match the breech opening*. (*A spherical rubber connector must be pre-compressed 1/8" to 3/16" during installation in order to obtain a correct installed face-to-face dimension.)

Make sure the mating flanges are clean and are a flat-faced type. When attaching beaded end flange expansion joints to raised face flanges, the use of composite gaskets are required to prevent metal flange faces from cutting rubber bead during installation.

Never install expansion joints next to wafer type check or butterfly valves.

6. Bolting Torque:

Table 8 shows the recommended torque values for non-metallic expansion joints with beaded end type-flanges: Tighten bolts in stages by alternating around the flange. Use the recommended torque values in Table 8 to achieve a good seal. Never tighten an expansion joint to the point that there is metal-to-metal contact between the expansion joint flanges and the mating flanges. A slight bulge in the rubber beaded end should create a flush tight seal.
Note: Torque values are approximate due to mating flange surfaces, installation offsets, operating pressures and environmental conditions.

7. Storage:

Ideal storage is in a warehouse with a relatively dry, cool location. Store flanges face down on a pallet or wooden platform. Do not store other heavy items on top of the expansion joints. Ten year shelf life can be expected with ideal conditions. If storage must be outdoors, place on a wooden platform and joints should not be in contact with the ground. Cover with a tarpaulin.

8. Large Joint Handling:

Do not lift with ropes or bars through the bolt holes. If lifting through the bore, use padding or a saddle to distribute the weight. Make sure cables or forklift tines do not contact the rubber. Do not let expansion joints sit vertically on the edges of the flanges for any period of time.

9. Additional Tips:

A. Do not insulate/cover over a rubber expansion joint. This prevents inspection of the tightness of the joint bolting.
B. It is acceptable (but not necessary) to lubricate the expansion joint beaded end with a thin film of graphite dispersed in glycerin or water at time of installation to prevent damage.
C. Do not weld in the near vicinity of a non-metallic joint.
D. If expansion joints are to be installed underground, or will be submerged in water, contact manufacturer for specific recommendations.
E. If the expansion joint will be installed outdoors, make sure the cover material will withstand ozone, sunlight, etc.
F. Check the tightness of flanges two or three weeks after installation and retighten if necessary. Refer to Notes in Para 6. Bolting Torque.
G. Expansion joint installation should be conducted by an authorized and qualified pipe fitter.
H. While all Proco expansion joints are guaranteed for a period of one year and designed for many years of service, it is suggested that expansion joints be routinely inspected based on service conditions.

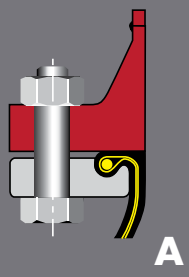
Warning: Expansion joints may operate in pipelines or equipment carrying fluids and/or gasses at elevated temperature and pressures and may transport hazardous materials. Precautions should be taken to protect personnel in the event of leakage or splash. Rubber joints should not be installed in areas where inspection is impossible. Make sure proper drainage is available in the event of leakage when operating personnel are not available.

Joints with Beaded End Flanges

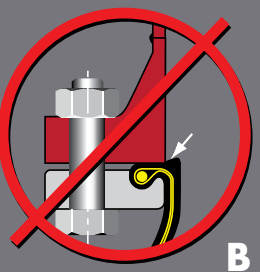
Table 8:	Bolt-Torque				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Step 1 FT-LBS (Nm)	Rest	Step 2 FT-LBS (Nm)	Rest	Step 3 FT-LBS (Nm)
1 (25)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.25 (32)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.5 (40)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2 (50)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2.5 (65)	18 (25)	30 Min	35 (50)	60 Min	50-60 (70-80)
3 (80)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
3.5 (90)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
4 (100)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
5 (125)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
6 (150)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
8 (200)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
10 (250)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
12 (300)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
14 (350)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
16 (400)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
18 (450)	30 (40)	30 Min	60 (80)	60 Min	90-95 (120-130)
20 (500)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
24 (600)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
30 (750)	30 (40)	30 Min	65 (90)	60 Min	95-220 (130-300)

Note: Bolt torque based on new bolts and nuts

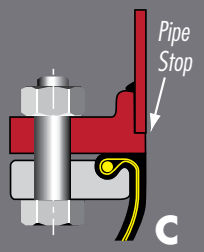
Right: Weld neck flanges with correct ID prevent damage to rubber.



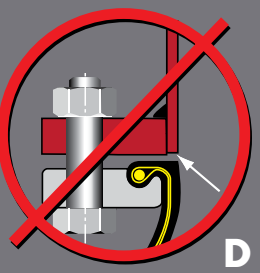
Wrong: Insure mating flange I.D. is flush with rubber.



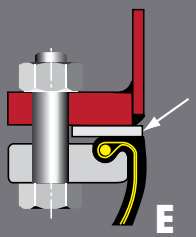
Right: Flanges with correct ID help prevent damage to rubber.



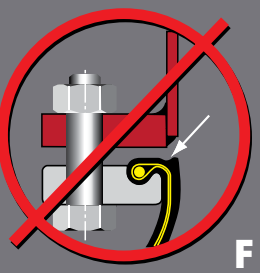
Wrong: Uneven end of pipe can cause damage to rubber.



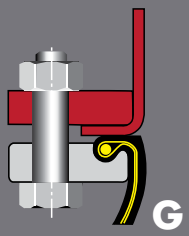
Right: In case of B, D, F an additional metal gasket can be used to prevent damage to rubber.



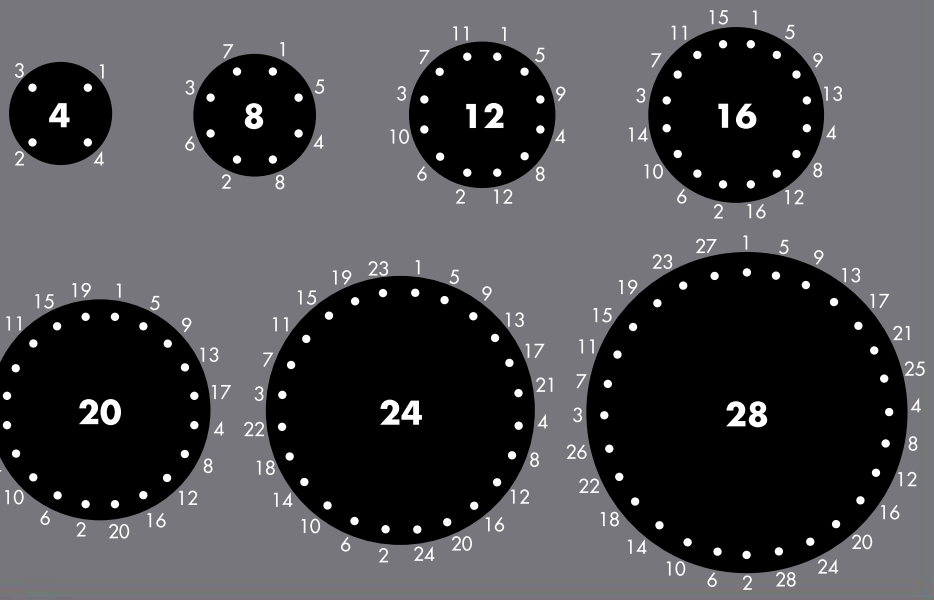
Wrong: Inner edge of flanges damages rubber.

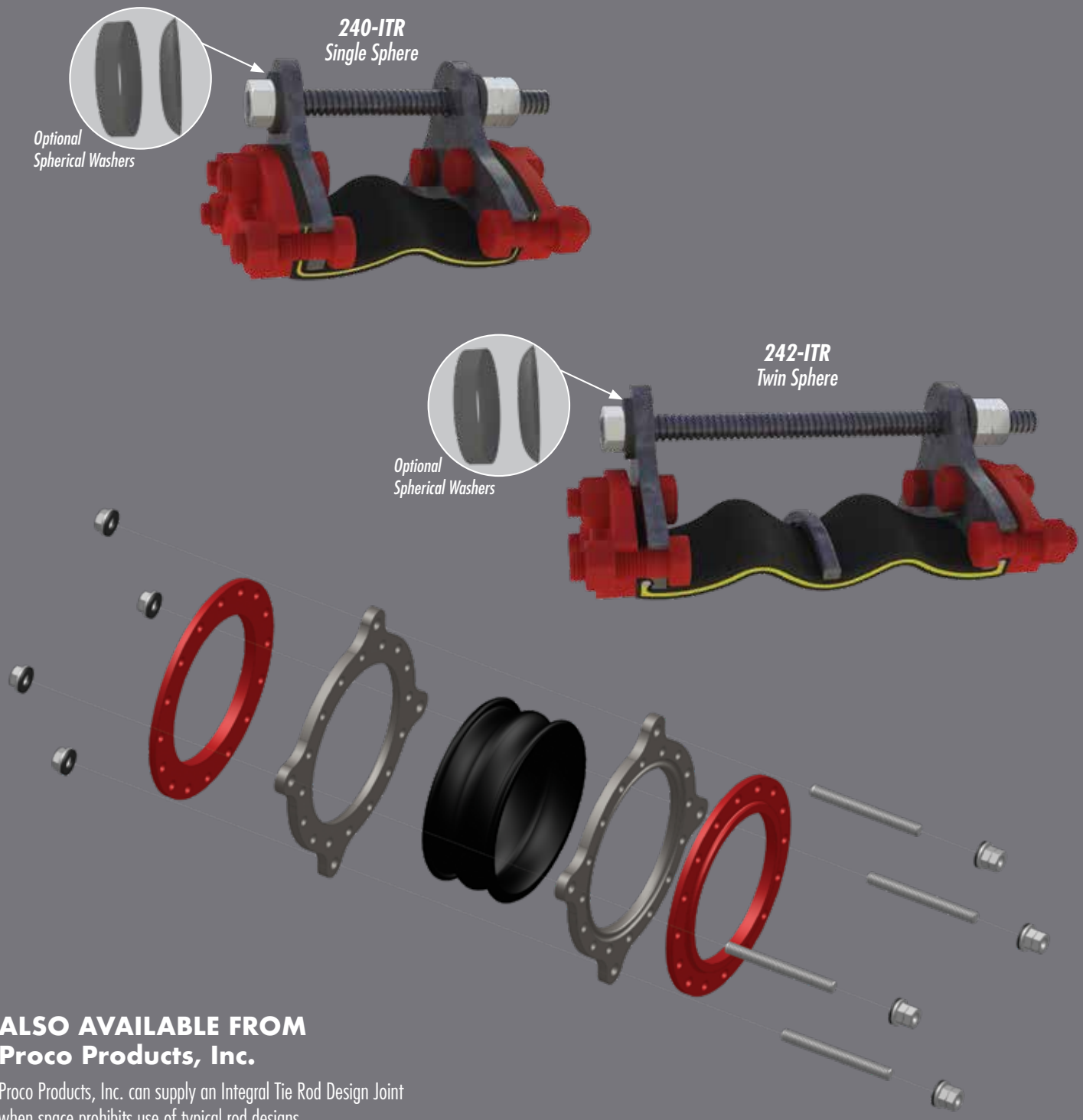


Right: Well rounded smooth edge prevents damage to rubber.



Tighten opposing nuts/bolts gradually according to the following sequence





ALSO AVAILABLE FROM
Proco Products, Inc.

Proco Products, Inc. can supply an Integral Tie Rod Design Joint when space prohibits use of typical rod designs.

PROCO PRODUCTS, INC.

2431 North Wigwam Dr. (95205)
P.O. Box 590 • Stockton, CA
95201-0590 • USA

Toll-Free Phone: (800) 344-3246 NATIONWIDE AND CANADA

Facsimile: (209) 943-0242

(209) 943-6088 INTERNATIONAL

email: sales@procoproducts.com

website: http://www.procoproducts.com

American Water Works Association

IDCO Industrial Distributor Co-op

NAHAD Charter Listed Member SAFETY - QUALITY - RELIABILITY

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ANSI American National Standards Institute MEMBER

UL CERTIFIED MH47689

Water Environment Federation® Preserving & Enhancing the Global Water Environment MEMBER

Cooling Technology Institute CTI EST. 1950 MEMBER ©

REPRESENTED BY:

Revised 4/19

1 Willow Avenue
Oakdale, PA 15071
p. 724-703-3020
f. 724-703-3026

Title: EA Engineering Attn: Alexander Spiller AOI-1

Report Basis

Flow Rate	245 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	1,500.000 ug/l
trichloroethylene	74.000 ug/l
cisdichloroethylene	490.000 ug/l
transdichloroethylene	3.700 ug/l
benzene	7.800 ug/l
toluene	13.000 ug/l
ethyl benzene	5.900 ug/l
xylene	21.000 ug/l
cyclohexane	2.300 ug/l
heptane	3.200 ug/l
hexane	3.600 ug/l

Report: 150.94 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 30.983 lbs./100 lbs. Carbon

Note: Contact TIGG Corporation if comments are needed on preferential adsorption of contaminants above.

Run 1

Report Basis

Flow Rate	245 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	1,500.000 ug/l
trichloroethylene	74.000 ug/l
cisdichloroethylene	490.000 ug/l
transdichloroethylene	3.700 ug/l
benzene	7.800 ug/l
toluene	13.000 ug/l
ethyl benzene	5.900 ug/l
xylene	21.000 ug/l
cyclohexane	2.300 ug/l
heptane	3.200 ug/l
hexane	3.600 ug/l

Band	Chemicals	Y	LBS/100 LBS Carbon	Overall LBS/100 LBS Carbon
1	perchloroethylene	0.59	42.120	42.120
	trichloroethylene	0.04	0.178	0.178
	cisdichloroethylene	0.33	0.187	0.187
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.019	0.019
	toluene	0.01	0.251	0.251
	ethyl benzene	0.00	0.424	0.424
	xylene	0.01	2.585	2.585
	cyclohexane	0.00	0.005	0.005
	heptane	0.00	0.040	0.040
	hexane	0.00	0.007	0.007
	17.886 Pounds Carbon Per Day			
2	perchloroethylene	0.60	46.102	43.613
	trichloroethylene	0.04	0.188	0.182
	cisdichloroethylene	0.33	0.194	0.190
	transdichloroethylene	0.00	0.001	0.001

	benzene	0.01	0.020	0.019
	toluene	0.01	0.272	0.259
	ethyl benzene	0.00	0.504	0.454
	xylene	0.00	0.000	1.615
	cyclohexane	0.00	0.006	0.006
	heptane	0.00	0.043	0.041
	hexane	0.00	0.008	0.007
	28.615 Pounds Carbon Per Day			
3	perchloroethylene	0.61	46.844	45.568
	trichloroethylene	0.04	0.189	0.186
	cisdichloroethylene	0.33	0.195	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.020	0.020
	toluene	0.01	0.275	0.269
	ethyl benzene	0.00	0.000	0.179
	xylene	0.00	0.000	0.638
	cyclohexane	0.00	0.006	0.006
	heptane	0.00	0.043	0.042
	hexane	0.00	0.008	0.007
	72.461 Pounds Carbon Per Day			
4	perchloroethylene	0.00	0.000	45.339
	trichloroethylene	0.04	0.255	0.187
	cisdichloroethylene	0.34	0.236	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.028	0.020
	toluene	0.60	24.935	0.393
	ethyl benzene	0.00	0.000	0.178
	xylene	0.00	0.000	0.635
	cyclohexane	0.00	0.008	0.006
	heptane	0.00	0.099	0.043
	hexane	0.00	0.011	0.007
	72.827 Pounds Carbon Per Day			
5	perchloroethylene	0.00	0.000	45.217
	trichloroethylene	0.05	0.339	0.187
	cisdichloroethylene	0.40	0.264	0.193
	transdichloroethylene	0.00	0.001	0.001
	benzene	0.01	0.039	0.020

	toluene	0.00	0.000	0.392
	ethyl benzene	0.00	0.000	0.178
	xylene	0.00	0.000	0.633
	cyclohexane	0.00	0.011	0.006
	heptane	0.53	20.116	0.096
	hexane	0.00	0.016	0.007
	73.022 Pounds Carbon Per Day			
6	perchloroethylene	0.00	0.000	43.995
	trichloroethylene	0.19	7.730	0.391
	cisdichloroethylene	0.41	1.008	0.215
	transdichloroethylene	0.00	0.004	0.001
	benzene	0.26	7.744	0.229
	toluene	0.00	0.000	0.381
	ethyl benzene	0.00	0.000	0.173
	xylene	0.00	0.000	0.616
	cyclohexane	0.03	0.990	0.032
	heptane	0.00	0.000	0.094
	hexane	0.10	3.406	0.099
	75.050 Pounds Carbon Per Day			
7	perchloroethylene	0.00	0.000	43.968
	trichloroethylene	0.19	6.886	0.395
	cisdichloroethylene	0.45	0.947	0.216
	transdichloroethylene	0.00	0.004	0.001
	benzene	0.00	0.000	0.229
	toluene	0.00	0.000	0.381
	ethyl benzene	0.00	0.000	0.173
	xylene	0.00	0.000	0.616
	cyclohexane	0.03	0.734	0.033
	heptane	0.00	0.000	0.094
	hexane	0.33	9.965	0.106
	75.098 Pounds Carbon Per Day			
8	perchloroethylene	0.00	0.000	43.836
	trichloroethylene	0.22	9.125	0.421
	cisdichloroethylene	0.41	1.026	0.218
	transdichloroethylene	0.00	0.005	0.001
	benzene	0.00	0.000	0.228
	toluene	0.00	0.000	0.380

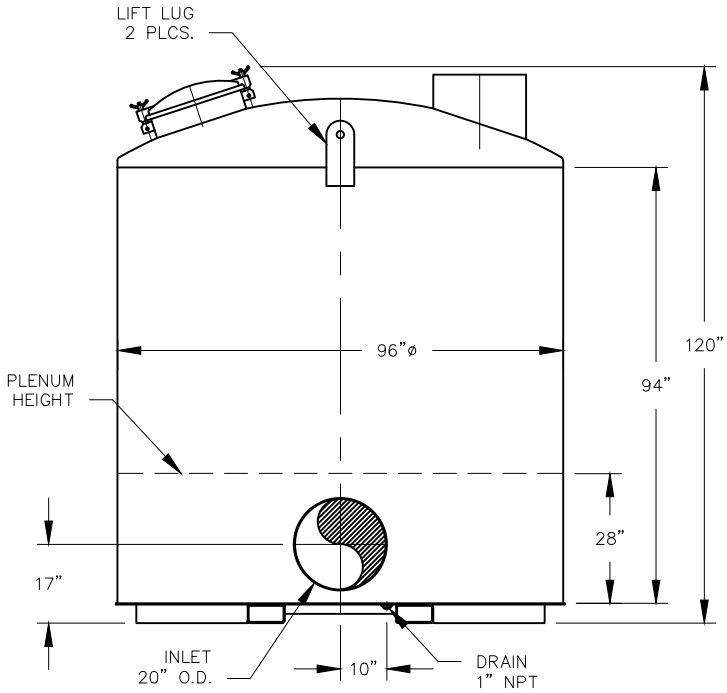
	ethyl benzene	0.00	0.000	0.172
	xylene	0.00	0.000	0.614
	cyclohexane	0.36	11.488	0.067
	heptane	0.00	0.000	0.094
	hexane	0.00	0.000	0.105
	75.324 Pounds Carbon Per Day			
9	perchloroethylene	0.00	0.000	41.330
	trichloroethylene	0.59	28.718	2.039
	cisdichloroethylene	0.40	1.146	0.271
	transdichloroethylene	0.00	0.005	0.001
	benzene	0.00	0.000	0.215
	toluene	0.00	0.000	0.358
	ethyl benzene	0.00	0.000	0.163
	xylene	0.00	0.000	0.579
	cyclohexane	0.00	0.000	0.063
	heptane	0.00	0.000	0.088
	hexane	0.00	0.000	0.099
	79.891 Pounds Carbon Per Day			
10	perchloroethylene	0.00	0.000	21.932
	trichloroethylene	0.00	0.000	1.082
	cisdichloroethylene	0.99	14.958	7.164
	transdichloroethylene	0.01	0.046	0.022
	benzene	0.00	0.000	0.114
	toluene	0.00	0.000	0.190
	ethyl benzene	0.00	0.000	0.086
	xylene	0.00	0.000	0.307
	cyclohexane	0.00	0.000	0.034
	heptane	0.00	0.000	0.047
	hexane	0.00	0.000	0.053
	150.553 Pounds Carbon Per Day			
11	perchloroethylene	0.00	0.000	21.875
	trichloroethylene	0.00	0.000	1.079
	cisdichloroethylene	0.00	0.000	7.146
	transdichloroethylene	1.00	12.390	0.054
	benzene	0.00	0.000	0.114
	toluene	0.00	0.000	0.190
	ethyl benzene	0.00	0.000	0.086

xylene	0.00	0.000	0.306
cyclohexane	0.00	0.000	0.034
heptane	0.00	0.000	0.047
hexane	0.00	0.000	0.053

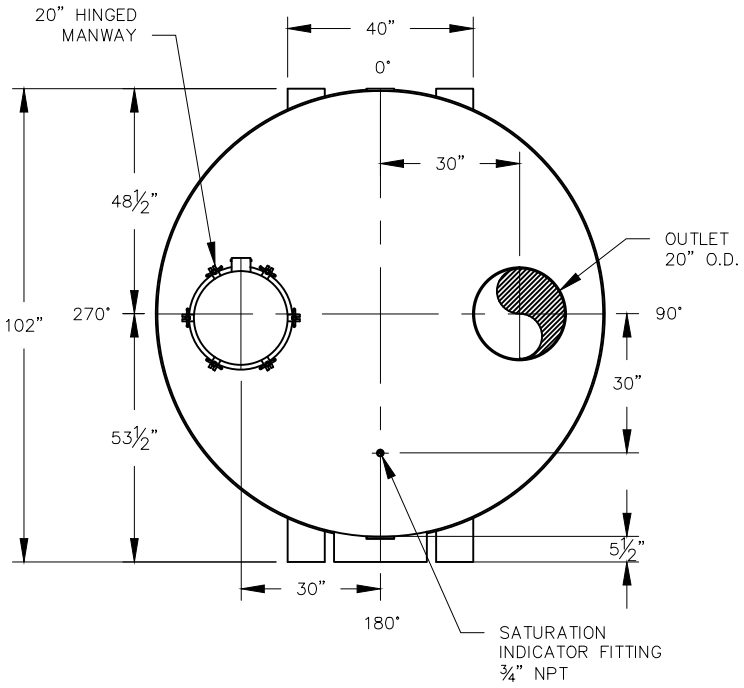
150.942 Pounds Carbon Per Day

Report: 150.94 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 30.983 lbs./100 lbs. Carbon



ELEVATION



PLAN

* STAINLESS STEEL BED RETENTION PLATE.
140°F WITH PE PLATE

VESSEL STANDARDS

VESSEL MATERIALS : SA-36	VESSEL ACCESS : 20" HINGED MANWAY
LINING : EPOXY	LIQUID DRAIN ASSEMBLY : 1" NPT W/ HDPE PLUG
EXTERIOR PAINT : EPOXY BASE W/ URETHANE TOP COAT	MAX. MEDIA FILL : 275 FT^3
HEAD THICKNESS : ¼" NOM.	SHIP WT. EMPTY : 4000 LBS
SHELL THICKNESS : ¼" NOM.	MAX. OPERATING PRESSURE : 15 PSIG
INTERNALS : STAINLESS STEEL PLENUM	MAX. OPERATING TEMPERATURE. : 180°F

NO.	REVISION	BY	DATE
3	ADD LIFT LUGS	JB	6/21/11
2	UPDATE VESSEL STANDARDS	JB	8/24/10
1	SHORTEN FORK TUBE LENGTH FOR TRANSIT	JB	10/3/09

PROJECT
N-5000-PDB

PROJ. NO.	SALES
P.O. NO.	

DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	2/23/06
SCALE	NTS

TIGG corporation

PLAN & ELEVATION

N-5000-PDB-1001 REV. 3

TIGG 5CC 0408

Virgin Vapor Phase Coconut Based Activated Carbon

www.TIGG.com

DESCRIPTION

TIGG 5CC 0408 is a granular activated carbon made from coconut shell. The combination of high activity level and selective transport and adsorption pores accommodates adsorbates of varied molecular size. This activated carbon also contains the high energy adsorption pores which are vital to attaining ultra high removal of low molecular weight volatile organic compounds.

TYPICAL PROPERTIES	TIGG 5CC 0408
U.S. Sieve, 90 wt% min	4 x 8
CCl_4 Number, min	60
Iodine Number, mg/g, min	1150
Apparent Density, (dense packing)	
g/cc	0.41 – 0.42
lbs/ft^3	26
Moisture - wt% max (as packed)	3
Hardness No. - min	98

TYPICAL APPLICATIONS

This activated carbon can be used to:

- Capture solvents
- Remove VOC's from:
  - Tank vents
  - Air stripper off gas
  - Soil venting
  - Remediation of excavated soil

Standard packaging of the activated carbon is in 55 pound bags or 1100 pound supersacks.

Wet drained activated carbon adsorbs oxygen from the air. Therefore, when workers need to enter a vessel containing wet activated carbon, they should follow confined space/low oxygen level procedures. Activated carbon dust does not present an explosion hazard.

VALTERRA

Gate Valve, Valve Class Class 125, PVC, Slip Connection Type, Pipe Size - Valves 6"

Item # **4HGE6** Mfr. Model # **6601** Catalog Page # **2889** UNSPSC # **40141613**

Web Price

$381.00 / each

1 Add to Cart

+ Add to List |

Shipping Pick

Expected to arrive **Thu. Jul 02**

Ship To 32135 (Change)

Shipping Weight **15.38 lbs.**

Country of Origin **Mexico** | *Country of Origin is subject to change.*

Note: Product availability is real-time updated and adjusted continuously. The product will be reserved for you when you complete your order. More

How can we improve our Product Images?

Compare

Product Details

Quick-opening VALTERRA gate valve provides unrestricted flow for low-pressure tank and drain applications with liquids, gases, dry/bulk solids,

View More

Technical Specs

Item	**Gate Valve**
Valve Class	**Class 125**
Body Material - Valves	**PVC**
Connection Type	**Slip**
Pipe Size - Valves	**6"**
Max. Water Pressure - CWP	**10 psi**
Valve Max. Fluid Temp.	**167 Degrees F**
Valve Stem Type	**Rising**

Top of Handle to Inlet Center	**16-27/32"**
Inlet to Outlet Length	**11-1/8"**
Stem Material	**304 Stainless Steel**
Bonnet Style	**Bonded**
Wedge Material	**304 Stainless Steel**
Handle Material	**304 Stainless Steel**
Handle Type	**Hand Wheel**
Standards	**MSS SP-70**

How can we improve our Technical Specifications?

Compliance and Restrictions

None

Alternate Search Terms

Shutoffs (4578) | Shutoff Valves (4466) | Gate Valves (435)

Customers Also Purchased

VALTERRA

Gate Valve, Valve Class Class 125, PVC, Slip Connection Type, Pipe ...

Item # 4HGE5

Web Price $129.50 / each

Qty 1 Add to Cart

GRAINGER APPROVED

Ball Valve, Brass, Inline, 2-Piece, Pipe Size 1/4", Connection Type FNPT x ...

Item # 1WMH3

Web Price $8.50 / each

Qty 1 Add to Cart

GF PIPING SYSTEMS

PVC Tee, Socket x Socket x Socket, 6" Pipe Size - Pipe Fitting

Item # 22JY30

Web Price $104.50 / each

Qty 1 Add to Cart

GF PIPING SYSTEMS

Flange, CPVC, Fitting Schedule/Class Schedule 80, 6" Pipe Size - Pipe ...

Item # 22JZ66

Web Price $109.00 / each

Qty 1 Add to Cart

GRAINGER APPROVED

Pipe, Non-Threaded, Pipe, Pipe Schedule 80, Pipe Size - Nominal ...

Item # 22FR52

Web Price $173.00 / each

Qty 1 Add to Cart

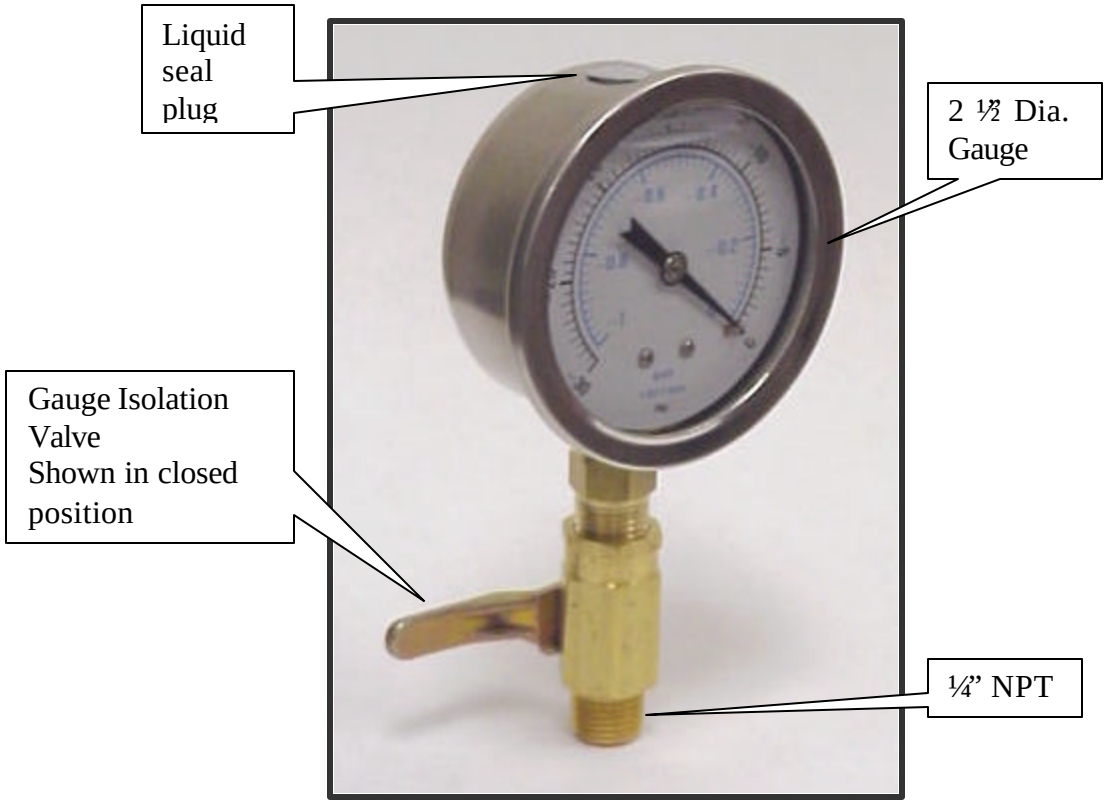
J. E. GASHO & ASSOCIATES, INC.

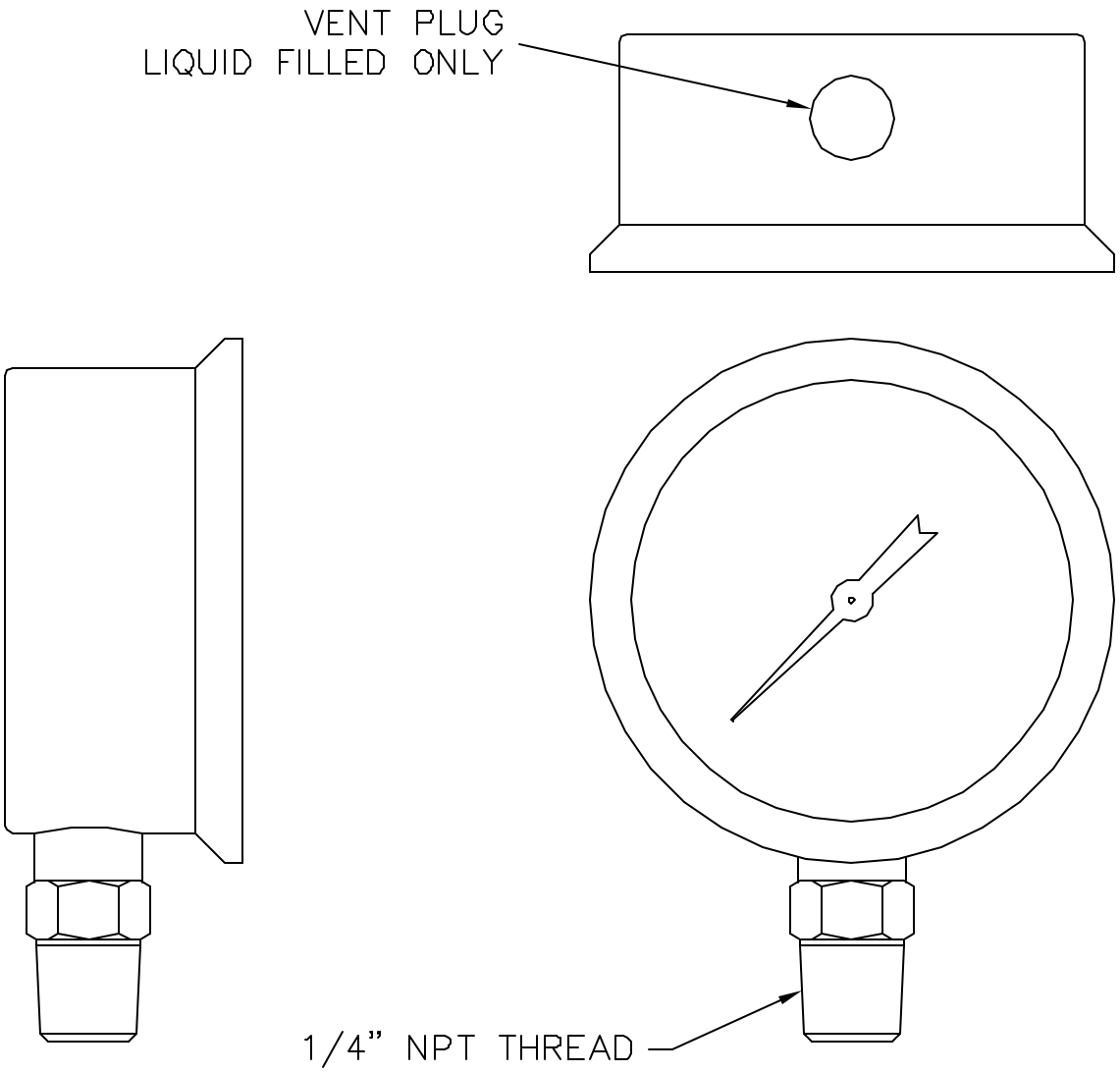
Authorized Manufacturer's Representative
Air / Gas Moving Equipment
460 W. GAY STREET
WEST CHESTER, PA 19380
PHONE: 610-692-5650 FAX: 610-692-5837

Pressure and Vacuum Gauges

We use both standard gauges and liquid filled gauges from a variety of manufacturers. Gauges are installed on our packages with gauge isolation valves (gauge cocks) part number VIS-0.25-FM-B-0000. The gauge isolation valve can be used as a snubber while reading the gauge by opening it slightly. To protect gauges from damage due to shocks or pulsations in the system, gauge isolation valves should be closed except when the gauge is being read.

Liquid filled gauges may display incorrect readings due to variations in atmospheric pressure. To determine if a gauge is subject to this condition, the liquid filled cavity should be temporarily vented to atmosphere. Most liquid filled gauges have a seal plug in the liquid filled cavity. Remove this plug to allow the cavity to be vented to atmosphere. In some instances the case can be lightly squeezed to burp it. Replace the plug.





25.0.015PSI

NOMINAL SIZE
- 25 = 2.5in
- 40 = 4.0 in.

TYPE
- 0 = NON-FILLED
- 1 = LIQUID FILLED

RANGE

NOTES:
1. WE USE BOTH STANDARD GAUGES & LIQUID FILLED GAUGES FROM A VARIETY OF MANUFACTURERS
2. STANDARD RANGES:
   - PRESSURE: 0-6 PSI & 0-160 IWC
     0-15 PSI
     0-30 PSI
   - VACUUM: 0-12 IN. HG. & 0-160 IWC
     0-30 IN., HG.

REV.	DATE	DESCRIPTION

DRAWN BY: M. WITTE	DATE 8-18-00
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE	
TOLERANCE	ANGULAR TOLERANCE
MATERIAL	WEIGHT
SHEET 1 OF 1	

J. E. GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

PRESSURE GAUGE NUMBERING SYSTEM

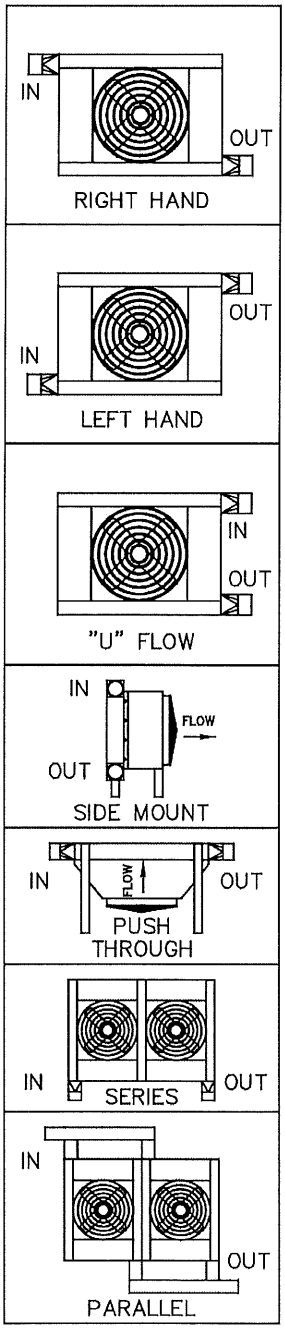
—

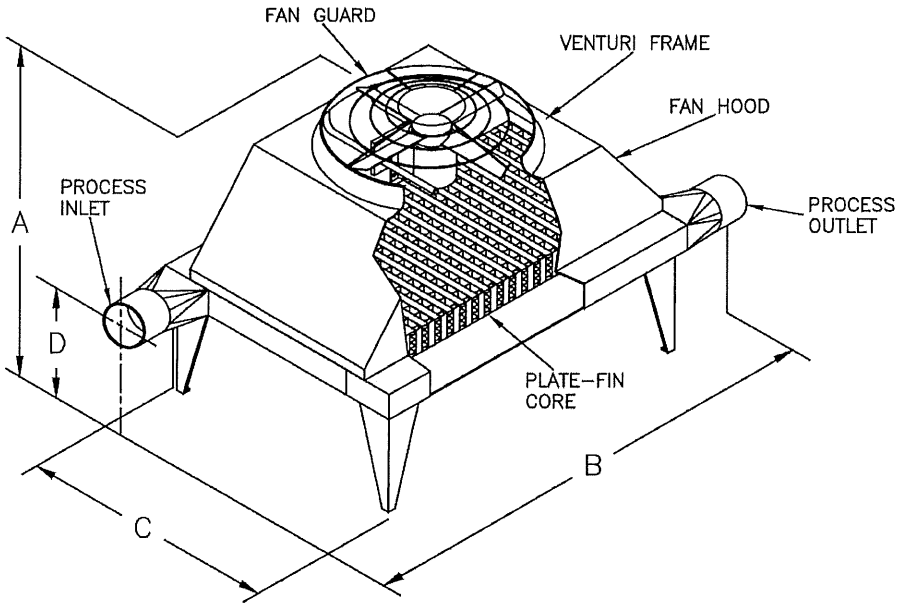
INDUSTRIAL HEAT EXCHANGERS
XCHANGER

1401 7th STREET S.
HOPKINS, MN 55343
952-933-2559
XCHANGER.COM

AA Series Heat Exchanger

AA Series exchangers cool low pressure air streams using fan-drafted ambient air. Air flows to 3,500 CFM from vacuum to 75 PSI can be cooled near ambient, with under 0.2 PSI pressure loss. AA Series exchangers are ideal for installation outdoors where cooling water is unavailable or undesirable due to freezing temperatures. Indoor installations should be well ventilated. The process air should be filtered and pulsating flow, such as that produced by rotary lobe blowers, should be dampened by a chambered silencer prior to entering the heat exchanger.





SEE LINE #54 OF DATA SHEET FOR APPROXIMATE DIMENSIONS

Design Options:

- Connection types: tube, pipe, flange, NPT, ferrule, etc
- Materials of construction:
  Core: aluminum (others available with our LC series)
  Propeller, venturi, and shroud: aluminum, painted, galvanized, or stainless steel
- Motors: any available
- Epoxy phenolic coating for corrosion protection of the core
- Units can be built to required dimensions
- Multiple cores combined together to make a single unit

Accessories:

• Instrument Coupling	$ 60
• Thermometer (Includes Coupling)	$ 90
• Differential Pressure Gauge	$ 280
• Service side filters	Ask
• Others available upon request	

Xchanger, Inc. **Rating for Model AA-1000 ref #146995**

Engineer: David Wangensteen June 16, 2020

Prepared for:

J.E. Gasho & Associates, Inc.

PERFORMANCE	**PROCESS MEDIA**	**SERVICE MEDIA**
Fluid Circulated	Air	Ambient Air
Volumetric Flow Rate	490.0 Std. ft^3/min	5,697.7 Std. ft^3/min
Total Fluid Entering	2,205.1 lb/hr	25,640.5 lb/hr
Liquid		
Vapor		
Non-Condensibles	2,205.1 lb/hr	25,640.5 lb/hr
Vaporized or (Cond.)		
Temperature In	250.0 °F	80.0 °F
Temperature Out	84.5 °F	94.3 °F
Inlet Pressure (Absolute)	16.196 lb/in^2	14.696 lb/in^2
Velocity (Standard)	1,334 ft/min	1,346 ft/min
Pressure Loss	0.10 lb/in^2	0.02 lb/in^2
Fouling Factor	0.0001 ft^2-°F-hr/BTU	0.00010 ft^2-°F-hr/BTU

Total Heat Exchanged: 87,610 BTU/hr

AVERAGE MEDIA PROPERTIES		
Thermal Conductivity	0.017 BTU/hr-ft-°F	0.015 BTU/hr-ft-°F
Specific Heat	0.240 BTU/lb-°F	0.240 BTU/lb-°F
Viscosity	0.050 lb/ft-hr	0.045 lb/ft-hr
Density (MW)	(29.0)	(29.0)
Latent Heat of Vapor		

CONSTRUCTION		
Design Temperature	250 °F	Not Applicable
Design Pressure (Gauge)	15 lb/in^2	Not Applicable
Test Pressure (Gauge)	15 lb/in^2	Not Applicable
Flow Direction	Right Hand Horizontal	Vertical Up/Pull Through
Coating	None	None

Plate-Fin Core	: Aluminum	Fan Hood	: Galvanized Steel
Fan Guard	: Galvanized Steel	Venturi Frame	: Galvanized Steel
Service Filter	: None	Weight	: 250 lb
Thermometers	: None	Diff Pres Gauge	: No
Instrument	:		

CONNECTIONS

Process Inlet	: 6 inch 150 lb. ANSI pattern FFF, 3/8" thick
Process Outlet	: 6 inch 150 lb. ANSI pattern FFF, 3/8" thick

MECHANICAL EQUIPMENT

Fan Diameter	: 24 inch	Motor	: 2.00 HP TEFC
Fan Qty/Speed	: 1 / 1725 RPM	Motor Qty/Speed	: 1 / 1725 RPM
Fan Type	: 4 Blade Mill Galv. St	Motor Electrical	: 208-230/460/3/60

NOTES

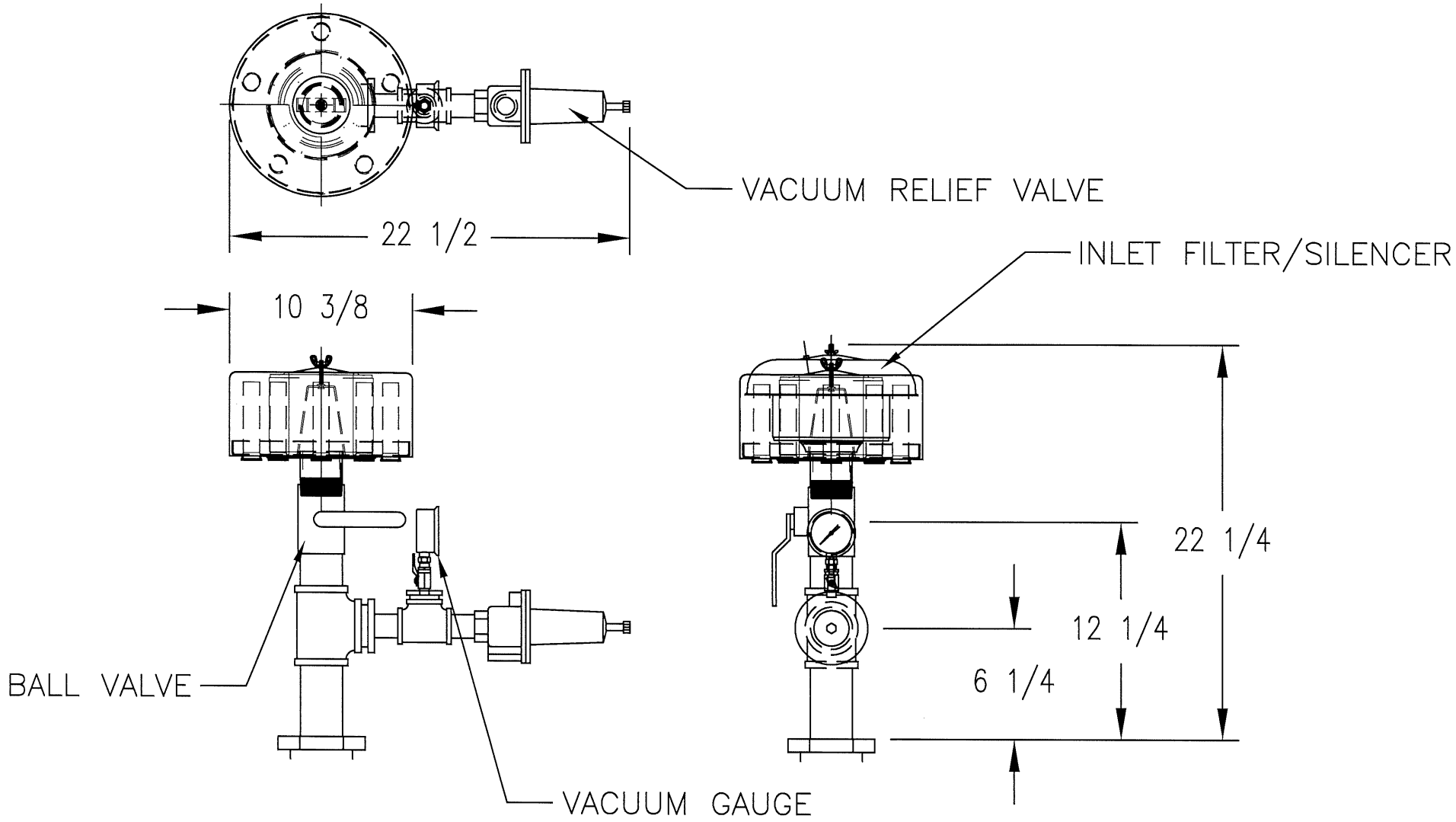
Approximate unit dimensions (inches): A = 35, B = 66, C = 36, D = 16

Construction material suitability must be determined by customer.

The process flow must be uniform, smooth and free of pulsation.

A motor access panel is included in the fan hood.

2" DILUTION VALVE



Compact Inlet Filters
F Series 1/2" - 6" MPT, Flange

Features

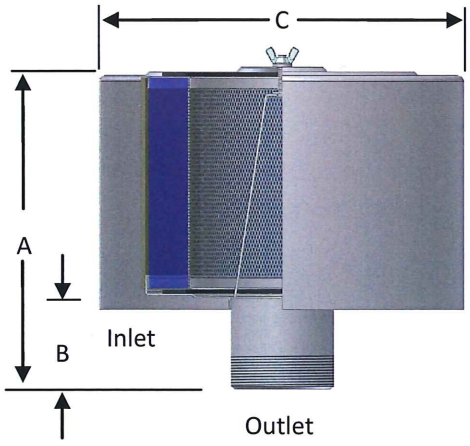
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Low entry velocity air gap between base and cover
- Heavy gauge base with low pressure drop outlet pipe and center bracket design
- Durable carbon steel construction with baked enamel finish & powder coated weatherhood

Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220° (104°C)
- Filter change out differential: 15-20" H_2O over initial Δ P
- Pressure drop graphs available upon request
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

- 1/8" tap holes available for 3" and larger connections
- Pressure drop indicator (See page 3-11)
- Various media for different environments
- Stainless steel construction
- Epoxy coated finish
- Special connections



www.solbergmfg.com • sales@solbergmfg.com • Sales: 630.773.1363 • Fax: 630.773.0727

Outlet Connections

MPT Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
1/2"	10	F-15-050	F-14-050	4	1 1/2	6	2	15	14	35
3/4"	25	F-15-075	F-14-075	4	1 1/2	6	2	15	14	35
1"	35	F-15-100	F-14-100	4	1 1/2	6	2	15	14	35
1"	55	F-19P-100	F-18P-100	6 5/8	1 5/8	6	3	19P	18P	100
1 1/4"	70	F-19P-125	F-18P-125	6 5/8	1 5/8	6	3	19P	18P	100
1 1/2"	85	F-19P-150	F-18P-150	6 5/8	1 5/8	6	3	19P	18P	100
2"	135	F-31P-200	F-30P-200	7 1/4	2 1/4	7 3/4	5	31P	30P	195
2"	135	F-231P-200	F-230P-200	12 1/4	2 1/4	10	12	231P	230P	300
2 1/2"	195	F-31P-250	F-30P-250	7 1/2	2 1/2	7 3/4	6	31P	30P	195
2 1/2"	195	F-231P-250	F-230P-250	12 1/2	2 1/2	10	13	231P	230P	300
3"	300	F-231P-300	F-230P-300	13	3	10	14	231P	230P	300
3"	300	F-235P-300	F-234P-300	13	3	10	15	235P	234P	570
3"	300	F-275P-300	F-274P-300	13	3	16	24	275P	274P	1100
4"	520	F-235P-400	F-234P-400	14	4	10	15	235P	234P	570
4"	520	F-275P-400	F-274P-400	14	4	16	26	275P	274P	1100
5"	800	F-245P-500	F-244P-500	14	4	16	23	245P	244P	880
5"	800	F-275P-500	F-274P-500	14	4	16	27	275P	274P	1100
6"	1100	F-275P-600	F-274P-600	15	5	16	29	275P	274P	1100

See Filter Assembly Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

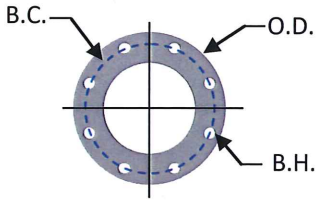
Flange Outlet Connections

Flange Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
4"	520	F-235P-400F	F-234P-400F	14	4	10	20	235P	234P	570
4"	520	F-275P-400F	F-274P-400F	14	4	16	31	275P	274P	1100
5"	800	F-245P-500F	F-244P-500F	14	4	16	27	245P	244P	880
5"	800	F-275P-500F	F-274P-500F	14	4	16	32	275P	274P	1100
6"	1100	F-275P-600F	F-274P-600F	15	5	16	34	275P	274P	1100

See Filter Assembly Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

125/150# Pattern Flg	Dimensions - inches O.D.	B.C.	B.H.	No. of Holes	Flange Thickness
4"	9	7 1/2	0.75	8	0.38
5"	10	8 1/2	0.88	8	0.38
6"	11	9 1/2	0.88	8	0.38



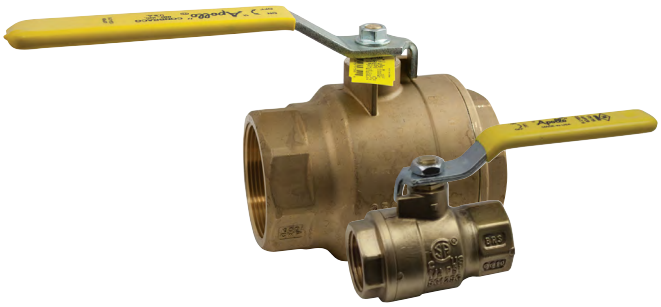
O.D.: Outside Dimension
B.C.: Bolt Circle
B.H.: Bolt Hole

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

"Apollo" Valves SUBMITTAL SHEET

77F-100 Series

Full Port Threaded End Brass Ball Valve



Job Name:	
Job Location:	
Engineer:	
Contractor:	
Tag:	
PO#:	
Rep:	
Wholesale Dist.:	

DESCRIPTION

The Apollo 77F-100 Series is a full port forged brass ball valve suitable for a wide range of flow control applications including HVAC, fuel gas, fire protection, irrigation etc. These NPT threaded, 2-piece valves combine reliable operation with maximum economy. Valves include most pertinent agency approvals. Proudly Made in the USA.

FEATURES

- Heavy Pattern Forged Design
- Corrosion Resistant Materials
- Full-Port Flow
- Premium RPTFE Seats and Packing
- Adjustable Stem Packing
- Blowout-Proof Stem
- 2-1/2" - 4" Sizes Now Feature 316SS Ball and Stem (Standard)
- Silicone Free Assembly
- 100% Factory Tested
- **Made in USA, ARRA Compliant**

PERFORMANCE RATING

- Rating: 600 CWP (1/4" – 2")
- Rating: 400 CWP (2-1/2" – 4")
- Steam Rating: 150 psi SWP
- Temperature Range: 0°F - 400°F
- Vacuum Service to 29 in. Hg

Not intended for potable water in USA

OPTIONS

• (-01) Standard Lever	
• (-04) 2-1/4" Stem Extension	1/4" – 2-1/2"
• (-07) Tee Handle	1/4" – 2"
• (-10) Stainless Steel Lever & Nut	1/4" – 2"
• (-11) Therma-Seal™ Insulating Tee Handle	1/4" – 2"
• (-27) Locking Handle SS	1/4" – 2-1/2"
• (77F140 Series) – SS Ball & Stem	
• (77FLF Series) Lead Free (0.25% Lead Max)	

STANDARD MATERIALS LIST

BODY	Brass, ASTM B283 alloy C37700
SEAT	RPTFE
BALL	Brass, ASTM B16, C36000 or B283, C37700 Chrome Plated 316 SS (2-1/2" - 4")
STEM PACKING	RPTFE
NUT	Corrosion Resistant Plated Steel
STEM	Brass, ASTM B16, C36000 316 SS (2-1/2" - 4")
RETAINER	Brass, ASTM B283 alloy C37700 or ASTM B16, C3600
HANDLE	Plated Steel / Insulated Polyvinyl
GLAND	Brass, ASTM B16, C36000

APPROVALS

- MSS SP-110
- IAPMO/ANSI Z1157

FM LISTED

- FM 1140 (<175 PSI) (1/4" – 2")

CSA LISTED

- CGA 3.16 (125 PSI)
- CGA CR91-002 (5 PSI)
- ANSI Z21.15/CSA 9.1 (1/2 PSI)
- ASME B16.44 (5 PSI)
- ASME B16.33 (125 PSI) (1/2" – 2")

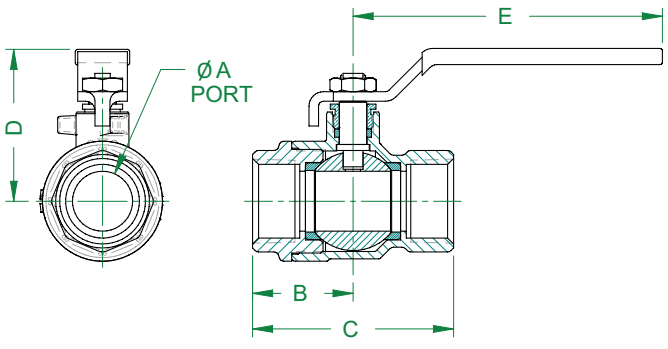
UL LISTED

- UL 125 - Flow Control Valves for LP-Gas, Guide YSDT to 250 psi max
- UL 258 - Fire Protection Trim & Drain, Guide VQGU to 175psi max (1/4" – 2")
- UL 842 - Valves for Flammable Fluids, Guides YRBX, YRPV, and MHKZ to 250 psi max. (1/4" - 4" NPT only)
- UL 1477 - Compressed Gas Shutoff Valves, Guide YQNZ to 250 psi max (1/4" - 4" NPT only)

Gas approvals apply to NPT models only

DIMENSIONS

PART NUMBER	SIZE (IN.)	DIMENSIONS (IN.)					WT. (LB.)
		A	B	C	D	E	
77F-101-01	1/4"	0.38	0.81	1.62	1.61	2.85	0.3
77F-102-01	3/8"	0.38	0.85	1.70	1.61	2.85	0.3
77F-103-01	1/2"	0.50	1.14	2.25	1.66	2.85	0.5
77F-104-01	3/4"	0.75	1.29	2.57	1.91	3.86	0.8
77F-105-01	1"	1.00	1.60	3.20	2.11	3.86	1.3
77F-106-01	1-1/4"	1.25	1.73	3.46	2.44	4.75	2.1
77F-107-01	1-1/2"	1.50	2.00	4.00	2.91	5.42	3.2
77F-108-01	2"	2.00	2.37	4.74	3.69	7.77	5.6
77F-149-01	2-1/2"	2.50	2.99	5.98	4.14	7.77	12.8
77F-140-01	3"	3.00	3.52	7.05	5.03	9.92	19.7
77F-14A-01	4"	4.00	3.83	7.65	5.70	14.78	25.5



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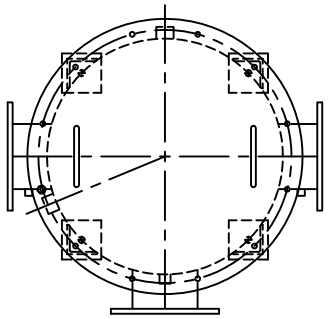
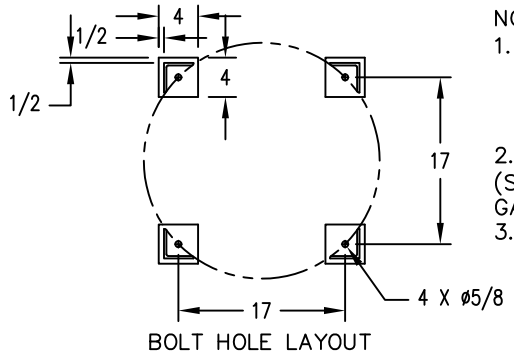
aalberts integrated piping systems

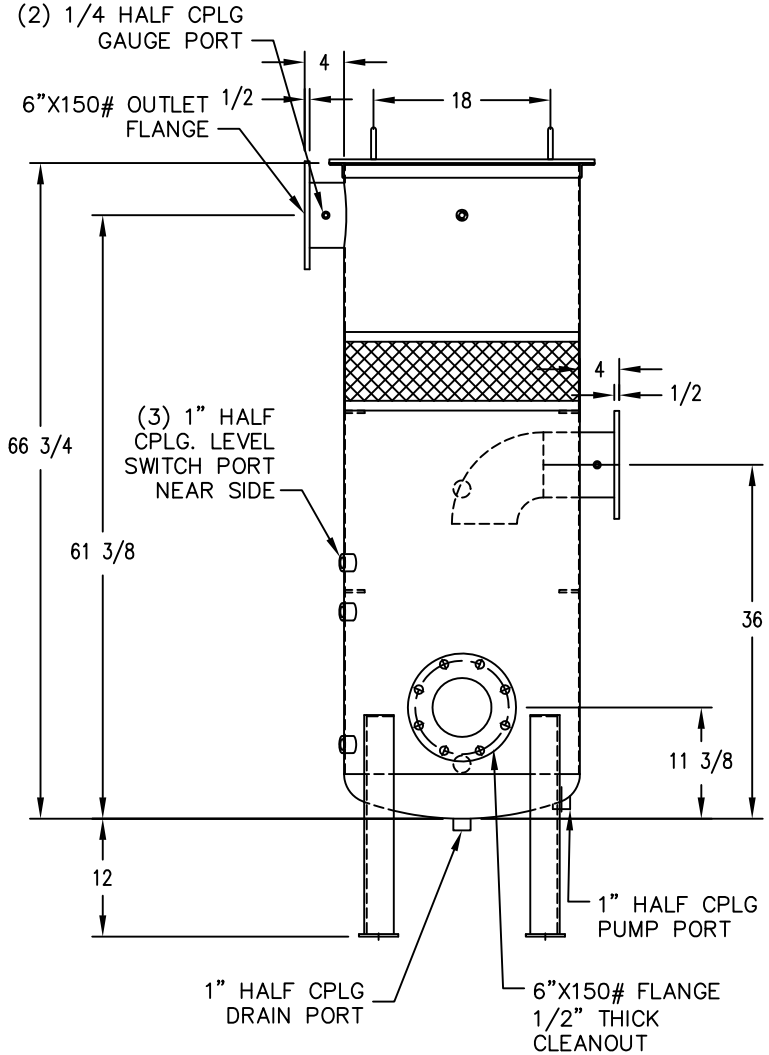


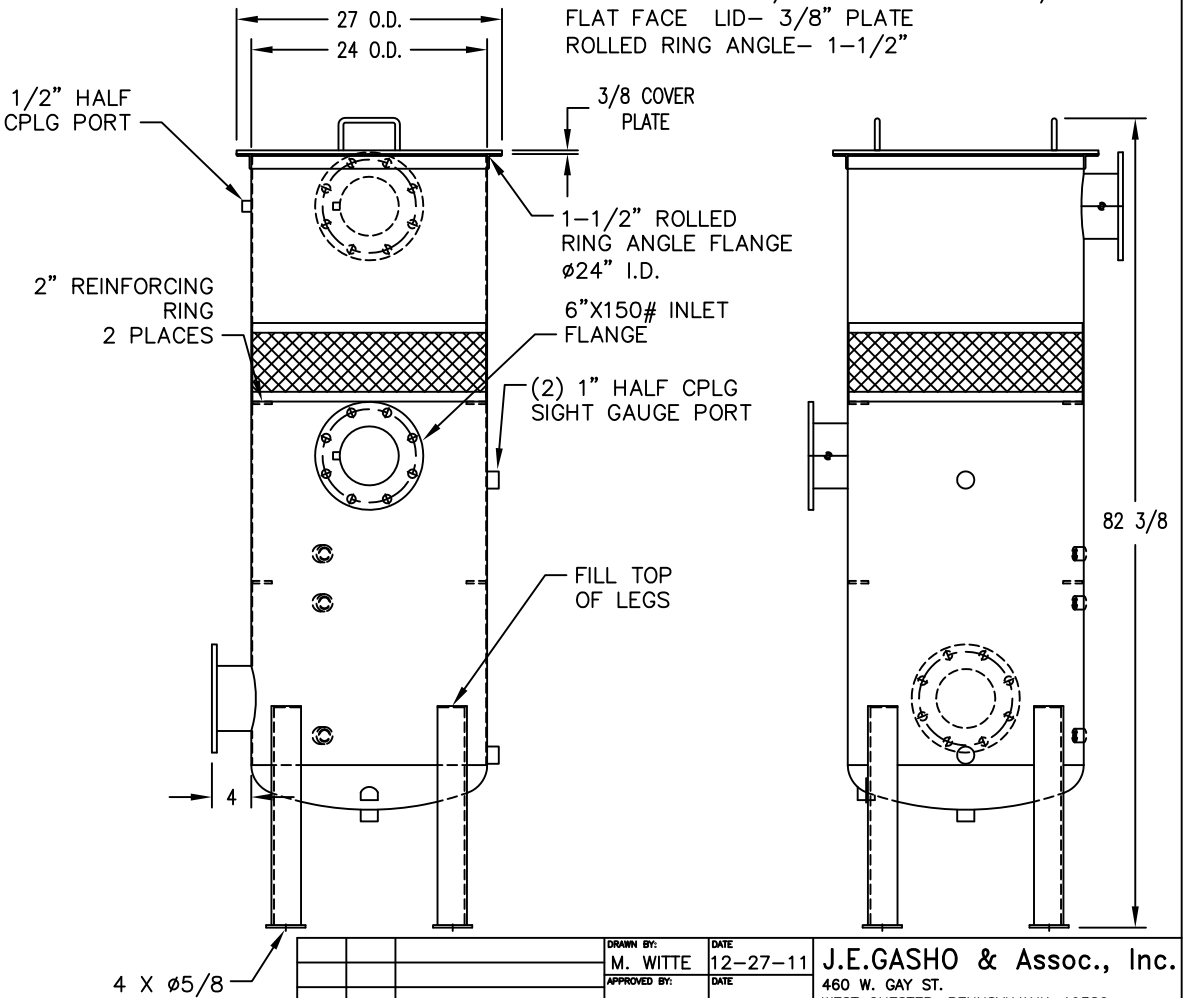


BOLT HOLE LAYOUT

NOTES:
1. VOLUME: 1.925 GAL/INCH HEIGHT
   52" NEEDED FOR 100 GALLONS
   35 GALLONS NOMINAL LIQUID STORAGE = 18.2"
   40 GALLONS NOMINAL LIQUID STORAGE = 21"
2. LEVEL SWITCH LOCATION: LO 7.5" = 14 GAL (STATIC VOLUME), HI 21" = 40 GAL, HI-HI 26" = 50 GAL, PUMP OUT VOLUME = 26 GAL.
3. ALL CONTINUOUS WELDS TESTED LEAK TIGHT.

MATERIAL:
SHELL- #12 GA. HRS
HEADS- #12 GA HRS P & O
REINFORCING RING- 2"X1/4" HRS
FEET- 4X 4 X 1/4 PLATE
LEGS- 3 X 3 X 1/4 ANGLE FLANGE- 1/2" THICK
FLAT FACE LID- 3/8" PLATE
ROLLED RING ANGLE- 1-1/2"





			DRAWN BY: M. WITTE	DATE 12-27-11
			APPROVED BY:	DATE
			DIMENSIONS IN INCHES	
			SCALE	
			TOLERANCE	ANGULAR TOLERANCE
			MATERIAL STEEL	WEIGHT 320 LB
A	4/26 2018	ROTATE L. SWITCH PORTS	SHEET 1 OF 1	
REV.	DATE	DESCRIPTION		

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

MOISTURE SEPARATOR
GX125DL HIGH VAC
USE WITH DEMISTER PAD

1500-C-9270 | A

460 West Gay Street
West Chester, PA
610-692-5650 Fax:

19380
610-692-5837
cs@gasho.org

The Leader in Blower & Vacuum Solutions

Moisture Separators

Moisture separators are used to remove water and other liquids from air streams. They are typically used on the inlet of vacuum systems to remove water and other contaminants before they enter the vacuum pump. The air volume of the moisture separator reduces the velocity of the air stream to allow liquids to precipitate. Up to 95% water removal is possible. The models GX-30 & GX-60 are rated for full vacuum. Other moisture separators are rated to 18 in. Hg. Higher vacuum ratings available.

Inside the top of the separators is a basket with stainless steel demister/filter media to trap entrained water droplets. Standard accessories include a sight gauge and drain valve.

Options include: 1 to 3 level switches, hand operated sludge pump, automatic pump down systems, heat tracing, vacuum gauges, and thermometers.

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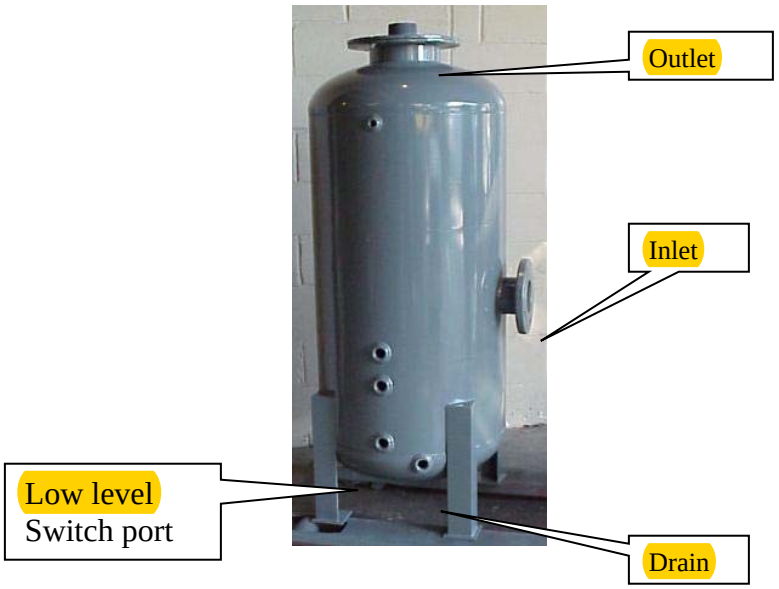


Orifice Plates

Simple, Predictable and Reliable Differential Flow Measurement

Series 500 & 520 Universal Plates and Seals
Series 560 & 590 Ring Type Joint Plates

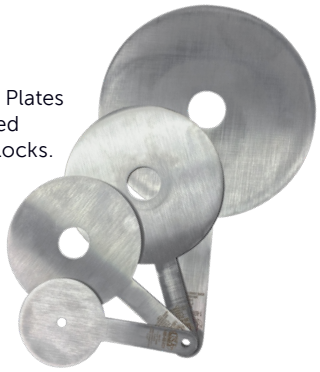
We manufacture all of our flow measurement universal orifice plates, paddle plates, ring type joint (RTJ) plates and restriction orifice unions to meet or exceed standards set by A.G.A., I.S.A., A.N.S.I., A.S.M.E. and A.P.I. recommendations. Stocked plates include 304 & 316 stainless steel in 1/8" and 1/4" thicknesses. Other material and/or thicknesses are available upon request. We bore the plates to the customer's supplied sizing calculation, but we also provide sizing calculation services for an additional fee.

Series 500 Orifice Plates & Seals

Our Universal Orifice Plates are designed to be used with all standard orifice fitting assemblies or RTJ plate holders. Standard industry sizing allows our plates to be used with any of the dual- or single-chambered orifice fittings on the market,

Seal rings for Series 500 Orifice Plates are sold separately.

Series 520 Paddle Orifice Plates



USA Industries' Paddle-Type Orifice Plates are manufactured for use with Raised Face Orifice Flanges and Holding Blocks.

Skilled craftsmen and state-of-the-art machining practices assure that our paddle orifice plates meet or exceed the stringent requirements of AGA, ISA, ANSI, ASME & API Standards.

Series 560 Plates & 590 Plate Holders

Series 560 plates are machined as one piece and available in all ring sizes.

Series 590 plates are manufactured with hold-down screws and use Universal Plates for the Orifice bore.

The RTJ type orifice plate incorporates an integral gasket, either oval or octagonal ring, for mounting between RTJ flanges. It's proven technology has no moving parts and is suitable for high temperature and pressure applications.

Plate thicknesses depend on line size and differential pressure, and may be machined in one piece, or alternatively from two pieces, with an Orifice Plate screwed onto a carrier ring/gasket.

Restriction Orifice Unions

Restriction Orifice Unions consist of orifice plates that are one-piece stainless steel shaped to fit the contour of the union seat (ball to cone), eliminating the need for gaskets. Plates can be configured to work as recessed, pressed, or pressed with tab so you can identify the orifice size without breaking the union.

Orifice unions are stocked in carbon & stainless steel bodies with pressure ratings of 3,000 PSIG. Restriction orifice unions are also available in line sizes from 1/4" through 2" and with female NPT or socket-weld connections. Other non-standard orifice union sizes and materials can be produced rapidly upon request.

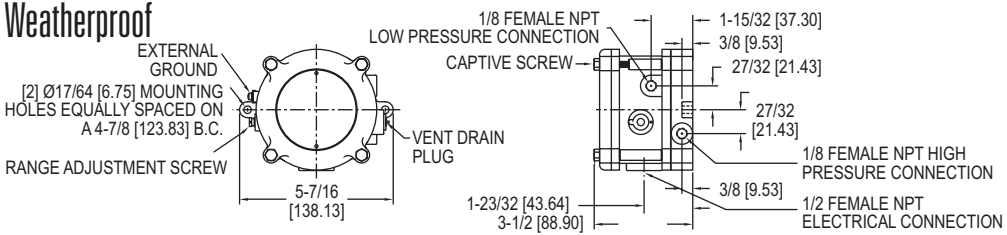
For more information on USA Industries, Inc.'s products, contact us at (713) 941-3797 or go to www.USAIndustries.com

Dwyer

SERIES 1950

EXPLOSION-PROOF DIFFERENTIAL PRESSURE SWITCH

Compact, Low Cost, Explosion-proof and Weatherproof



Series 1950 Explosion-Proof Differential Pressure Switch combines the best features of the popular Dwyer® Series 1900 Pressure Switch with an integral explosion-proof and weatherproof housing, making it an exceptional value for either application. It is CE, UL and CSA listed, FM approved for use in Class I, Div 1, Groups C and D, Class II Groups E, F, and G and Class III hazardous atmospheres NEMA 7 & 9. Rain tight NEMA 3 (IP54), weatherproof features include a drain plug and O-ring seal in cover. Electrical connections are easily made by removing front cover. For convenience the set point adjustment screw is located on the outside of the housing. Twelve models offer set points from .03 to 20 in w.c. (0.0075 to 5 kPa) and from .5 to 60 psi (0.035 to 3.5 bar). The unit is very light and compact - about half the weight and bulk of other explosion-proof or weatherproof switches with separate enclosures. CAUTION: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.

FEATURES/BENEFITS

- Explosion-proof and weatherproof housing provides device protection for outdoor use or harsh environment operation
- External set point screw provides easy access that simplifies making adjustments without opening or disassembling enclosure
- Easily accessible electrical connection simplifies the installation

APPLICATIONS

- HVAC applications
- Process applications
- All-weather applications

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits: Continuous: 1950's - 45 in w.c. (0.11 bar); 1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar). Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: NEMA 3 (IP54), NEMA 7 & 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8″ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, CSA, FM, UL.

MODEL CHART

Model	Range, psid	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point	Model*	Range*	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point	Model	Range, in w.c.	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point
1950P-2-2F	0.5 to 2	0.3	0.3	**1950P-50-2F**	15 to 50	1.0	1.5	**1950-1-2F**	.4 to 1.6	.15	.20
1950P-8-2F	1.5 to 8	1.0	1.0	**1950-02-2S**	.03 to .10	.025	.05	**1950-5-2F**	1.4 to 5.5	.30	.40
1950P-15-2F	3 to 15	0.9	0.9	**1950-00-2F**	.07 to .15	.04	.05	**1950-10-2F**	3 to 11	.40	.50
1950P-25-2F	4 to 25	0.7	0.7	**1950-0-2F**	.15 to .50	.10	.15	**1950-20-2F**	4 to 20	.40	.60

*P=PSID range models. Other ranges in w.c.

Caution: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.

Rotameters for Air Sparge and Vapor Extraction

PRMFiltration

- Designed For Vapor Extraction, Air Sparge and other industrial air flow applications.
- Scaled for standard cubic feet per minute (SCFM) and can be used on pressure and high vacuum applications.
- Meter sizes designed to provide an ample working range and are less prone to failure through impact exposure.
- Larger than comparable meters on the market which provides a fine scale control for a higher degree of accuracy.

Specifications:

- Materials:
  - Body: Acrylic with PVC (gray) or Polypropylene (white) replaceable end tails
  - 304 SS Float and travel rod
  - Viton® O-rings and seals
- Maximum 85 psig pressure rating
- Maximum Temperature rating of 125°F
- Accuracy: +/- 4% of full scale flow

SCFM scale based on 1 atm air @ 68° F
Rotameter readings must be adjusted for pressure and temperature. Discover more about air flow readings: https://www.prmfiltration.com/scfm-acfm-calculator

Options:

PRM can provide meters scaled for custom applications. Typical lead time is 3-5 weeks from time of order. Custom meters require a minimum quantity commitment of 50 meters.

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Rotameters for Air Sparge and Vapor Extraction

PRMFiltration

INSTALLATION & USE:
PRM rotameters are available in a broad choice of flow ranges with direct reading scales for air, gas or water. Installation, operation and maintenance are very simple and only a few common sense precautions must be observed to assure long, trouble-free service.

Before proceeding with the installation of your PRM Rotameter, check to be sure you have the model and flow range you require. PRM Flowmeters are designed for use at pressures up to 85 psi and temperatures up to 125°F. DO NOT EXCEED THESE LIMITS!
The installation should not be exposed to strong chlorine atmospheres or solvents such as benzene, acetone, carbon tetrachloride, etc. The mounting panel should be free of excessive vibration since it may prevent the unit from operating properly.

Inlet Piping Run: It is good practice to approach the flowmeter inlet with as few elbows and restrictions as possible. In every case the inlet piping should be at least as large as the connection to the flowmeter. Discharge Piping: As on the inlet, discharge piping should be at least as large as the flowmeter connection.

POSITION AND MOUNTING All PRM Rotameters must be mounted in a vertical position with the inlet connection at the bottom and outlet at the top .

It is important to understand that a rotameter is affected by variations in temperature and air pressure. This rotameter has been calibrated at the Standard operating conditions of 14.7 psia (0 psi) pressure and 70° F. When using the rotameter at a different temperature and pressure than where it was calibrated, the following formula will provide a correction factor:

$$Q_2 = Q_1 \times \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

Where:

Q1 = Actual or Observed Flowmeter Reading
Q2 = Standard Flow Corrected for Pressure and Temperature
P1 = Actual Pressure (14.7 psia + Gauge Pressure)
P2 = Standard Pressure (14.7 psia, which is 0 psig)
T1 = Actual Temperature (460 R + Temp °F)
T2 = Standard Temperature (530 R, which is 70°F)

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Rotameters for Air Sparge and Vapor Extraction

PRMFiltration

FMDFG03: 0.3-3 scfm
1/2" FNPT
8" tall
1.3" OD

FMDFG15: 1-8 scfm
1/2" FNPT
8" tall
1.3" OD

FMDFG25: 1-15 scfm
1" FNPT
10.5" tall
2" OD

FMDFG40: 2-25 scfm
1.5" MNPT
12" tall
2" OD

FMDFG4050:
5-50 scfm
1.5" MNPT
12" tall
2" OD

FMDFG50: 10-100 scfm
2" FNPT
13.5" tall
3" OD

FMDFG51: 20-200 scfm
2" FNPT
13.5" tall
3" OD

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Equipment Specifications may vary. Product Recovery Management, Inc. • 200 20th Street • Butner, NC 27509 P-02 (2)









SCH 80 PVC Sample Port Ball Valve - 1/4 Inch MNPT X Barb

$ 7.75

Quantity 1

ADD TO CART

SKU: 13PVC80SP025

Category: PVC Valves, Sch 80 PVC Sample Port Ball Valves, Sch 80 PVC Valves, Schedule 80 PVC Fittings & Valves

← VIEW ALL PVC VALVES

Description | Warranty | Shipping and Delivery | Exchanges | Customer Review

SCH 80 PVC 1/4" SAMPLE PORT VALVE WITH HOSE BARB AND CHEMICAL RESISTANT VITON O-RING.

SAMPLE PORT VALVE -

HOSE BARB FOR 1/4" ID HOSE X 1/4" BSPP CONNECTION, COMES WITH 1/4" PVC ADAPTER TO CONVERT BSPP CONNECTION TO NPT. CHEMICAL RESISTANT BUNA-N SEALING WASHER INCLUDED.

This Sch 80 PVC Sample Port Valve is a ball valve is made of PVC (polyvinyl chloride) for less weight than metals, and has a lever handle for on/off manual control. This inline valve has 1/4" male BSPP threads and comes with a National Pipe Taper (NPT) adapter to connect to a female threaded pipe and a 1/4" ID hose connection to connect to a hose going in the same direction. This valve has a Viton Rubber seal for increased chemical resistance. This inline ball valve is suitable for chemical processing and water and wastewater applications.

Ball valves use a spherical disc to control the flow between pipes, tubes, or hoses. Flow is allowed when the hole that pierces the ball-shaped disc is in line with the inlet and outlet of the valve and is blocked when the ball is horizontally swiveled 90 degrees, so that the hole of the ball is perpendicular to the opening of the valve. Ball valves can be referred to as full port or reduced port (also known as regular or standard port) depending on the inner diameter or the valve. A ball valve is full port if the hole of the ball is the same size as the inner diameter of the connecting pipeline (resulting in lower friction) and termed reduced port if the hole of the valve is one pipe size smaller than the pipe, resulting in less flow through the valve than through the shaft of the pipe. Ball valves may have a handle or lever that aligns with the ball's position (open or closed) for manual operation. They are primarily used in air, gas, liquid, and steam applications.

CUSTOMERS HAVE ALSO PURCHASED

ERA Sch 80 PVC 12 Inch Butterfly Valve, Gear Operated

$ 738.39 Lead Time

ADD TO CART

ERA Sch 80 PVC 2 Inch Butterfly Valve Kit, With Flanges and Hardware

$ 59.27

ADD TO CART

ERA Sch 80 PVC 2 Inch Butterfly Valve, Lever Handle

$ 27.86

ADD TO CART

ERA Sch 80 PVC 2-1/2 Inch Bu Lever Handle

$ 29.63

ADD TO CART

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bruce.baize@prmfiltration.com | 941-400-6151

Luke Kemp | Project Manager & Field Services
luke.kemp@prmfiltration.com | 919-957-8890

Sonic Fiber Sound Absorber

Sonic Fiber Sound Absorber is a semi-flexible non-asbestos mineral wool that provides much greater sound attenuation and absorption than fiberglass bats or urethane foam Sonic Fiber is naturally hydrophobic (repels water), fire resistant, does not promote mold growth, and is vermin-proof. It is available in sheets that are either un-faced or faced on one side with an encapsulant which protects the fibers yet remains breathable. Sonic Fiber comes in standard size sheets of 4' x 6' with a 2" thickness, and a density of 8 lbs/ cu. ft. Different thicknesses, sheet sizes and facings are available upon request. Mechanical and acoustic properties are provided below.

Un-Faced

Faced in Black

The Noise Reduction Coefficient (NRC) of a material is obtained through testing by a certified laboratory to ASTM standards. The NRC is an indication of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection (such as a smooth concrete surface) and an NRC of 1 indicates perfect absorption. Sonic Fiber is used inside rooms, enclosures and walls to significantly reduce acoustical reflections and overall sound energy, and may be used together with sound barrier materials, such as Sonic-Shield™ Noise Barrier.

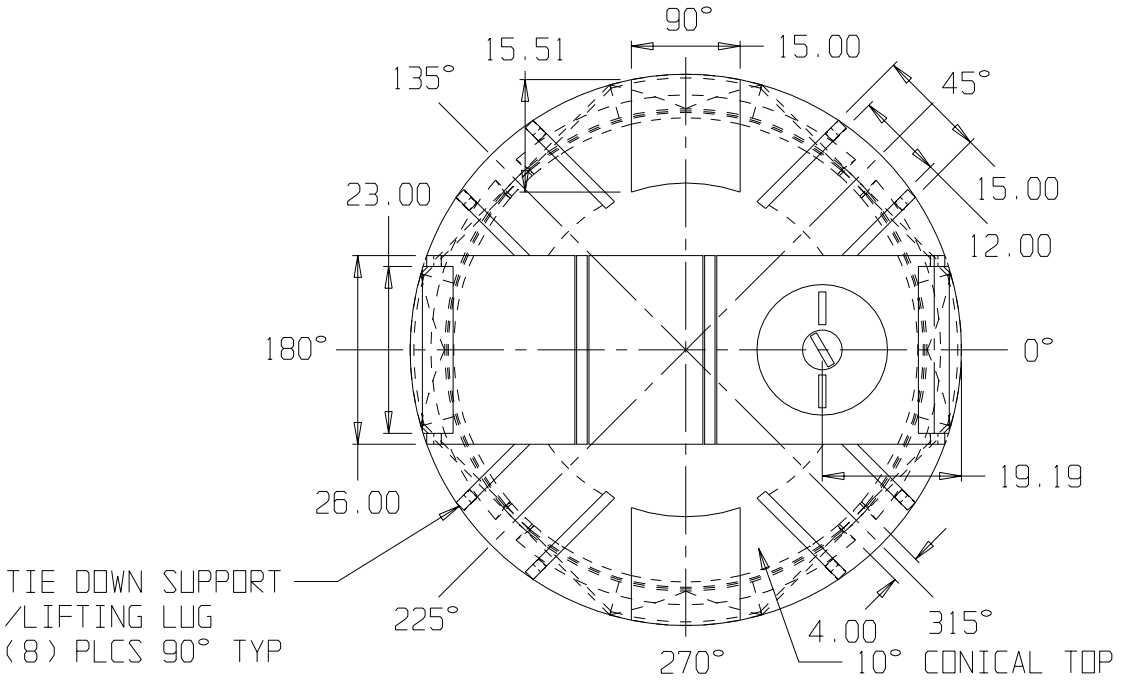
Typical Mechanical Properties	
Weight Density	8 lb./cu.ft.
Thickness	2.00Ó
Adsorption[1]	<1% by volume
Combustibility[2]	Non-combustible
Corrosivity[3]	Non-corrosive
Thermal R-Value	8.3
Maximum Temperature[4]	1200°F

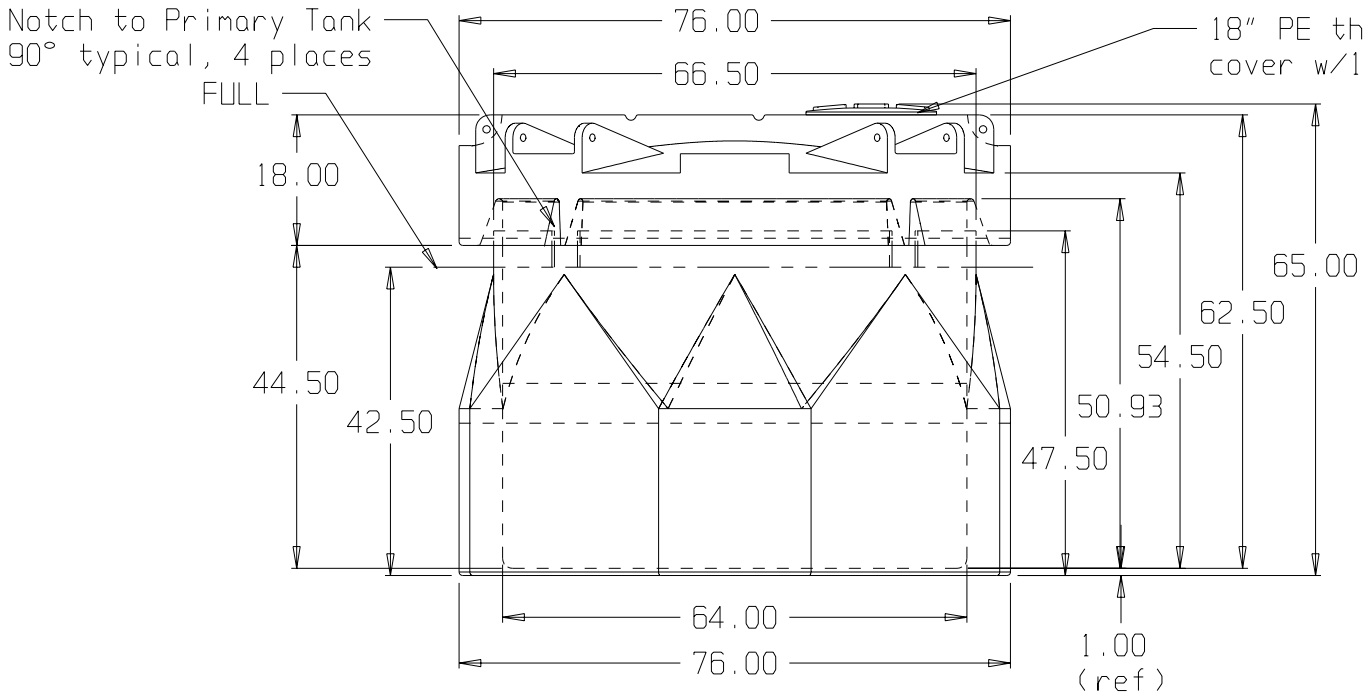
1. *ASTM C 1104*
2. *NFPA Standard 220 tested IAC ASTM E 136*
3. *ASTM C 665, MIL-I-24244*
4. *ASTM C 411*
5. *ASTM C 423*

Typical Acoustical Properties (NRC)[5]		
Frequency (Hz)	2" thick	4" thick*
125	0.35	1.15
250	0.84	1.17
500	1.08	1.18
1000	1.04	1.03
2000	0.96	1.06
4000	0.93	1.08
NRC	1.00	1.10

*estimated

For other product information, technical assistance or ordering, please call Sonic-Shield at 888-769-0766 or on-line at www.sonic-shield.com





(all dimensions in inches)

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE

550 GALLON CAPTOR CONTAINMENT SYSTEM

PART # PRIMARY: 504--

CONTAINMENT: 503--

REF#: 0000 01/23/03

SNYDER INDUSTRIES INC.

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Contact Dial Thermometer

Special features

- Class 1.5
- Display range -40° C to +600° C
- Temperature controller with actual value display as built-in or add-on device in the stainless steel case with a bayonet connection
- Case size ∅: 100 mm
- Protection type IP 65

Brief description

Contact dial thermometers are devices with an actual value display for temperature measurement, control, and monitoring and can be used universally.

The temperature-dependent volume change in a measuring system filled with liquid or the temperature-dependent pressure change in a measuring system filled with gas is converted to a rotational movement of the actual value indicator by a bourdon tube; no transmission gear is required. The microswitch is actuated by the rotational movement of the indicator shaft via a tap system.

Technical data

Basic type extension	0210, 1010, 2010, 2210, 2310
Case	Stainless steel case with bayonet connection (1.4301)
Protection type	IP 65 according to DIN EN 60529
Front pane	Polycarbonate
Scale	White, with black lettering
Display	Class 1.5 similar to DIN EN 13190
Strain relief spring	For capillary devices on the case and the temperature probe
Setpoint value adjustment	By setpoint adjuster in the front pane; with screwdriver, protected by the bolted cover.
Display correction	On the rear, no display correction with design type 20
Limit value temperatures	For transport and storage -20°C to +70°C (for display range 0 to +60°C up to max. 65°C; -40 to +40°C up to max. 50°C; -30 to +50°C up to max. 60°C)
Rated position (NL)	Any

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Technical data

Display range (AB)	Display range in °C	Measuring range in °C	Tolerance in °C (+/-)
469	-40 to +40	-30 to +30	1.5
566	-30 to +50	-20 to +40	1.5
643	-20 to +120	0 to +100	3.0
807	0 to +60	+10 to +50	1.5
810	0 to +80	+10 to +70	1.5
814	0 to +100	+10 to +90	1.5
818	0 to +120	+20 to +100	3.0
826	0 to +160	+20 to +140	3.0
832	0 to +200	+20 to +180	3.0
834	0 to +250	+30 to +220	4.0
926	+50 to +250	+70 to +230	3.0
840	0 to +300	+30 to +270	6.0
927	+50 to +300	+80 to +270	4.0
843	0 to +350	+50 to +300	6.0
932	+50 to +350	+80 to +320	6.0
848	0 to +400	+50 to +350	6.0
851	0 to +450	+50 to +400	6.0
854	0 to +500	+50 to +450	8.0
858	0 to +600	+100 to +500	10.0

	Liquid filling	**Gas filling**
Measuring system	Display range (AB) ≤ 350°C	Display range (AB) ≥ 400°C
Time constant $t_{0.632}$	Approx. 12 s, measured in water, with a probe Ø of 6 mm made of Cu.	Approx. 4 s, measured in oil, with a probe Ø of 10 mm made of stainless steel.
Ambient temperature influence effect	In % of the display range (referring to the deviation from the reference value +23°C)	
On case	0.15% of the display range per K ambient temperature change	0.05% of the display range per K ambient temperature change
On capillary (per m)	0.03% of the display range per K ambient temperature change	No influence
	At higher ambient temperature – higher temperature display – lower switching point	

	Standard	**Extra code (TZ) 650**
Electrical contact		
Contact type	Single-pole microswitch with mechanically actuated changeover contact	
Switching capacity	AC 230V, +10/-15%, 48 to 63Hz, cos φ = 1 (0.6)	
	5 (1.5) A	10 (3) A
Switching differential	Approx. 1.5% of the display range	1.5 to 3% of the display range
Switching point accuracy	± 0.5% of the display range referring to the switch-off point with rising temperature	
Switching reliability	To ensure a high switching reliability, we recommend a minimum voltage of 24 V and a minimum current of 100 mA	

Electrical connection	Junction box: conductor cross-section up to 2.5 mm^2, suitable for cable Ø from 6.5 to 13 mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
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Temple Bank, Riverway
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Dimensions

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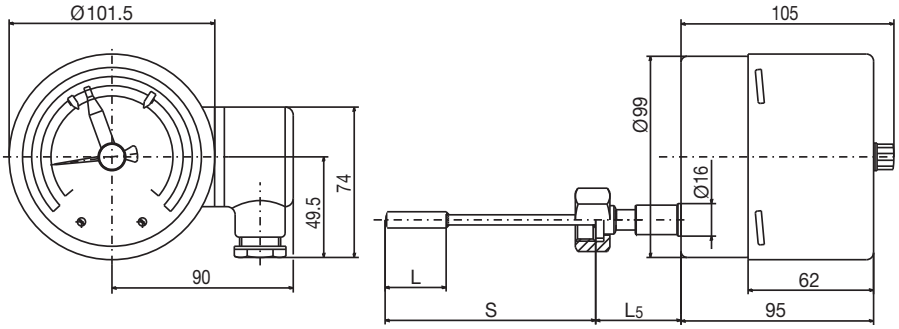

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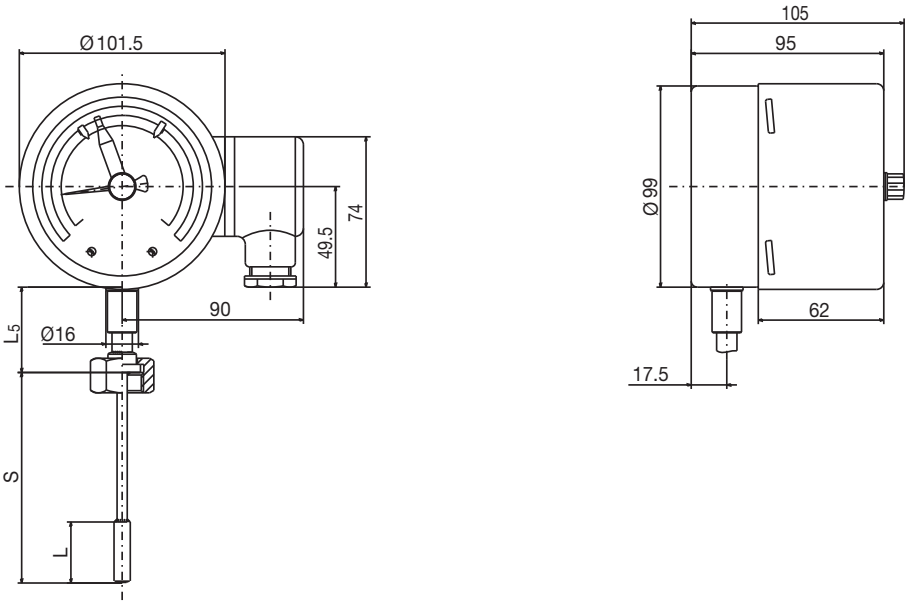

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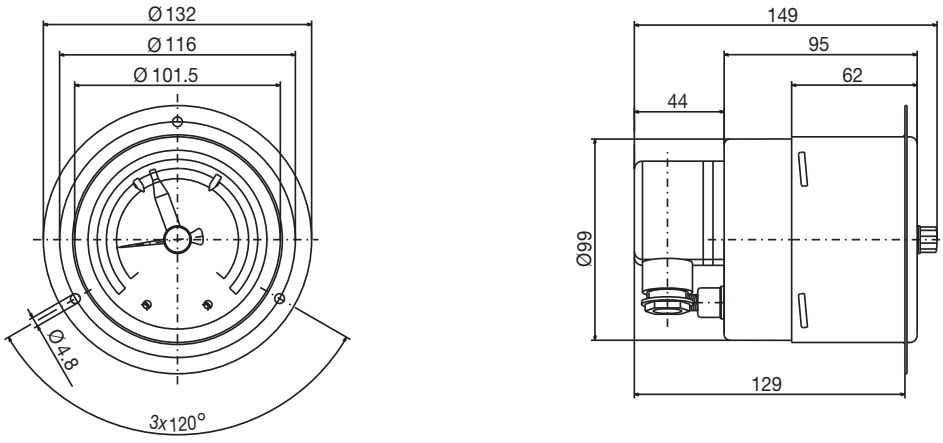

Panel cut-out Ø 105 $^{+0,5}$ mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
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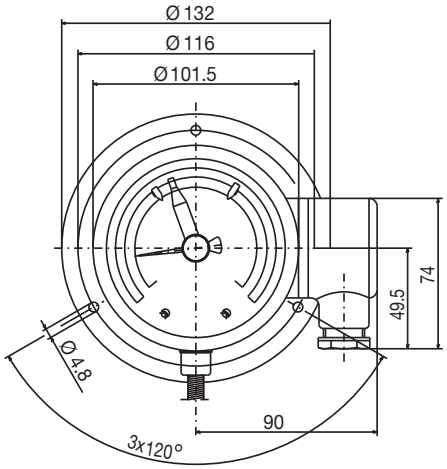
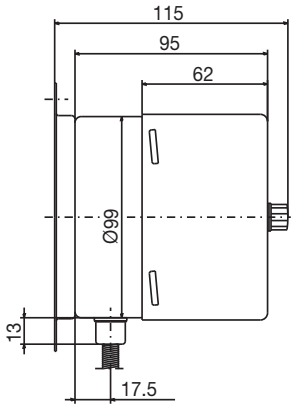
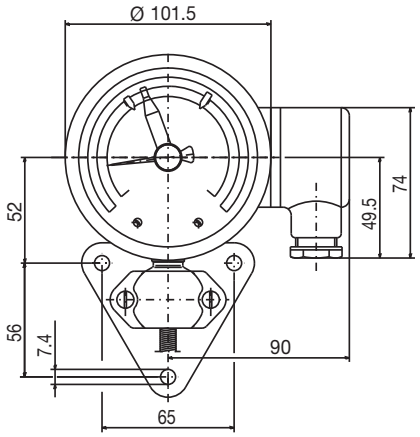


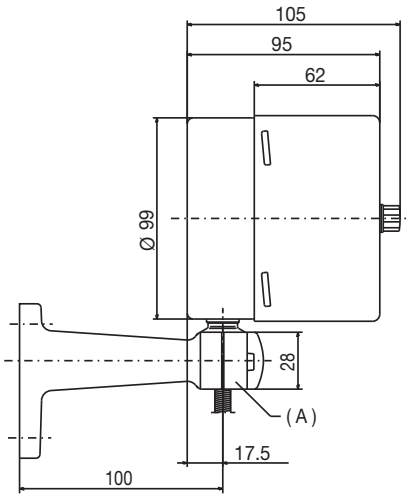


Panel cut-out Ø 105 $^{+0,5}_{0}$ mm

Type:
608523/2310



Bracket for measuring device according to DIN 16281



(A) Spigot Ø 26 mm

L_5	Protection tube connection type
40 mm	TA 03, TA 30
≤ 69 mm	TA 02
42.5 mm	TA 21
51.5 mm	TA 22, TA 31

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
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JUMO Process Control, Inc.
6733 Myers Road
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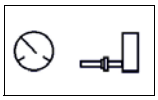
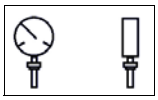
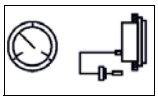
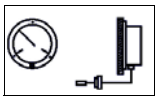
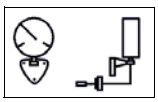
Order details

Order code	(1)	Basic type	
608523		Mechanical contact dial thermometer class 1.5	
	(2)	**Basic type extension**	Case size Ø
0210		Design type 02 	100 mm
1010		Design type 10 	100 mm
2010		Design type 20 	100 mm
2210		Design type 22 	100 mm
2310		Design type 23 	100 mm

	(3)	Display range in °C
469		-40 to +40
566		-30 to +50
643		-20 to +120
807		0 to +60
810		0 to +80
814		0 to +100
818		0 to +120
826		0 to +160
832		0 to +200
834		0 to +250
926		+50 to +250
840		0 to +300
927		+50 to +300
843		0 to +350
932		+50 to +350
848		0 to +400
851		0 to +450
854		0 to +500
858		0 to +600

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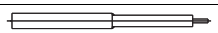
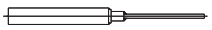
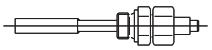
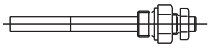
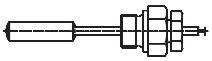
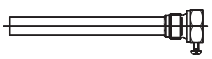
Order code	(4)	Capillary type (FL) [a]
00		Without (with rigid connection)
02		FL 02 Cu capillary with Cu textile braiding, approx. Ø 2.5 mm (up to AB end value +300°C)
11		FL 11 Cu capillary with PE coating, approx. ø 3.5 mm (up to AB end value +120°C)
17		FL 17 Stainless steel capillary, approx. Ø 1.5 mm
21		FL 21 Cu capillary, approx. Ø 1.0 mm (up to AB end value +300°C)

	(5)	Capillary length [b]
0		Without (with rigid connection)
1000		1000 mm
2000		2000 mm
3000		3000 mm
4000		4000 mm
5000		5000 mm
. . . .		Special length (specification in plain text: 1,000 mm increments, maximum length 10,000 mm), additional lengths upon request

	(6)	Process connection (PC)[a]		
750	TF 01	Temperature probe with stepped support tube		
752	TF 11	Temperature probe without support tube		
843	TA 02	Protection tube with union nut and loose screw connection [b]		
161	TA 03	Protection tube with loose screw connection		
847	TA 06	Protection tube with displaceable threaded fitting on support tube [b]		
311	TA 20	Protection tube with loose screw connection and connection collar [b]		
872	TA 21	Protection tube with loose pressure screw and conical seal (only G 3/8 possible)		
873	TA 22	Protection tube with loose pressure screw, conical seal, and loose screw connection [b]		
401	TA 23	Protection tube with pressure screw and contact pressure spring (only M 10x1 possible)		
913	SH 07	Screw-in protection tube, multi-sectional, with clamping piece and fixing screw (suitable for TF 01 and TF 11)		
820	SH 09	Weld-in protection tube, multi-sectional, with clamping piece and fixing screw[b] (not for FL 21 – welding collar with steel 1.4515)		
876	SH 10	Screw-in protection tube, multi-sectional[b] (suitable for TA 21)		
871	SH 11	Screw-in protection tube, multi-sectional[b] (suitable for TA 21)		

[a] For the description and special features refer to data sheet 608730.
[b] Screw-in spigot according to DIN 3852, form A.

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Order code	(7)	Ø Process connection (PC) [a]
6		6 mm
8		8 mm
10		10 mm
11		11 mm
12		12 mm

	(8)	Thread type of process connection (PC)[a]
000		Without thread (for TA 01 and TF 11)
103		Screw connection G 3/8
104		Screw connection G 1/2
105		Screw connection G 3/4
114		Screw connection M 10 x 1 (only with TA 23 and SH 11)

	(9)	Material, probe / support tube [a]
26		Stainless steel (CrNi, 1.4571)
96		Copper (Cu) / Brass (CuZn) (up to 200°C)
95		Stainless steel (CrNi, 1.4571) - probe / Brass (CuZn) - support tube from 250°C)

	(10)	Material of process connection (PC)[a]
00		Without (only TF 01 and TF 11)
26		Stainless steel (CrNi, 1.4571)
46		Brass (CuZn)

	(11)	Insertion length, process connection (PC) [a] (dimension "EL" or "S")
0		Minimum insertion length TF 11 (active probe dimension)
50		50 mm
100		100 mm
150		150 mm
200		200 mm
. . .		Special length (specifications in plain text – 50 mm increments)

[a] For the description and special features refer to data sheet 608730.

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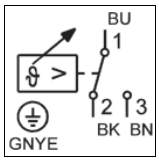
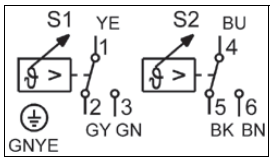
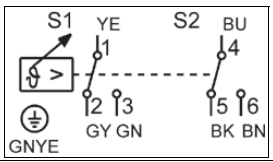
Order code	(12)	Switching output	
28		1 switch	
27		2 switches	
19		2 switches in fixed sequence	

	(13)	Extra codes (TZ)
000		Without extra code
434		Drag indicator can be adjusted with a screwdriver, protected by a cover
650		Microswitch 10 (3) A (AC/DC 230 V, +10/-15%, 48 to 63 Hz, cos φ = 1 (0.6))
518		Stop for Min. — or Max. — setpoint value limitation, default setting
522		Customized scale

Special versions upon request!

Order code

(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)		(13)	
608523	/	....	-	...	-	..	-	....	-	...	-	..	-	...	-	..	-	..	-	...	-	..	/	...	, ...

Order example

608523 / 2010 - 818 - 21 - 2000 - 750 - 10 - 000 - 26 - 00 - 100 - 28 / 000[a] , ...

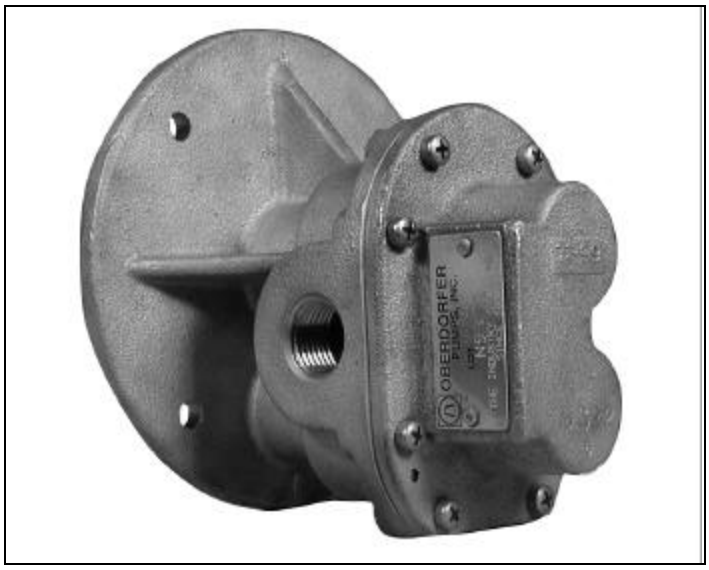
[a] List extra codes in sequence, separated by commas.

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

OBERDORFER PUMPS
A Subsidiary of Thomas Industries Inc.

MODEL N994 SERIES

MODEL N994 - 1/2" NPT PORTS



FEATURES

- **n** Bronze Construction with Stainless Steel Shafts
- **n** Helical gears for quiet operation
- **n** Easy Field Assembly to Motors
- **n** Self-Lubricating Carbon Bearings
- **n** O-ring seal for maximum leak protection

GENERAL DESCRIPTION

Pump housings and gears are made of top quality bronze, shafts are stainless steel 303. Bearings are made of high performance carbon-graphite material selected for wear resistance and long service life.

Gear pumps are positive displacement pumps. Each shaft revolution displaces a definite amount of liquid relatively unaffected by the back pressure in the discharge line. Shaft speed and flow are directly proportional.

DRIVE ARRANGEMENT

Close coupled pumps are mounted directly to the electric motor by means of a suitable adapter bracket. The pump drive shaft is connected to the motor shaft by a flexible coupling.

LIQUIDS AND TEMPERATURE

These pumps are suitable for all liquids that are compatible with bronze. Most common liquids are water, oil, and mild chemicals in the pH-range of 4 to 11. Viscous liquids require reduced shaft speeds of 1150 RPM or lower. Consult factory.

Liquids containing solids, abrasives, powders or paint pigments are definitely not recommended for gear pumps. If abrasives are unavoidable, use a very low shaft speed. The recommended liquid temperature range is 32^{0}F to 140^{0}F for longest pump life. If more extreme temperature conditions exist, our factory should be consulted. Freezing of water-filled pumps can cause damage and must be avoided. Oils at low temperatures are very viscous requiring a lower speed or extra power.

PERFORMANCE

Water 70^0 F

1725 R.P.M.					Pump & Motor No.	
PSI	GPM	HP Req.	HP Motor	Motor Frame	Single Phase	Three Phase
0	10.5	0.50	1/2	56C	N994HJ45	N994HJ95
20	10.3	0.75	3/4	56C	N994HM26	N994HM95
40	10.1	0.9	1	56C	N994HN26	N994HN95
60	9.9	1.2	1 1/2	145TC	N994JT45	N994JT95
80	9.6	1.5	1 1/2	145TC	N994JT45	N994JT95
100	9.4	1.75	2	145TC	N994JW45	N994JW95
125*	9.2	2	2	145TC	N994JW45	N994JW95
150*	9	2.32	3	182TC	N994KY45	N994KY95

1150 R.P.M.					Pump & Motor No.	
PSI	GPM	HP Req.	HP Motor	Motor Frame	Single Phase	Three Phase
0	6.9	0.24	1/2	56C	N994HJ46	N994HJ96
20	6.6	0.29	1/2	56C	N994HJ46	N994HJ96
40	6.4	0.43	1/2	56C	N994HJ46	N994HJ96
60	6.1	0.58	3/4	56C	N994HM46	N994HM96
80	5.9	0.72	3/4	56C	N994HM46	N994HM96
100	5.6	0.93	1	145TC	N994JN46	N994JN96
125*	5.4	1.25	1 1/2	145TC	N994JT46	N994JT96
150*	5.2	1.63	2	184TC	N994KW46	N994KW96

*For pressures over 100 psi, the above selections are suitable for pumping fluids with lubricity (e.g. oils, polymers). Service life will decrease for fluids without lubricity (e.g. water, solvents).

SUCTION LIFT

As a general rule, the suction lift should be kept at an absolute minimum by placing the pump as close to the liquid source as possible. A gear pump in new condition can lift 20 feet of water in the suction line. A foot valve (preferably with built-in strainer) is recommended at the beginning of the suction line. For a first start-up, the pump should be primed to avoid dry running. Minimum size of the suction pipe is the size of the pump inlet port. For longer suction lines (over 3 feet), or for viscous liquids, the pipe size should be at least one size or two sizes larger than the pump inlet port.

ROTATION AND RELIEF VALVE

The relief valve is not intended to be a metering or flow control device. Its main purpose is to function as a discharge pressure relief when the spring tension is exceeded by the discharge pressure. Overheating can occur within 5-10 minutes if the discharge line is completely shut off for extended periods.

Unless otherwise specified, the pump motor unit is supplied by the factory for shaft rotation clockwise from shaft end. Reversing the motor rotation will reverse the "in" and "out" ports and also requires changing the relief valve location. The relief valve is always on the discharge side in this pump series. The factory pressure setting is 50 PSIG. To increase pressure, turn the relief valve adjusting screw in a clockwise direction.

To reverse single phase motors, find instructions on the inside of the junction box cover or on the name plate of the motor.

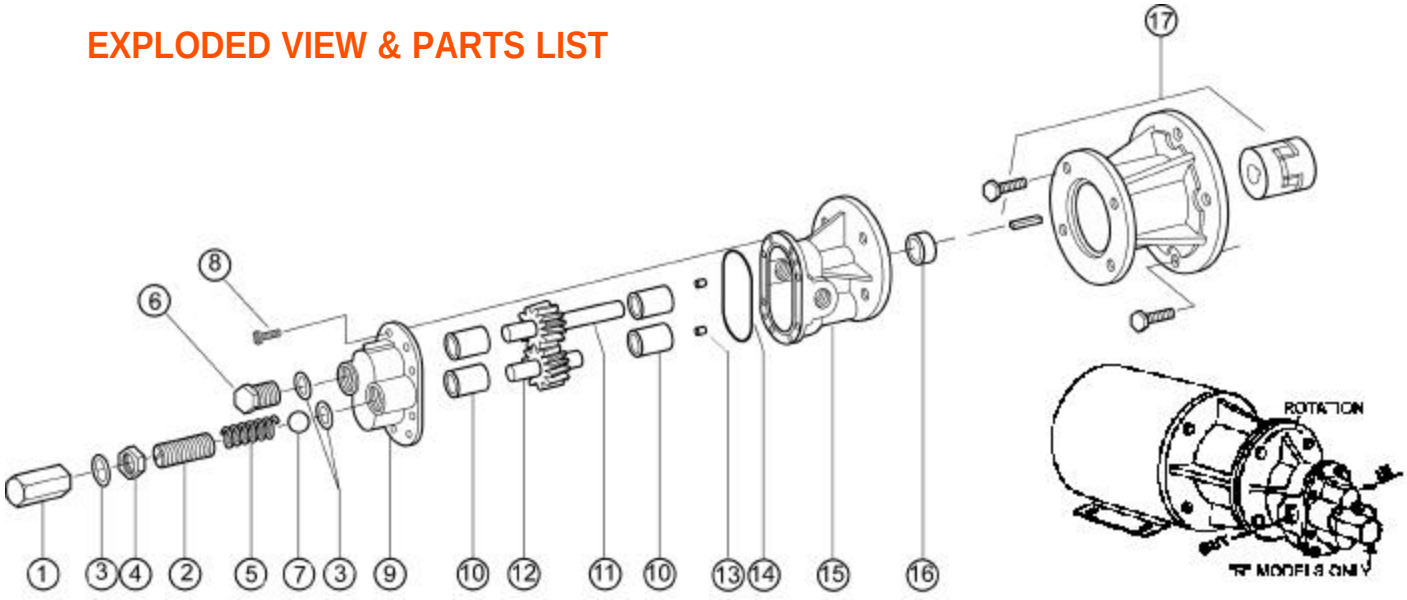
Three phase motors are not wired for any particular rotation. They can be reversed by interchanging any two (2) wires of the three (3) wire leads.

MODEL
N994
SERIES

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

OBERDORFER PUMPS
A Subsidiary of Thomas Industries Inc.

EXPLODED VIEW & PARTS LIST



Pump No.	1	2	3	4	5	6	7	8	9	10[1]	11[1]	12[1]	13	14[1]	15	16[1,2]	17
	Bypass Nut	Adj. Screw	Fiber Washer	Locknut	Spring	Plugnut	Ball	Screw	Cover	Bearing	Drive Gear Assy.	Idle Gear Assy.	Dowel Pin	O-Ring	Body	Lipseal	Adapter Kits
	1 Req'd	1 Req'd	3 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	8 Req'd	1 Req'd	4 Req'd	1 Req'd	1 Req'd	2 Req'd	1 Req'd	1Req'd	1 Req'd	
N994	---	---	---	---	---	---	---	5385	9322NN5N	5091	33011	33008	8885	9797-041	9320ND2N	5463	See Below
N994R	5204	5200	6964	5209	5207	5205	5206	5385	9323NN5B	5091	33011	33008	8885	9797-041	9320ND2N	5463	

[1] Repair kits contain items 10, 11, 12, 14 & 16. Repair kit for N994(R) is 11333.

[2] Part # 5463 is standard Buna N, part #9997 is Viton(R)*-Teflon(R)*.

Adapter Kits

Adapter Kit	Part Number	Description
H	11299	56C Frame
J	11300	143TC/145TC
K	11301	182TC/184TC
L	11302	213TC/215TC

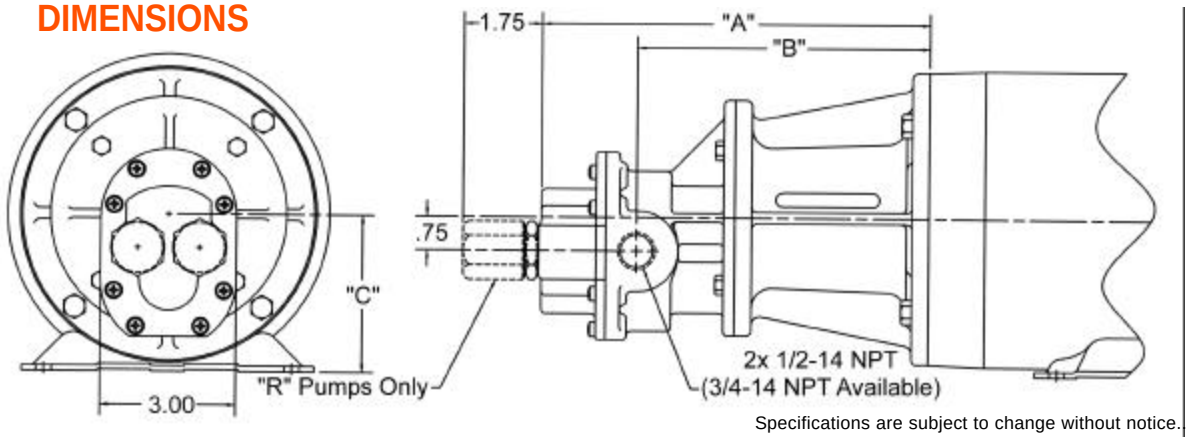
Variations

Pump Model	16[1,2] Lipseal	Description	Repair Kit
N994S15	9997	Viton(R)*-Teflon(R)*	12100
N994RS15	9997	Viton(R)*-Teflon(R)*	12100

Motor/Adapter Kit Dimensions (see below)

Model	Motor Frame	"A"	"B"	"C"
N994(R)H	56C	8.63	6.50	3.50
N994(R)J	143TC/145TC	8.63	6.50	3.50
N994(R)K	182TC/184TC	9.45	7.31	4.50
N994(R)L	213TC/215TC	9.45	7.31	5.25

DIMENSIONS



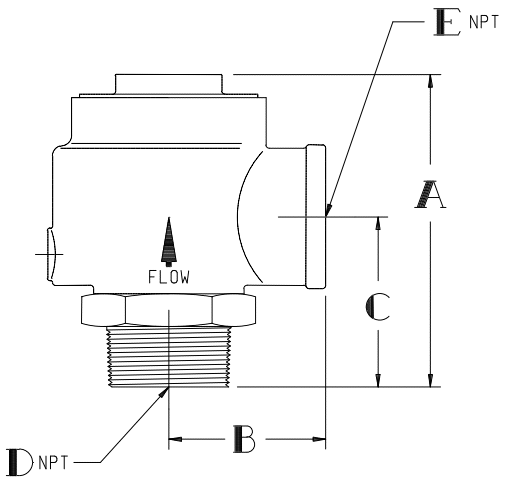
Specifications are subject to change without notice.

*Viton(R) or equivalent FKM will be used. Viton(R) is a trademark of DuPont Dow Elastomers.
Teflon(R) or equivalent PTFE will be used. Teflon(R) is a registered trademark of DuPont.

6/00

LTR	REVISION	DATE	DR	CH
A	REDRAWN WITH REVISIONS (ECN 2665)	8-22-97	SM	NF

M-D PART NUMBER	SEAT DIAMETER	VALVE SIZE	A ± 1/4	B ± 3/32	C ± 3/32	D NPT	E NPT	WEIGHT LBS
1362-6	2	2	7 1/4	3 1/4	3 1/4	2" MALE	2" FEMALE	8
1362-7	2 1/2	2 1/2	8	3 3/4	3 3/4	2 1/2" MALE	2 1/2" FEMALE	12
1362-8	3	3	9 1/2	4 1/4	4 1/4	3" MALE	3" FEMALE	19



NOTE:
SERVICE RECOMMENDATONS: AIR OR GAS. 22" HG AT 300°F

MATERIALS OF CONSTRUCTION:
BRONZE NOZZLE. DISC. GUIDE & SEAT.
SST SPRING.

INSTRUCTIONS:
1. AVOID OVERTIGHTENING OF VALVE DURING INSTALLATION.
2. VACUUM SETTING MAY BE VARIED APPROXIMATELY ± 10% OF ORIGINAL SETTING BY REMOVING AND LOOSENING THE FILLISTER HEAD MACHINE SCREW AND THEN RUNNING SCREW IN OR OUT AS DESIRED.
3. VALVE MAY BE CLEANED BY REMOVING DISC AND CLEANING SEAT SURFACE WITH A SOFT CLOTH. SEATING SURFACE MAY BE LAPPED IN CASE OF LEAKAGE BY USING A FINE GRIT COMPOUND.
4. REFER TO M-D SPRING DRAWING 1352S SERIES FOR VACUUMS FROM 1" HG TO 30" HG.
5. VALVE PRE-SET TO RECOMMENDED SPECIFICATIONS OF PURCHASE ORDER AT M-D PRIOR TO SHIPMENT.

VACUUM SET AT 180 HG

TOLERANCES
.XX ± .
.XXX ± .
.XXXX ± .
ANGULAR ±
FRACTIONAL ±
CHAMFERS ± 2°

BREAK ALL SHARP EDGES AND CORNERS

DR SM 8-21-97
CH NF 9-12-97

FIRST USED ON

MATL P/N:
MATL:

TUTHILL Pneumatics Group Springfield, Missouri USA

VACUUM RELIEF VALVE

SIZE: B | 1362

SCALE: NONE | WT LBS | SHEET OF

Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

Dayton® Automatic Power Attic Roof Ventilator

Description

Dayton Automatic Power Attic Roof Ventilator are used to provide a high volume of air circulation for general cooling applications and remove high humidity air in attic area. Low sound levels for domestic or commercial applications. The metal dome is a weather proof powder coated galvanized steel that comply with UL standard UL507 wind test requirement. Stamped aluminum 6-blade propeller, 115V, 60 Hz motor has automatic reset thermal protection. The thermostat and humidistat allow setting the attic roof ventilator to operate at the desired temperature/humidity to remove high temperature/humidity attic air and keep the attic cool and dry. Motors are permanently lubricated.

All ventilators are UL and cUL listed and comply with UL507.

Figure 1 – Attic Roof Ventilator

Figure 2 – Control box

Unpacking

1. Inspect carefully for any signs of damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.

General Safety Information

⚠ WARNING ***To reduce the risk of fire, electric shock, or injury to persons, observe the following:***

1. All wiring must be in accordance with the National Electrical Code (ANSI/NFPA 70-1999) and local electrical code. Electrical installation should be performed by a qualified listed electrician.
2. Ensure that the power source conforms to the electrical requirements of the ventilator.

⚠ WARNING ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the ventilator. Failure to do so may result in fatal electrical shock.***

⚠ WARNING ***Do not insert fingers or foreign objects into the fan. Do not block or tamper with the fan in any manner while it is in operation.***

⚠ WARNING ***Do not touch motor. May be hot enough to cause injury.***

3. Fan is intended for general air venting ONLY. It must NOT be used in potentially dangerous locations such as flammable, explosive, chemical-laden, or wet atmospheres.

⚠ WARNING ***Unplug prior to servicing unit.***

4. Fan motor is equipped with an automatically resetting thermal protector that will disconnect power if the motor overheats. Always disconnect ventilator before removing guard, as motor may restart unexpectedly.
5. In cases in which property damage may result from malfunction of the ventilator, a suitable alarm (air switch, temperature sensor, etc.) should be used.
6. Do not operate any fan with a damaged electric connection. Discard ventilator or return to an authorized service facility for examination and/or repair.
7. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
8. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent excessive low air pressure and back drafting.Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and the local code authorities.
9. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
10. Ducted fans must always be vented to the outdoors.
11. If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application and be connected to a GFCI (Ground Fault Circuit Interrupter) – protected branch circuit.

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Dayton® Automatic Power Attic Roof Ventilator

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Installation

LOCATION

1. Place the Attic Ventilator to the center of the rear slope of the roof will get the best effect to remove the hot and humidity air in the roof. It will also be invisible from the street. Make sure the location is free of obstacles like TV atenna, Electric lines...etc before installation.

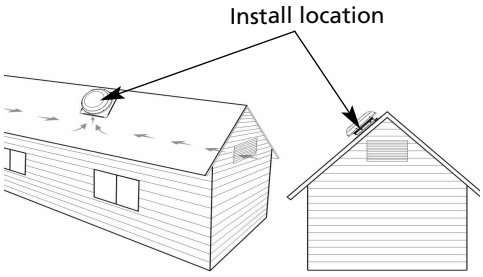


Figure 3 – Location & Air intake opening

2. Go to attic and find the central location in the attic. Put a nail on the roof that go through the other side of the roof board by a hammer. It will use as a center location of the Attic fan.

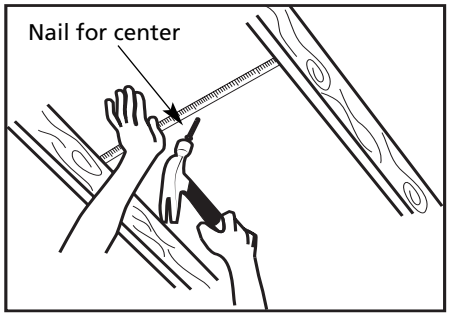


Figure 4 – Put a nail go throught the roof board as a center point

3. Go to the roof, use template to mark and cut the shingles and remove them all.

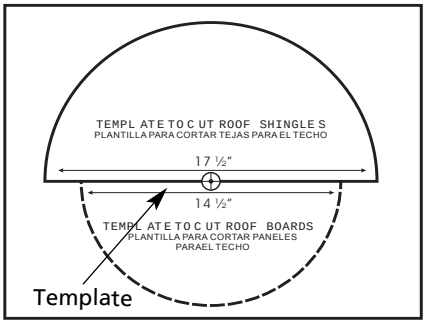
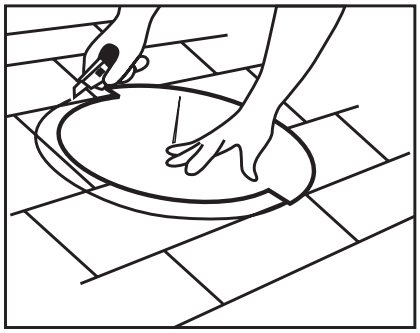
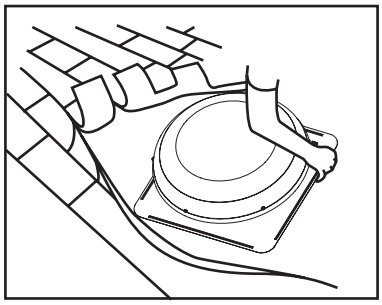


Figure 5 – Template for shingle & roof board marking and cutting





4. Trail the line and use a Reciprocating saw to cut a hole for air intake of the attic fan

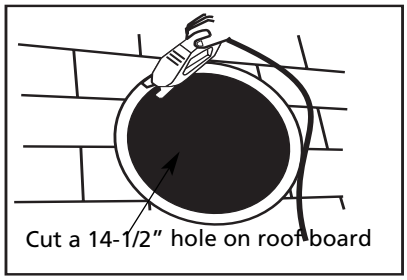
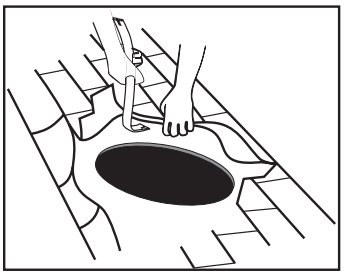
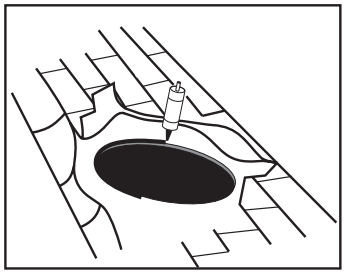


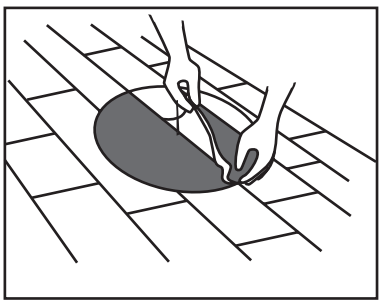
Figure 6 – Cut the air intake hole

5. Use the prying bar to move the shingles around the holes for lay down the attic fan. Try to preserve the shingle becasue you need to put back the shingle after lay down the attic fan.

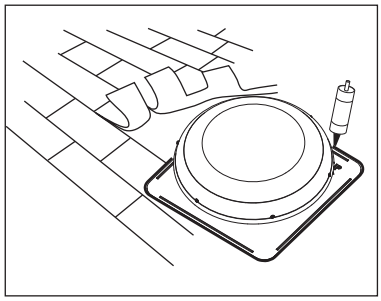


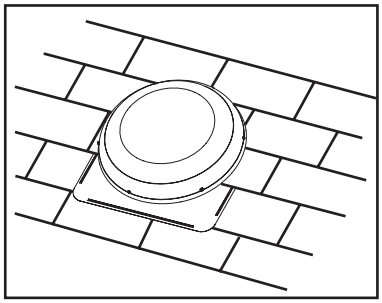


6. Place attic Fan - Apply caulk on the roof board around the holes and lay down the attic fan on the hole. Secure the attic fan by nailing the roof nails around the flange of the attic fan. Then apply caulk again around the base of the attic fan to seal, put back the shingles.Seal the flange and shringle by non-hardening sealant.



Models 10N201, 10N202 and 10N203





7. After secure the roof ventilator unit. Go inside to the attic. Secure the control box of 10N202 onto the rafter adjacent to the unit before wire connection.

Remark: The control box of 10N201 with thermostat only was mounted on the unit directly.

⚠ WARNING ***Consult a licensed electrician for wiring.***

Figure 7 – Control box of 10N201 was mounted on the base.

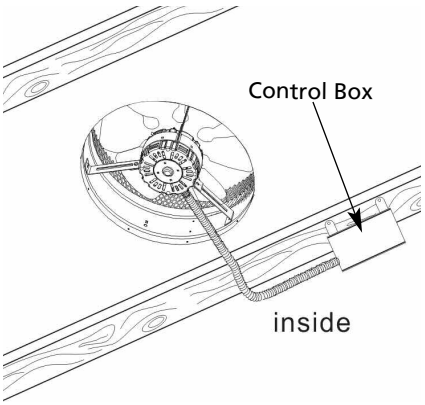


Figure 8 – Mount the control box of 10N202 on the adjacent rifter

8. Connect the Black and White wire line out from the control box to the electric lines controlled by a master On/Off switch as shown in the wiring diagram in Fig 9 for 10N201 and Fig.10 for 10N202.

⚠ WARNING ***Turn off the master switch prior to servicing unit.***

To avoid personal injury, wall switch must be turn off before servicing since the built-in theraml protection may turn on the circulator automatically.

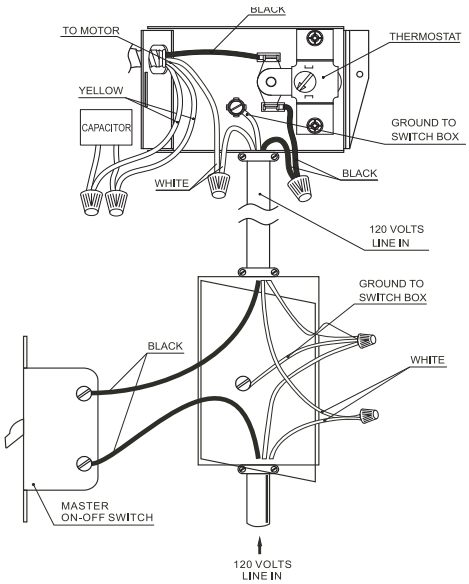


Figure 9 – Wiring Diagram for wire connection of 10N201

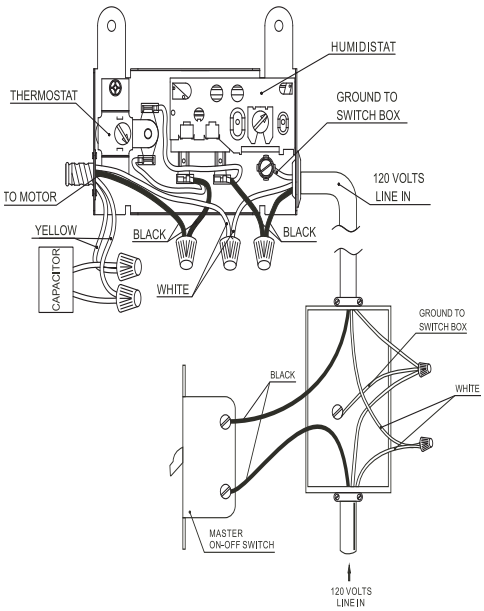


Figure 10 – Wiring Diagram for wire connection of 10N202

Operation

Please set the Thermostat and/or Humidistat to desired condition before operated, using screw driver to turn the arrow of the knob to the desire temperature/humidity mark on the panel of the control box.

Maintenance

⚠ WARNING ***Parts replacement and troubleshooting to be performed only by qualified personnel.***

⚠ WARNING ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the vetilator. Failure to do so may result in fatal electrical shock.***

⚠ CAUTION ***Do not use gasoline, benzene, thinner, harsh cleaners, etc., which are dangerous and will damage the air circulator.***

⚠ WARNING ***Turn off the master switch before servicing or cleaning.***

⚠ WARNING ***The thermostat + humidistat 10N203 control box is to be used only with Dayton attic ventilators.***

CLEANING

The propeller and motor should be cleaned periodically to prevent overheating, and/or operating in an imbalanced condition.

If cleaning requires the removal of the dome, remove only the top dome and re-install when finished in its originally installed position.

Do not repair propeller if it becomes damaged. The propeller is accurately balanced at the factory and should be replaced if damaged. Motor is permanently lubricated.

Notes

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

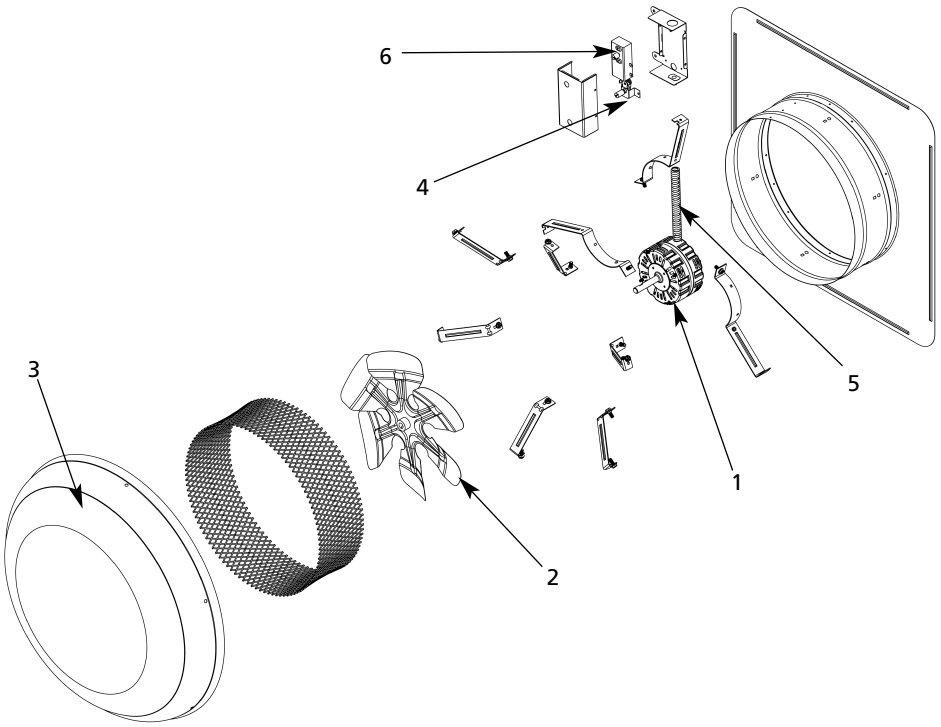


Figure 13 – Repair Parts Illustration for Automatic Power Attic Roof Ventilator

Repair Parts List for Automatic Power Attic Roof Ventilator

Reference Number	Description	Part Number for Models: 10N201	10N202	Quantity
1	Motor	VESP127416DG	VESP127416DG	1
2	Blade	VEVRM150300G	VEVRM150300G	1
3	Dome	VEVRM150001G	VEVRM150001G	1
4	Thermostat	VEVRM150420G	VEVRM150420G	1
5	Flexible Conduit	VEVRM150009G	VEVRM150009G	1
6	Humidistat		VEVRM150009G	1

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Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Unit fails to operate	1. Blown fuse or open circuit breaker 2. No power 3. Defective motor	1. Replace fuse or reset circuit breaker 2. Contact power company 3. Replace unit; motor is not field serviceable
Excessive vibration	1.Propeller imbalance due to accumulation of dirt, etc.	1. Clean propeller

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® AUTOMATIC POWER ATTIC ROOF VENTILATOR, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

LIMITATION OF LIABILITY. *TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

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Product Suitability. *Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While attempts are made to assure that Dayton products comply with such codes, Dayton cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, review the product applications, and all applicable national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

Manufactured for Dayton Electric Mfg. Co.
Niles, Illinois 60714 U.S.A.

Por favor lea y guarde estas instrucciones. *Léalas cuidadosamente antes de tratar de montar, instalar, operar o dar mantenimiento al producto aquí descrito. Protéjase usted mismo y a los demás observando toda la información de seguridad. ¡El no cumplir con las instrucciones puede ocasionar daños, tanto personales como a la propiedad! Guarde estas instrucciones para referencia en el futuro.*

Ventilador automático de techo del ático de Dayton®

Descripción

El ventilador automático de techo del ático de Dayton se utiliza para proporcionar un alto volumen de circulación de aire para las aplicaciones de refrigeración y eliminar el aire de alta humedad en el área del ático. Los bajos niveles de ruido son ideales para aplicaciones domésticas o comerciales. La cúpula de metal es resistente a mal tiempo con recubrimiento de polvo de acero galvanizado que cumplen con el requisito de la prueba de viento de las normas UL UL507. La hélice de 6 palas es de aluminio estampado, y motor automático de 115 V, 60 Hz tiene la protección térmica de reposición. El termostato y el higrostato permiten que el ventilador de techo del ático funcione a la humedad/la temperatura deseada para quitar la alta temperatura / humedad del aire del ático y mantener elático fresco y seco. Los motores están permanentemente lubricados.

Todos los ventiladores son UL y cUL listados y cumplen con UL507.

Figura 1 – Ventilador de techo del ático

Figura 2 – Caja de control

Desempaque

1. Inspeccione el producto cuidadosamente para verificar si se han producido daños durante el transporte.
2. Si han ocurrido daños durante el envío, se deberá presentar un reclamo a la compañía de transporte.

Información de Seguridad General

⚠ ADVERTENCIA ***Para reducir el riesgo de incendio, una sacudida eléctrica o lesiones a personas, observe lo siguiente:***

1. Todos los cableados deben estar de acuerdo con el Código Eléctrico Nacional (ANSI / NFPA 70-1999) y el código eléctrico local.La instalación eléctrica debe ser realizada por un electricista calificado.
2. Asegúrese que la fuente de alimentación satisfaga los requisitos eléctricos del ventilador.

⚠ ADVERTENCIA ***No dependa de un interruptor como único medio de desconectar la alimentación eléctrica cuando instale o le dé servicio al ventilador. Si no lo hace, podría sufrir un choque eléctrico fatal.***

⚠ ADVERTENCIA ***No inserte sus dedos ni objetos extraños en el ventilador. No bloquee ni altere el ventilador en forma alguna mientras está funcionando.***

3. El ventilador está diseñado UNICAMENTE para la circulación general del aire. NO debe utilizarse en lugares posiblemente peligrosos, tales como áreas donde haya productos inflamables, explosivos o químicos o en ambientes húmedos. No use el ventilador en o cerca de una ventana, ya que la lluvia podría crear un peligro eléctrico. No conecte conductos en el ventilador.

⚠ ADVERTENCIA ***Desenchúfelo antes de darle servicio a la unidad.***

4. El motor del ventilador está equipado con un protector térmico de restablecimiento automático que desconectará la alimentación eléctrica si el motor se sobrecalienta. Siempre desenchufe el ventilador antes de quitarle la rejilla ya que el motor podría arrancar inesperadamente.
5. En los casos donde podrían ocurrir daños a la propiedad debido a un mal funcionamiento del ventilador, se debe utilizar una alarma adecuada (interruptor de aire, sensor de temperatura, etc.).
6. No opere ningún aparato con un cable o enchufe dañado. Deseche el ventilador o el retorno a un centro de servicio autorizado para su revisión y / o reparación.
7. El trabajo de instalación y el cableado eléctrico debe ser realizado por personal cualificado (s) de acuerdo con todos los códigos y normas aplicables, incluyendo la construcción resistente al fuego.
8. Suficiente aire es necesario para la combustión y escape adecuados de los gases de combustión a través de la chimenea del equipo de la quema de combustible para prevenir la presión del aire baja y la redacción de nuevo. Siga el equipo de calefacción fabricante de referencia y normas de seguridad tales como los

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Ventilador automático de techo del ático de Dayton®

publicados por la Asociación Nacional de la Protección de Fuego (NFPA), y la Sociedad Americana de Calefacción, Refrigeración y Aire Acondicionado Ingenieros Acondicionado (ASHRAE), y las autoridades del código local.

9. Cuando corte o perfore una pared o el techo, no dañe el cableado eléctrico y otros equipamientos ocultos.
10. Ventiladores con conductos deben siempre tener ventilación hacia el exterior.
11. Si esta unidad se va a instalar sobre más de una bañera o ducha, debe estar marcado adecuado para la aplicación y conectarse a un GFCI (Ground Fault Circuit Interruptor) - rama protegida de circuito.

Información localización

1. Colocar el Ventilador del Ático en el centro de la ladera posterior del techo conseguirá el mejor efecto para quitar el aire caliente y la humedad en el techo. También será visible desde la calle. Asegúrese de que el lugar está libre de obstáculos como la antena de televisión, líneas eléctricas ... etc antes de la instalación.

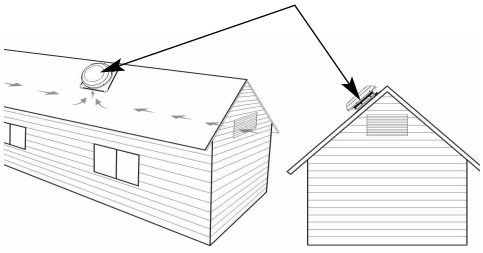


Figura 3 – Localización y apertura de entrada de aire

2. Vaya al ático y busque la ubicación central en el ático. Ponga un clavo en el techo que pasa por el otro lado de la placa del techo con un martillo. Se utilizará como la ubicación central del ventilador de ático.

Figure 4 – Ponga un clavo que pasa por la placa del techo como un punto central

3. Vaya a la azotea, use la plantilla para marcar y cortar las tejas y elimine todos.

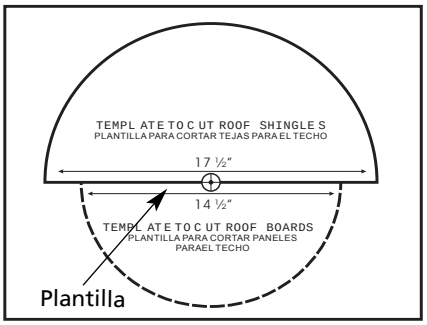
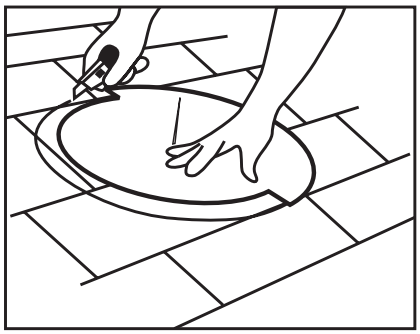
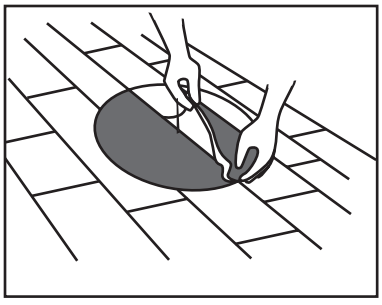


Figure 5 – Plantilla para el marcado y corte de la teja y placa de techo

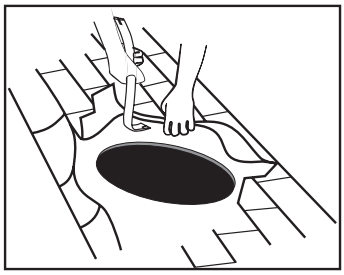


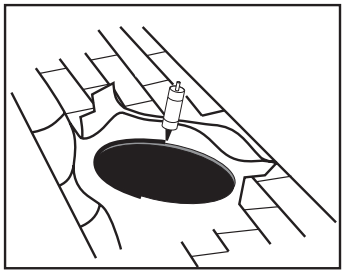


4. Siga la línea y use una sierra de sable para cortar un agujero para la entrada de aire del ventilador de ático.

Figure 6 – Corte el orificio de entrada de aire

5. Utilice la barra de palanca para mover las tejas alrededor de los agujeros para fijar el ventilador de ático. Trate de preservar la teja porque es necesario volver a poner la teja después de fijar el ventilador de ático.





6. Colocar el Ventilador del ático - Aplique masilla en la placa del techo alrededor de los agujeros y fije el ventilador de ático en el agujero. Asegure el ventilador del ático clavando los clavos del techo alrededor de la brida del ventilador del ático. A continuación, aplique

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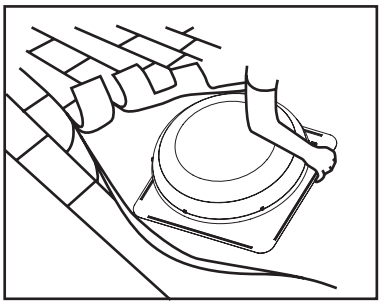
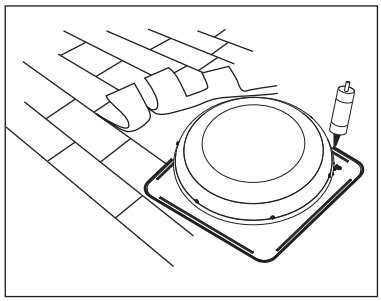
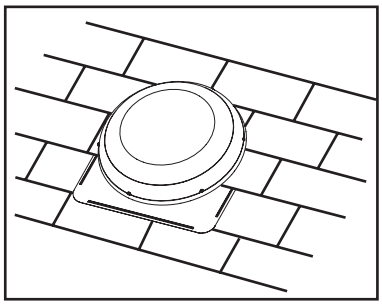
Modelos 10N201, 10N202 and 10N203

masilla de nuevo alrededor de la base del ventilador del ático para sellar, ponga de nuevo las tejas. Selle la brida y teja por sellador no endurecido.







7. Después de asegurar la unidad de ventilador de techo, vaya al interior del ático. Asegure la caja de control de 10N202 en la viga adyacente a la unidad antes de la conexión de cable.

Nota: La caja de control de 10N201 con termostato sólo fue montado en la unidad directamente.

⚠ ADVERTENCIA ***Consulte a un electricista con licencia para el cableado.***

Figure 7 – La caja de control de 10N201 fue montada en la base.

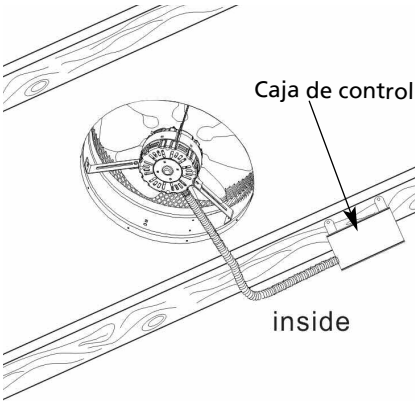


Figure 8 – Monte la caja de control de 10N202 en la viga adyacente

8. Conecte el cable Blanco y Negro desde la caja de control a las líneas eléctricas controladas por un interruptor principal de Encendido / Apagado como se muestra en el diagrama de cableado en la Figura 9 para 10N201 y Figura 10 para 10N202.

⚠ ADVERTENCIA ***Apague el interruptor principal antes de hacer el mantenimiento a la unidad. Para evitar lesiones personales, el interruptor de pared debe desactivarse antes de hacer el mantenimiento,porque la protección térmica incorporada puede activar el circulador de forma automática.***

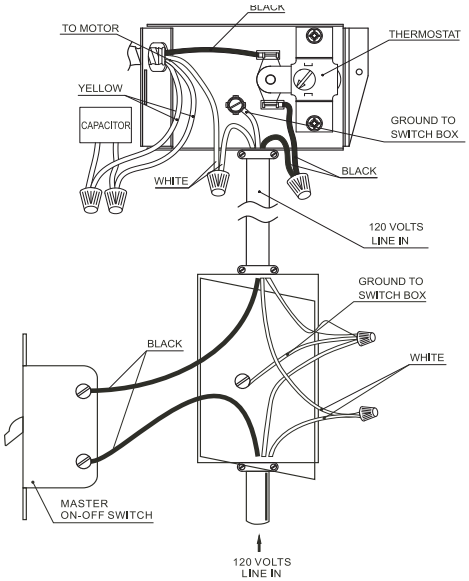


Figure 9 – Diagrama de cableado para la conexión del cable de 10N201

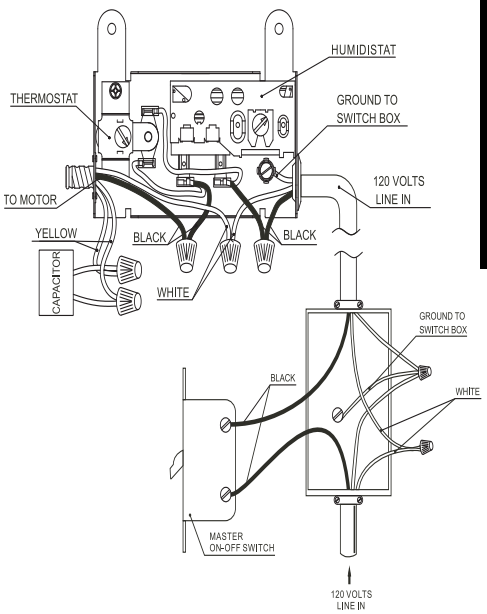


Figure 10 – Diagrama de cableado para la conexión del cable de 10N202

Operación

Por favor ajuste el Termostato y/o Humidistato a condición deseada antes de operar, utilizando un destornillador para girar la flecha de la perilla a la marca de temperatura / humedad deseada en el panel de la caja de control.

ESPAÑOL

Mantenimiento

⚠ ADVERTENCIA ***Todo reemplazo de partes y toda identificación y solución de problemas deberán ser realizados únicamente por personal calificado.***

⚠ ADVERTENCIA ***No dependa de un interruptor como único medio de desconectar la alimentación eléctrica cuando instale o le dé servicio al ventilador. Si no lo hace, podría sufrir un choque eléctrico fatal.***

⚠ PRECAUCION ***No utilice gasolina, benceno, diluyente, limpiadores duros, etc., ya que son peligrosos y le ocasionarán daños al circulador de aire.***

⚠ ADVERTENCIA ***Apague el interruptor principal antes de mantenimiento o limpieza.***

El termostato + higrostato 10N203 caja de control se va a utilizar sólo con ventiladores Dayton ático.

LIMPIEZA

La hélice, la rejilla y el motor se deben limpiar periódicamente para evitar el sobrecalentamiento, y/o el funcionamiento en condición desequilibrada.

Si la limpieza requiere la remoción de una rejilla, remueva sólo la protección frontal y vuelva a instalarla en la posición original cuando termine de limpiar. No repare la hélice si se daña. La hélice se equilibra en forma precisa en la fábrica y se debe reemplazar si se daña.

El motor está permanentemente lubricado.

Notas

ESPAÑOL

Para Obtener Partes de Reparación en México Llame al 001-800-527-2331 en EE.UU. Llame al 1-800-323-0620

Servicio permanente – 24 horas al día al año

Por favor proporciónenos la siguiente información:
-Número de modelo
-Número de serie (si lo tiene)
-Descripción de la parte y número que le corresponde en la lista de partes

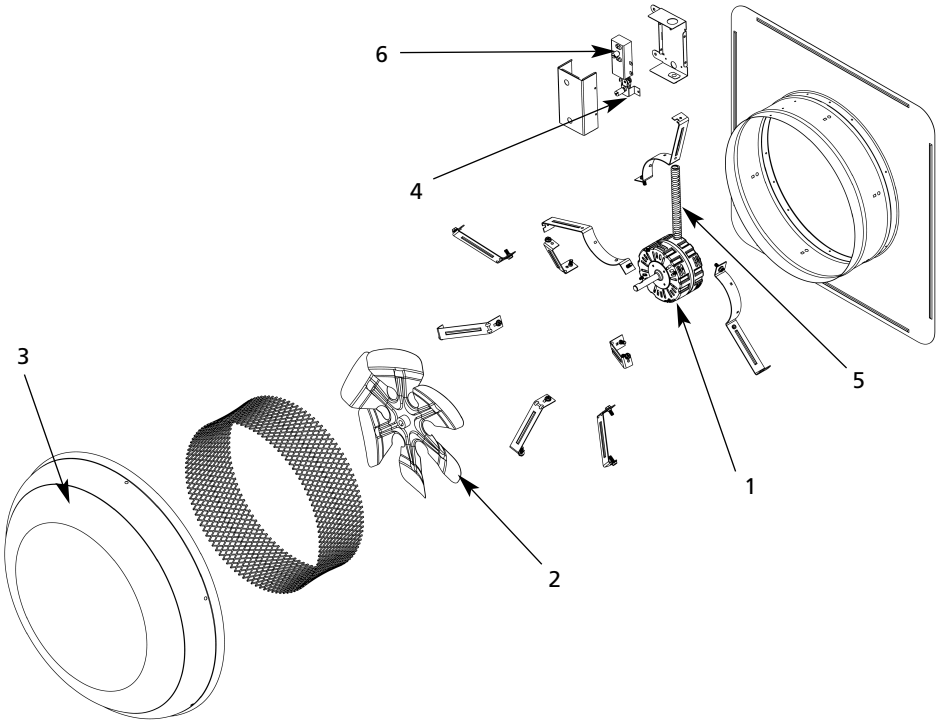


Figura 13 – Ilustración de las Partes de Reparación para los Ventilador automático de techo del ático

Lista de Partes de Reparación para los Ventilador automático de techo del ático

Número de Referencia	Descripción	Número de Parte para Modelos: 10N201	10N202	Cantidad
1	Motor	VESP127416DG	VESP127416DG	1
2	Hoja	VEVRM150300G	VEVRM150300G	1
3	Cúpula	VEVRM150001G	VEVRM150001G	1
4	Termostato	VEVRM150420G	VEVRM150420G	1
5	Conductos / flexibles	VEVRM150009G	VEVRM150009G	1
6	Humidistato		VEVRM150009G	1

ESPAÑOL

Ventilador automático de techo del ático de Dayton®

Tabla de Identificación de Problemas

Síntoma	Causa(s) Posible(s)	Medida Correctiva
La unidad no funciona	1. Fusible o cortacircuitos abierto o quemado	1. Reemplace el fusible o reinicie el cortacircuitos
	2. No hay alimentación	2. Comuníquese con la empresa de energía eléctrica
	3. Motor defectuoso	3. Reemplace la unidad; al motor no se le puede hacer servicio en campo
Vibración excesiva	1. Hélice desequilibrada debido a acumulaciones de suciedad, etc.	1. Limpie la hélice

ESPAÑOL

GARANTIA LIMITADA

GARANTIA LIMITADA DE DAYTON POR UN AÑO. *DAYTON ELECTRIC MFG. CO. (DAYTON) LE GARANTIZA AL USUARIO ORIGINAL QUE LOS MODELOS TRATADOS EN ESTE MANUAL DE LOS VENTILADOR AUTOMÁTICO DE TECHO DEL ÁTICO DAYTON® ESTAN LIBRES DE DEFECTOS EN LA MANO DE OBRA O EL MATERIAL, CUANDO SE LES SOMETE A USO NORMAL, POR UN AÑO A PARTIR DE LA FECHA DE COMPRA. CUALQUIER PARTE QUE SE HALLE DEFECTUOSA, YA SEA EN EL MATERIAL O EN LA MANO DE OBRA, Y SEA DEVUELTA (CON LOS COSTOS DE ENVIO PAGADOS POR ADELANTADO) A UN CENTRO DE SERVICIO AUTORIZADO DESIGNADO POR DAYTON, SERA REPARADA O REEMPLAZADA (NO EXISTE OTRA POSIBILIDAD) SEGUN LO DETERMINE DAYTON. PARA OBTENER INFORMACION SOBRE LOS PROCEDIMIENTOS DE RECLAMO CUBIERTOS EN LA GARANTIA LIMITADA, VEA LA SECCION "ATENCION OPORTUNA" QUE APARECE MAS ADELANTE. ESTA GARANTIA LIMITADA CONFIERE AL COMPRADOR DERECHOS LEGALES ESPECIFICOS QUE VARIAN DE JURISDICCION A JURISDICCION.*

LIMITES DE RESPONSABILIDAD. *EN LA MEDIDA EN QUE LAS LEYES APLICABLES LO PERMITAN, LA RESPONSABILIDAD DE DAYTON POR LOS DAÑOS EMERGENTES O INCIDENTALES ESTA EXPRESAMENTE EXCLUIDA. LA RESPONSABILIDAD DE DAYTON EXPRESAMENTE ESTA LIMITADA Y NO PUEDE EXCEDER EL PRECIO DE COMPRA PAGADO POR EL ARTICULO.*

EXCLUSION DE RESPONSABILIDAD DE LA GARANTIA. *SE HAN HECHO ESFUERZOS DILIGENTES PARA PROPORCIONAR INFORMACION E ILUSTRACIONES APROPIADAS SOBRE EL PRODUCTO EN ESTE MANUAL; SIN EMBARGO, ESTA INFORMACION Y LAS ILUSTRACIONES TIENEN COMO UNICO PROPOSITO LA IDENTIFICACION DEL PRODUCTO Y NO EXPRESAN NI IMPLICAN GARANTIA DE QUE LOS PRODUCTOS SEAN VENDIBLES O ADECUADOS PARA UN PROPOSITO EN PARTICULAR NI QUE SE AJUSTAN NECESARIAMENTE A LAS ILUSTRACIONES O DESCRIPCIONES. CON EXCEPCION DE LO QUE SE ESTABLECE A CONTINUACION, DAYTON NO HACE NI AUTORIZA NINGUNA GARANTIA O AFIRMACION DE HECHO, EXPRESA O IMPLICITA, QUE NO SEA ESTIPULADA EN LA "GARANTIA LIMITADA" ANTERIOR.*

Consejo Técnico y Recomendaciones, Exclusiones de Responsabilidad. *A pesar de las prácticas, negociaciones o usos comerciales realizados previamente, las ventas no deberán incluir el suministro de consejo técnico o asistencia o diseño del sistema. Dayton no asume ninguna obligación o responsabilidad por recomendaciones, opiniones o consejos no autorizados sobre la elección, instalación o uso de los productos.*

Adaptación del Producto. *Muchas jurisdicciones tienen códigos o regulaciones que rigen la venta, la construcción, la instalación y/o el uso de productos para ciertos propósitos que pueden variar con respecto a los aplicables a las zonas vecinas. Si bien se trata de que los productos Dayton cumplan con dichos códigos, no se puede garantizar su conformidad y no se puede hacer responsable por la forma en que se instale o use su producto. Antes de comprar y usar el producto, revise su aplicación y todos los códigos y regulaciones nacionales y locales aplicables y asegúrese de que el producto, la instalación y el uso los cumplan.*

Ciertos aspectos de limitación de responsabilidad no se aplican a productos al consumidor; es decir (a) algunas jurisdicciones no permiten la exclusión ni limitación de daños incidentales o consecuentes, de modo que las limitaciones o exclusiones anteriores quizás no apliquen en su caso; (b) asimismo, algunas jurisdicciones no permiten limitar el plazo de una garantía implícita, por lo tanto, la limitación anterior quizás no aplique en su caso; y (c) por ley, mientras la Garantía Limitada esté vigente no podrán excluirse ni limitarse en modo alguno ninguna garantía implícita de comercialización o de idoneidad para un propósito en particular aplicables a los productos al consumidor adquiridos por éste.

Atención Oportuna. *Se hará un esfuerzo de buena fe para corregir puntualmente, o hacer otros ajustes, con respecto a cualquier producto que resulte defectuoso dentro de los términos de esta garantía limitada. En el caso de que encuentre un producto defectuoso y que esté cubierto dentro de los límites de esta garantía haga el favor de escribir primero, o llame, al distribuidor a quien le compró el producto. El distribuidor le dará las instrucciones adicionales. Si no puede resolver el problema en forma satisfactoria, escriba a Dayton a la dirección a continuación, dando el nombre del distribuidor, su dirección, la fecha y el número de la factura del distribuidor y describa la naturaleza del defecto. La propiedad del artículo y el riesgo de pérdida pasan al comprador en el momento de la entrega del artículo a la compañía de transporte. Si el producto se daña durante el transporte, debe presentar su reclamo a la compañía transportista.*

Fabricado para Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 EE.UU.

Fabricado para Dayton Electric Mfg. Co.
Niles, Illinois 60714 EE.UU.

Veuillez lire et conserver ces instructions. *Lire attentivement avant de commencer à assembler, installer, faire fonctionner ou entretenir l'appareil décrit. Protégez-vous et les autres en observant toutes les informations sur la sécurité. Négliger d'appliquer ces instructions peut résulter en des blessures corporelles et/ou en des dommages matériels ! Conserver ces instructions pour références ultérieures.*

Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

Description

Le Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton est utilisé pour fournir un grand volume de circulation de l'air pour des applications de refroidissement générales et pour enlever l'air de humidité élevé dans le secteur de grenier. Niveaux sonores bas pour des applications commerciales ou domestiques. Le dôme en métal est un acier galvanisé enduit par poudre imperméable qui sont conforme à la condition d'essai du vent UL507. Estampé en aluminium 6-pale d'hélice, le moteur de 60 hertz, 115V, a la protection thermique de remise automatique. Le thermostat et l'hygrostat permet de régler le ventilateur de grenier pour fonctionner à la température/humidité désirées pour enlever l'air de grenier de température/humidité et pour maintenir le grenier frais et le grenier sec. Des moteurs sont lubrifiés en permanence.

Tous les ventilateurs sont UL et cUL énumérés et sont conformes à UL507.

Figure 1 – Ventilateur de grenier sur le toit

Figure 2 – Boîtier de contrôle

Déballage

1. Vérifier soigneusement qu'aucun dommage n'est survenu durant le transport.
2. Toute réclamation pour des dommages pendant le transport doit être soumise au transporteur.

Informations générales sur la sécurité

⚠ AVERTISSEMENT ***Pour reduire le risque du feu, la décharge électrique, ou blessures corporelles, observer ce qui suit***

1. Tout le câblage doit être conforme au Code Electrique National (ANSI/NFPA 70-1999) et au code électrique local. L'installation électrique devrait être effectuée par un électricien qualifié listé.
2. S'assurer que la source d'alimentation est conforme aux exigences électriques du ventilateur.

⚠ AVERTISSEMENT ***Ne pas dépendre d'un quelconque interrupteur comme moyen unique de coupure de l'alimentation lors de l'installation ou de l'entretien du ventilateur. Le fait de négliger cette consigne peut entraîner une décharge électrique fatale.***

⚠ AVERTISSEMENT ***Ne pas insérer les doigts ou des corps étrangers dans le ventilateur. Ne pas bloquer ou manipuler le ventilateur d'une quelconque manière pendant son fonctionnement.***

3. Le ventilateur est conçu pour la circulation générale de l'air SEULEMENT. Il ne doit PAS être utilisé dans des endroits potentiellement dangereux comme des atmosphères inflammables, explosives, chargées de produits chimiques ou humides. Ne pas utiliser le ventilateur dans ou à proximité d'une fenêtre, car la pluie peut créer un risque de choc électrique. Ne pas raccorder de conduit au ventilateur.

⚠ AVERTISSEMENT ***Débrancher avant de réparer l'appareil.***

4. Le moteur du ventilateur est équipé d'une protection thermique à réenclenchement automatique qui coupe l'alimentation au moteur en cas de surchauffe. Toujours débrancher le ventilateur avant d'enlever la protection, car le moteur peut redémarrer subitement.
5. Dans les cas où des dommages à la propriété peuvent survenir suite à une anomalie de fonctionnement du ventilateur, utiliser une alarme qui convient (disjoncteur à l'air libre, capteur de température, etc.).
6. Ne pas utiliser un ventilateur avec un cordon ou une fiche endommagé. fan Jeter ou retourner à un centre de service autorisé pour examen et / ou réparation.
7. Les travaux d'installation et le câblage électrique doivent être faits par les personnes qualifiées selon tous les codes et normes applicables, y compris la construction coupe-feu.
8. Suffisamment d'air est nécessaire pour la combustion et l'épuisement appropriés des gaz par la conduite (cheminée) de l'équipement brûlant de carburant pour éviter trop faible pression d'air et le dos rédaction. Suivre les directives du fabricant d'équipement de chauffage et les

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Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

normes de sécurité comme ceux édités par l'Association Nationale de Protection du Feu (NFPA),et Société Americaine pour Chauffage, Réfrigération et Air conditionnement (ASHRAE),et les normes stipulées par l'autorite locale.

9. Quand la coupure ou le forage dans le mur ou le plafond, n'endommage pas le câblage électrique et tous autres utilités cachées.
10. Des ventilateurs canalisés doivent toujours être exhalés à l'extérieur.
11. Si cette unité doit être installée au-dessus d'un bac ou d'une douche, elle doit être marquée appropriée pour l'application et reliée à un circuit de branchement protégé GFCI (interrupteur de circuit de défaut de la terre).

Installation

LOCALISATION

1. Placez le ventilateur de grenier au centre de la pente arrière du toit obtiendra le meilleur effet pour enlever l'air chaud et d'humidité dans le toit. Il sera également invisible de la rue. Assurez-vous que l'endroit est libre d'obstacles comme l'antenne de télé, des lignes électriques… etc. avant l'installation.

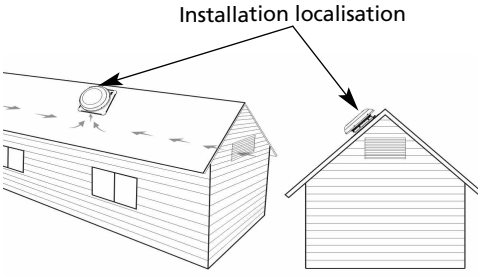


Figure 3 – Localisation & trou d'entrée d'air

2. Allez au grenier et trouvez l'endroit central dans le grenier. Mettez un clou sur le toit qui passent par l'autre côté du panneau de toit par un marteau. Il sera utilize comme un endroit central du ventilateur de grenier.

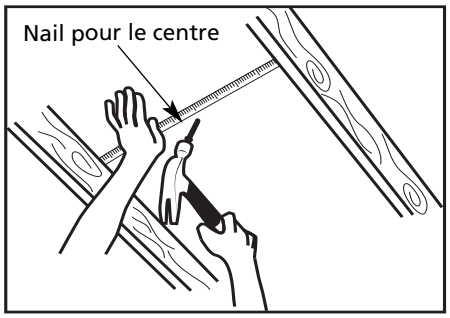


Figure 4 – Mettez un clou de passer par le panneau de toiture comme un point central

3. Allez sur le toit, utilisez le modèle pour marquer et couper les bardeaux et les supprimer tous.

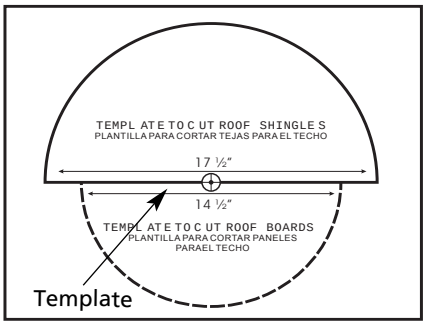
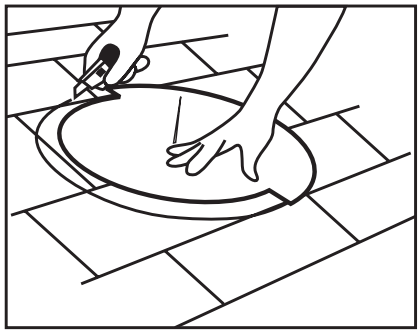
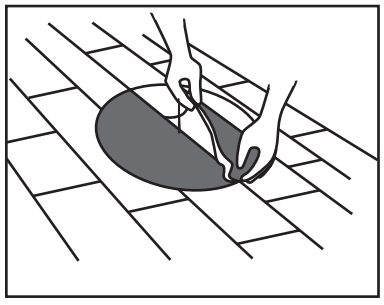


Figure 5 – Modèle pour le bardeau & marquage et découpage de panneau de toit





4. Suivez la ligne et utilisez une scie alternative pour couper un trou pour l'entrée d'air du ventilateur de grenier.

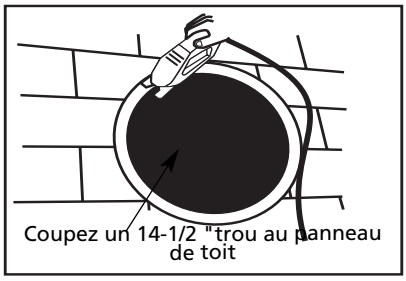
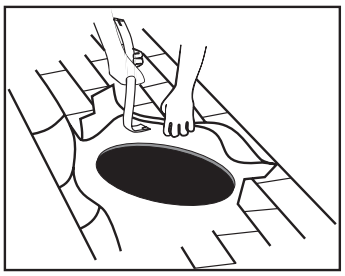
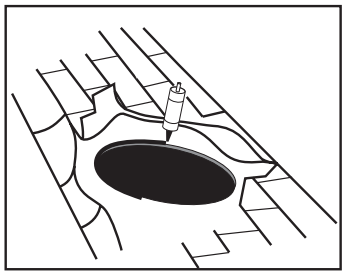


Figure 6 – Couper le trou d' entrée d'air

5. Utilisez le levier pour déplacer les bardeaux autour des trous pour fixer le ventilateur de grenier. Essayez de préserver le bardeau car vous avez besoin de remettre le bardeau après fixant le ventilateur de grenier.





6. Placez le ventilateur de grenier - Appliquez le mastic sur le bord du toit autour des trous et fixez le ventilateur de grenier sur le trou. Fixez le ventilateur de grenier en clouant les clous de toit autour de la bride du ventilateur de grenier. Appliquez alors le mastic encore autour de la base du ventilateur de grenier, remettez les bardeaux. Scellez de bride et du bardeau par le mastic non durcissant.

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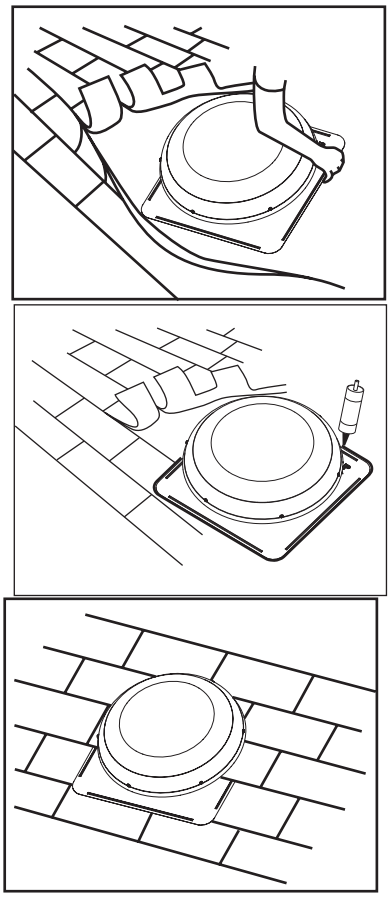
Modèles 10N201, 10N202 et 10N203



7. Après bloqué l'unité de ventilateur de toit, allez à l'intérieur au grenier. Fixez la boîte de commande de 10N202 sur le comble à côté de l'appareil avant que la connexion du fil.

Remarque: La boîte de commande de 10N201 avec le thermostat seulement a été montée sur l'appareil directement.

⚠ AVERTISSEMENT ***Consultez un électricien agréé pour le câblage.***

Figure 7 – La boîte de commande 10N201 a été montée sur la base.

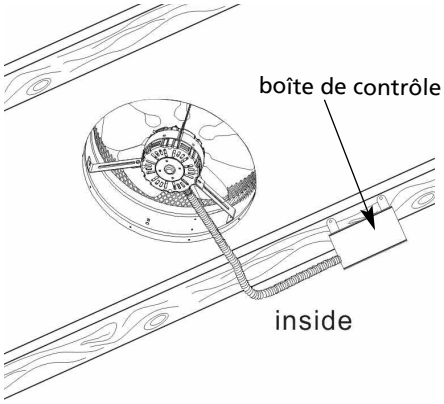


Figure 8 – Montez la boîte de commande 10N202 sur le comble adjacent

8. Reliez la ligne de fil noire et blancheà partir de la boîte de contrôle sur les lignes électriques commandées par un commutateur "Marche/Arrêt", comme indiqué dans le schéma de câblage de la figure 9 pour 10N201 et 10N202 pour Fig.10.

⚠ AVERTISSEMENT ***Arrêtez le commutateur principal avant l'opération de l'unité. Pour éviter les blessures, le commutateur mural doit êtreéteindre avant l'entretien puisque la protection thermique intégrée peut allumer le circulateur automatiquement.***

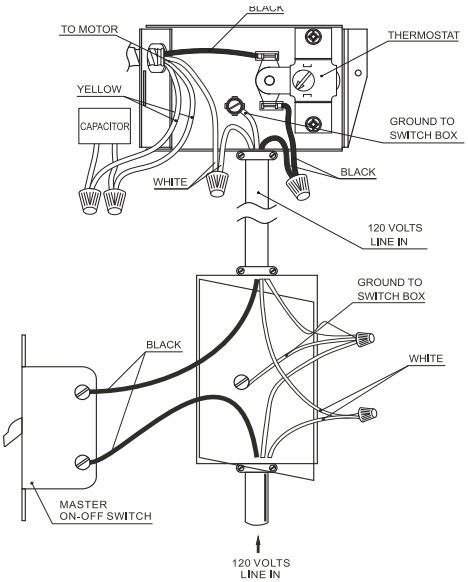


Figure 9 – Montez la boîte de commande 10N202 sur le comble adjacent

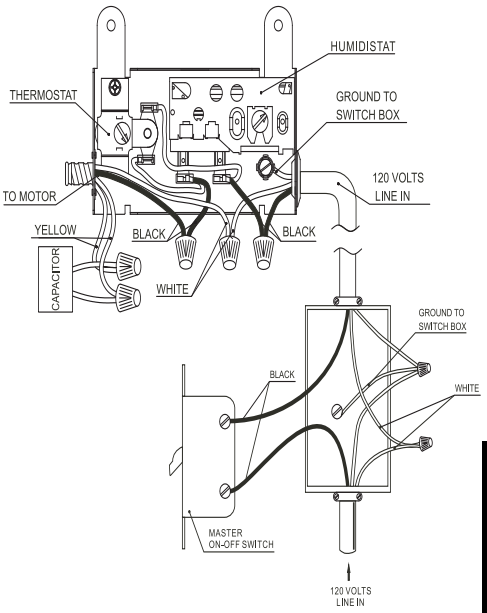


Figure 10 – Schéma de câblage pour le raccordement de fil 10N202

Fonctionnement

Veuillez régler le thermostat et/ou l'hygrostat à l'état désiré avant fonctionné, utilisant le tournevis pour tourner la flèche du bouton à la marquee de température/d'humiditéde désirée sur le panneau de boîte de commande.

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Entretien

⚠ AVERTISSEMENT ***Le remplacement des pièces et le dépannage doivent être effectués pardu personnel qualifié.***

⚠ AVERTISSEMENT ***Ne pas dépendre d'un quelconque interrupteur comme moyen unique de coupure de l'alimentation lors de l'installation ou de l'entretien du ventilateur. Le fait de négliger cette consigne peut entraîner une décharge électrique fatale.***

⚠ ATTENTION ***Ne pas utiliser d'essence, de benzène, de diluant, de nettoyants forts, etc. qui présentent un danger et endommageront le ventilateur.***

⚠ AVERTISSEMENT ***Arrêtez le commutateur principal avant entretien ou nettoyage.***

Le thermostat + hygrostat boîte de contrôle 10N203 doit être utilisé uniquement avec les ventilateurs de Dayton grenier.

NETTOYAGE

Nettoyer l'hélice, la protection et le moteur régulièrement pour éviter une surchauffe et/ou des conditions de fonctionnement déséquilibré.

Si le nettoyage exige le démontage d'une protection, enlever seulement la protection avant et la réinstaller dans sa position d'origine lorsque terminé. Ne par réparer une hélice qui a subi des dommages. L'hélice est équilibrée avec précision en usine et doit être remplacée si elle subit des dommages.

Le moteur est lubrifié en permanence.

Notes

FRANÇAIS

Commandez les pièces détachées en appelant gratuitement 1 800 323-0620

24 heures par jour – 365 jours par an

S'il vous plaît fournir l'information suivante :
-Numéro de modèle
-Numéro de série (s'il y en a un)
-Description de la pièce et son numéro comme montré sur la liste de pièces

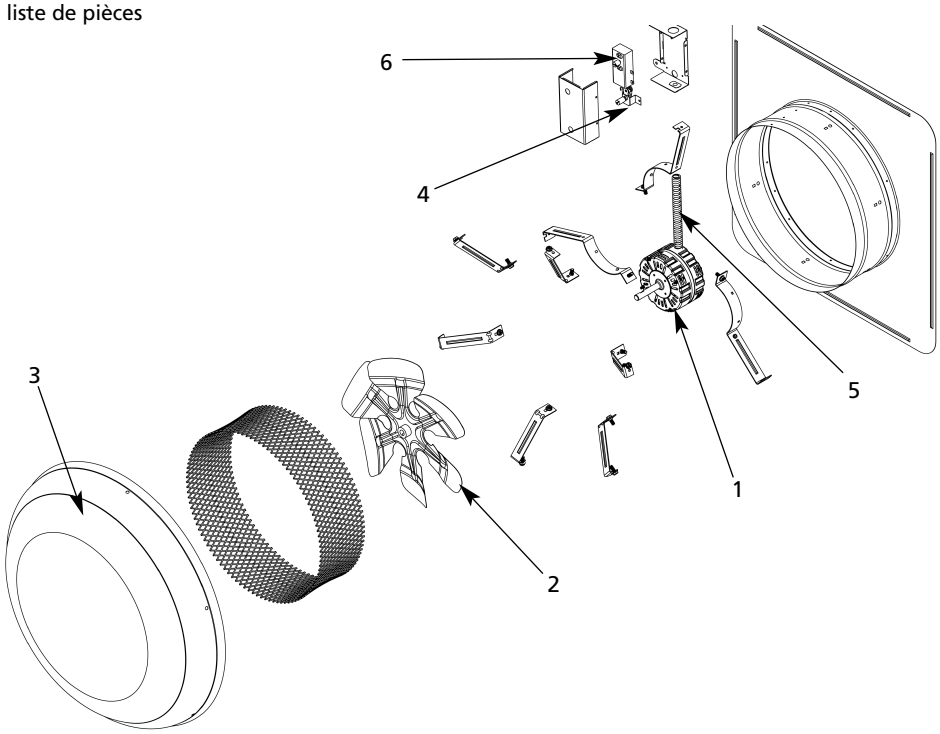


Figure 13 – Illustrations des pièces détachées pour Ventilateur de Grenier sur le Toit de Puissance Automatique

Liste des pièces détachées pour Ventilateur de Grenier sur le Toit de Puissance Automatique

Numéro de référence	Description	Numéro de pièce pour modèles : 10N201	10N202	Quantité
1	Moteur	VESP127416DG	VESP127416DG	1
2	Lame	VEVRM150300G	VEVRM150300G	1
3	Dôme	VEVRM150001G	VEVRM150001G	1
4	Thermostat	VEVRM150420G	VEVRM150420G	1
5	Conduit / flexible	VEVRM150009G	VEVRM150009G	1
6	Hygrostat		VEVRM150009G	1

FRANÇAIS

Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

Tableau de dépannage

Symptôme	Cause(s) possible(s)	Action corrective
L'appareil ne fonctionne pas	1. Fusible grillé ou disjoncteur déclenché 2. Pas d'alimentation électrique 3. Moteur défectueux	1. Remplacer le fusible ou réenclencher le disjoncteur 2. Contacter le pourvoyeur d'électricité 3. Remplacer l'appareil; le moteur ne peut être réparé sur place
Vibration excessive	1. Fusible grillé ou disjoncteur déclenché	1. Nettoyer l'hélice

GARANTIE LIMITÉE

GARANTIE LIMITÉE DE UN AN DE DAYTON. *LES MODÈLES DE VENTILATEUR DE GRENIER SUR LE TOIT DE PUISSANCE AUTOMATIQUE DAYTON® COUVERTS DANS CE MANUEL SONT GARANTIS À L'UTILISATEUR D'ORIGINE PAR DAYTON ELECTRIC MFG. CO. (DAYTON), CONTRE TOUT DÉFAUT DE FABRICATION OU DE MATÉRIAUX, LORS D'UNE UTILISATION NORMALE, ET CELA PENDANT UN AN APRÈS LA DATE D'ACHAT. TOUTE PIÈCE, DONT LES MATÉRIAUX OU LA MAIN D'OUVRE SERONT JUGÉS DÉFECTUEUX, ET QUI SERA RENVOYÉE PORT PAYÉ, À UN CENTRE DE RÉPARATION AUTORISÉ PAR DAYTON, SERA, À TITRE DE SOLUTION EXCLUSIVE, SOIT RÉPARÉE, SOIT REMPLACÉE PAR DAYTON. POUR LE PROCÉDÉ DE RÉCLAMATION SOUS GARANTIE LIMITÉ, REPORTEZ-VOUS À LA CLAUSE DE « DISPOSITION PROMPTE » CI-DESSOUS. CETTE GARANTIE LIMITÉE DONNE AUX ACHETEURS DES DROITS LÉGAUX SPÉCIFIQUES QUI VARIENT DE JURIDICTION À JURIDICTION.*

LIMITES DE RESPONSABILITÉ. *LA RESPONSABILITÉ DE DAYTON, DANS LES LIMITES PERMISES PAR LA LOI, POUR LES DOMMAGES INDIRECTS OU FORTUITS EST EXPRESSEMENT DÉNIÉE. DANS TOUS LES CAS LA RESPONSABILITÉ DE DAYTON EST LIMITÉE ET NE DÉPASSERA PAS LA VALEUR DU PRIX D'ACHAT PAYÉ.*

DÉSISTEMENT DE GARANTIE. *DE DILIGENTS EFFORTS SONT FAITS POUR FOURNIR AVEC PRÉCISION LES INFORMATIONS ET ILLUSTRATIONS DES PRODUITS DÉCRITS DANS CETTE BROCHURE; CEPENDANT, DE TELLES INFORMATIONS ET ILLUSTRATIONS SONT POUR LA SEULE RAISON D'IDENTIFICATION, ET N'EXPRIMENT NI N'IMPLIQUENT QUE LES PRODUITS SONT COMMERCIALISABLES, OU ADAPTABLES À UN BESOIN PARTICULIER, NI QUE CES PRODUITS SONT NÉCESSAIREMENT CONFORMES AUX ILLUSTRATIONS OU DESCRIPTIONS. SAUF POUR CE QUI SUIT, AUCUNE GARANTIE OU AFFIRMATION DE FAIT, ÉNONCÉE OU IMPLICITE, AUTRE QUE CE QUI EST ÉNONCÉ DANS LA « GARANTIE LIMITÉE » CI-DESSUS N'EST FAITE OU AUTORISÉE PAR DAYTON.*

Désistement sur les conseils techniques et les recommandations. *Peu importe les pratiques ou négociations antérieures ou les usages commerciaux, les ventes n'incluent pas l'offre de conseils techniques ou d'assistance ou encore de conception de système. Dayton n'a aucune obligation ou responsabilité quant aux recommandations non autorisées, aux opinions et aux suggestions relatives au choix, à l'installation ou à l'utilisation des produits.*

Conformité du produit. *De nombreuses juridictions ont des codes et règlements qui gouvernent les ventes, constructions, installations et/ou utilisations de produits pour certains usages qui peuvent varier par rapport à ceux d'une zone voisine. Bien que Dayton essaie de s'assurer que ses produits s'accordent avec ces codes, Dayton ne peut garantir cet accord, et ne peut être jugée responsable pour la façon dont le produit est installé ou utilisé. Avant l'achat et l'usage d'un produit, revoir les applications de ce produit, ainsi que tous les codes et règlements nationaux et locaux applicables, et s'assurer que le produit, son installation et son usage sont en accord avec eux.*

Certains aspects de désistement ne sont pas applicables aux produits pour consommateur; ex : (a) certaines juridictions ne permettent pas l'exclusion ou la limitation des dommages indirects ou fortuits et donc la limitation ou exclusion ci-dessus peut ne pas s'appliquer dans le cas présent; (b) également, certaines juridictions n'autorisent pas de limitations de durée de la garantie implicite, en conséquence, la limitation ci-dessus peut ne pas s'appliquer dans le cas présent; et (c) par force de loi, pendant la période de cette Garantie Limitée, toutes garanties impliquées de commerciabilité ou d'adaptabilité à un besoin particulier applicables aux produits de consommateurs achetés par des consommateurs, peuvent ne pas être exclues ni autrement désistées.

Disposition prompte. *Un effort de bonne foi sera fait pour corriger ou ajuster rapidement tout produit prouvé défectueux pendant la période de la garantie limitée. Pour tout produit considéré défectueux pendant la période de garantie limitée, contacter tout d'abord le concessionnaire où l'appareil a été acheté. Le concessionnaire doit donner des instructions supplémentaires. S'il est impossible de résoudre le problème de façon satisfaisante, écrire à Dayton à l'adresse ci-dessous, en indiquant le nom et l'adresse du concessionnaire, la date et le numéro de la facture du concessionnaire, et en décrivant la nature du défaut. Le titre et le risque de perte passent à l'acheteur au moment de la livraison par le transporteur. Si le produit a été endommagé pendant le transport, une réclamation doit être faite auprès du transporteur.*

Fabriqué pour Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 États-Unis

FRANÇAIS

EMCO
WHEATON RETAIL

A0721
Monitor Well Manholes

All Emco Wheaton Monitoring Well Manholes incorporate cast-in identification triangles in accordance with API recommendations and meet AASHTO H20 wheel loading.

- Painted ductile iron lid and rim
- Optional galvanized steel or polyethylene skirt
- Bolt-down units have water-tight lids
- Custom skirt heights available

Built-in side handle on 18" models - one hand opening and positioning

- Heavy-duty (16 gauge hot rolled carbon steel) skirts available. 100% welded skirt and seam. To order, replace the first digit of the variant number with a 2.
- ID tag available on all models; large enough for all new regulatory requirements. To order, add "ID" to the end of the part number.

A0726-050ID ID Tag Kit
Includes tags and rivets for 50 units

EMCO WHEATON RETAIL

A0721

Monitor Well Manholes

Size	Model No.	Style	Skirt Type	Lid Color	Overall Height	Clear Hole ID	Max. Dia.	Lbs.
5”	* **A0721-105**	Bolt-down	Steel	Black	8.5”	3.8”	6.0”	5.7
6”	* **A0721-106**	Bolt-down	Steel	Black	7.5”	4.5”	6.7”	6.3
	A0721-106A	Bolt-down	Steel	Black	9.5”	4.5”	6.7”	6.4
8”	* **A0721-008**	Bolt-down	Poly	Black	12.3”	6.0”	9.9”	11.7
	A0721-008CE	BD, Large Bolts	Poly	White	12.3”	6.0”	9.9”	11.1
	* **A0721-108**	Bolt-down	Steel	Black	12.7”	6.0”	9.9”	13.7
	A0721-108W	Bolt-down	Steel	White	12.7”	6.0”	9.9”	13.7
	* **A0721-188**	Bolt-down	Steel	Black	9.2”	6.0”	9.9”	12.8
	* **A0721-188L**	Lay-in	Steel	Black	8.9”	7.8”	9.9”	11.9
	*** A0721-208W****	BD, Welded w/Lugs	HD Steel	Black	12.5”	6.0”	9.9”	12.7
	A0721-308	BD, 3 Bolts	Steel	White	8.8”	6.4”	9.4”	12.8
	A0721-308A	BD, 3 Bolts	Steel	White	12.8”	6.4”	9.4”	13.7
	** A0722-008	Bolt-down	Poly	Black	12.3”	6.0”	9.9”	12.4
12”	* **A0721-001**	Bolt-down	Poly	White	12.0”	9.4”	15.1”	23.0
	A0721-001CC	BD w/Rebar Tabs	Poly	White	12.0”	9.4”	15.1”	23.1
	A0721-001L	Lay-in	Poly	Black	12.0”	11.2”	13.8”	22.8
	* **A0721-101**	Bolt-down	Steel	White	12.0”	9.4”	15.1”	28.8
	A0721-101A	Bolt-down	Steel	White	18.0”	9.4”	15.1”	31.0
	A0721-101L	Lay-in	Steel	Black	12.0”	11.2”	13.8”	28.6
	A0721-119	Bolt-down	Steel	White	19.0”	9.4”	15.1”	36.3
	A0721-128	Bolt-down	Poly	White	8.1”	9.4”	15.1”	21.9
	A0721-128A	Bolt-down	Steel	White	8.0”	9.4”	15.1”	23.6
	** A0722-001	Bolt-down	Poly	White	12.0”	9.4”	15.1”	24.3
18”	* **A0721-018**	Bolt-down	Steel	Black	12.3”	13.8”	18.4”	58.5
	A0721-118	Bolt-down	Steel	Black	18.0”	13.8”	18.4”	69.5

* Most common variant
** Includes locking cap & collar
*** Heavy duty
**** Compliant with Wisconsin Administrative Code, Groundwater Monitoring Well Requirements, NR141.13, Subsection 4b

Lid Replacement Parts

Part No.	Lid	Description	Lbs.
569883	5”	Lid Ductile Bolt-down	3.0
569885	5”	Lid Gasket	
494263	5”	Bolt, 3/8” x 0.5”	
568692	6”	Lid Ductile Bolt-down	2.4
568820	6”	Lid Gasket	
568662	6”	Bolt, 5/16” x 0.75”	
571700	7”	Lid Ductile Bolt-down	3.3
571702	7”	Lid Gasket	
494261	7”	Bolt & Neoprene Washer, 3/8” x 1”	
569285	8”	Lid Ductile Lay-in	5.1
569106	8”	Lid Ductile Bolt-down	5.1
567150	8”	Lid Ductile Bolt-down, A0721-008CE	5.1
570767	8”	Lid Ductile Bolt-down, A0721-308 (3 bolt)	5.1
567146	8”	Lid Gasket	
494260	8”	Bolt & O-ring, 5/8” x 1”, A0721-008CE	
494261	8”	Bolt & Neoprene Washer, 3/8” x 1”	
566419	8”	O-ring for 3/8” Bolt	
566334	8”	O-ring for 5/8” Bolt	
568715	8”	Neoprene Washer for 3/8” Bolt	
569723	12”	Lid Ductile Lay-in	11.6
563980	12”	Lid Ductile Bolt-down	11.0
563593	12”	Lid Gasket	
494262	12”	Bolt & O-ring, 5/8” x 1.75”	
566334	12”	O-ring for 5/8” Bolt	
567712	18”	Lid Ductile Bolt-down	28.8
567995	18”	Lid Gasket	
494262	18”	Bolt & O-ring, 5/8” x 1.75”	
494375	18”	Bolt & O-ring, 3/8” x 2”	
566419	18”	O-ring for 3/8” Bolt	
566334	18”	O-ring for 5/8” Bolt	
568715	18”	Neoprene Washer for 3/8” Bolt	

EMCO WHEATON RETAIL CORPORATION
2300 Industrial Park Drive • Wilson, North Carolina 27893 • 252-243-0150 • 252-243-4603 (fax) • www.emcoretail.com

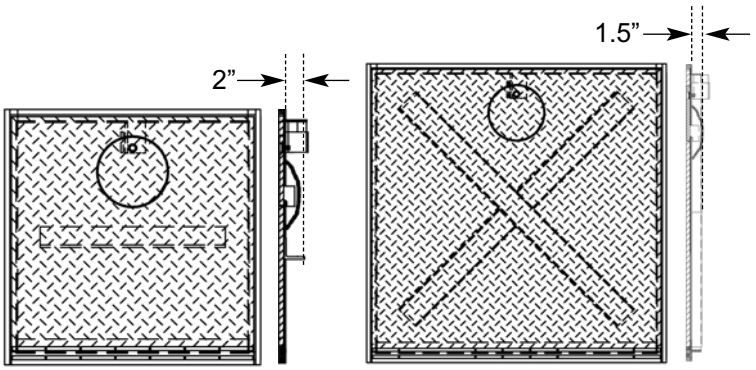
A0717
Square Manholes And Vaults

Lift Assist

A0717-736VWL

A0717-724VW

The Emco Wheaton A0717 square manhole provides ease of access to a variety of tank hardware and monitoring equipment.



The 24” and 30” vaults are reinforced with 2”x2”x1/4” steel angle

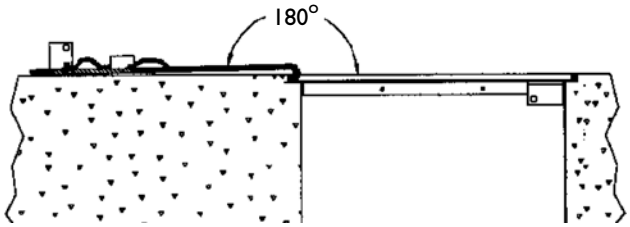
The 36” and 48” vaults are reinforced with cross bracing of 3” structural steel channel

All Square Manholes

- 3/8” heavy duty diamond plate lid
- 16 gauge steel skirt
- Meets AASHTO H20 wheel loading

Locking Vault Manholes

- Double hinged lid opens and folds back to 180°
- Lock-access lid permanently fastened with anti-theft chain; secured with single pinned bolt



EMCO WHEATON RETAIL

A0717 Vaults

Size	Model No.	Style	Overall Height	Lid Lbs.	Total Lbs.
12”	* **A0717-712VW**	Locking Vault Water-resistant	11.6”	18	38.1
	A0717-712VWA	Locking Vault Water-resistant	24.6”	18	38.1
	A0717-712VWB	Locking Vault Water-resistant	18.6”	18	42.5
18”	A0717-718	Lay-in	9.6”	36	56.3
	* **A0717-718ABW**	Bolt-down Water-resistant	18.6”	36	73.3
	A0717-718BWA	Bolt-down Water-resistant	24.6”	36	87.3
	* **A0717-718VW**	Locking Vault Water-resistant	18.6”	36	76.8
	A0717-718VWA	Locking Vault Water-resistant	24.6”	36	96.0
	A0717-718VWL	Locking Vault Lift Assist Water-resistant	18.6”	36	77.3
24”	A0717-724	Lay-in	9.6”	65	88.4
	A0717-724A	Lay-in	24.6”	65	112.0
	A0717-724ABW	Bolt-down Water-resistant	24.6”	65	119.8
	A0717-724BBW	Bolt-down Water-resistant w/Handle	24.6”	65	122.2
	A0717-724BW	Bolt-down Water-resistant w/Handle	9.6”	65	107.2
	A0717-724E	Lay-in w/Handle	12.6”	65	117.0
	A0717-724V	Locking Vault	24.6”	65	116.5
	* **A0717-724VW**	Locking Vault Water-resistant	24.6”	65	121.5
	A0717-724VWB	Locking Vault Water-resistant	10.6”	65	116.5
	A0717-724VWC	Vault Bolt-down Water-resistant w/Handle	24.6”	65	126.4
	A0717-724VWE	Locking Vault Water-resistant	18.6”	65	117.0
	* **A0717-724VWL**	Locking Vault Lift Assist Water-resistant	24.6”	68	120.9
30”	A0717-730VW	Locking Vault Water-resistant	24.6”	123	200.0
	A0717-730VWL	Locking Vault Lift Assist Water-resistant	24.6”	123	200.0
36”	A0717-736VW	Locking Vault Water-resistant	36.6”	165	307.4
	A0717-736VWA	Locking Vault Water-resistant 36x24x24	24.6”	165	265.0
	A0717-736VWAL	Locking Vault Lift Assist WR 36x24x24	24.6”	165	270.0
	A0717-736VWL	Locking Vault Lift Assist Water-resistant	36.6”	171	287.0
	A0717-736VWLA	Locking Vault Lift Assist Water-resistant	24.6”	171	268.5
48”	A0717-748VWL	Locking Vault Lift Assist Water-resistant	48.6”	165	270.0
	A0717-748VWLA	Locking Vault Lift Assist Water-resistant	24.6”	165	270.0
	A0717-748VWLF	Locking Vault Lift Assist WR 24x48x24	24.6”	171	273.0

*Most common variant *Custom sizes available upon request*

V = Hinged; B = Bolt-down; W = Water-resistant; L = Lift Assist Lid

495320 Standard Spring Assembly Kit for 24” Vaults
495779 24” Safety Latch Assembly for 24” Vaults

EMCO WHEATON RETAIL CORPORATION
2300 Industrial Park Drive • Wilson, North Carolina 27893 • 252-243-0150 • 252-243-4603 (fax) • www.emcoretail.com

Appendix E-2

AOI 2 Equipment Data

Tuthill
PUMP YOUR HEART INTO IT

M-D Pneumatics™
Compact Rotary Blower Packages

PneuPak

Based on the dependable CP Series rotary positive blowers, PneuPak rotary blower packages are a dependable and economical low pressure (up to 15 PSIG or 16" Hg vacuum) air source for many industrial and municipal applications such as pneumatic conveying of bulk powder or seed, fluidization/agitation of bulk powders, wastewater aeration, milking of dairy cattle and motive force for vacuum exhausting and cleaning systems.
In addition to dependability and economy, PneuPak rotary blower packages offer many distinct advantages:

Maintenance Friendly
Designed for easy access to vital areas for maintenance, PneuPak provides easy access to grease fittings and the oil reservoir.

Factory Built and Factory Warranted
PneuPak compact rotary blower packages are built in the Tuthill Springfield manufacturing facility under our ISO 9001 registered quality assurance system to assure you that your PneuPak is of the highest quality.
All PneuPak rotary blower packages are covered by a factory warranty of 18 months after installation, not to exceed 24 months after shipment.

Mounting Base with Integral Silencer
PneuPak utilizes an integrated silencer/base to provide a wide variety of blower-motor combinations.

Multiple Configurations
Whatever your air handling needs, there is a PneuPak available for your application. Automated configuration optimizes your PneuPak to afford you the best value for your investment.

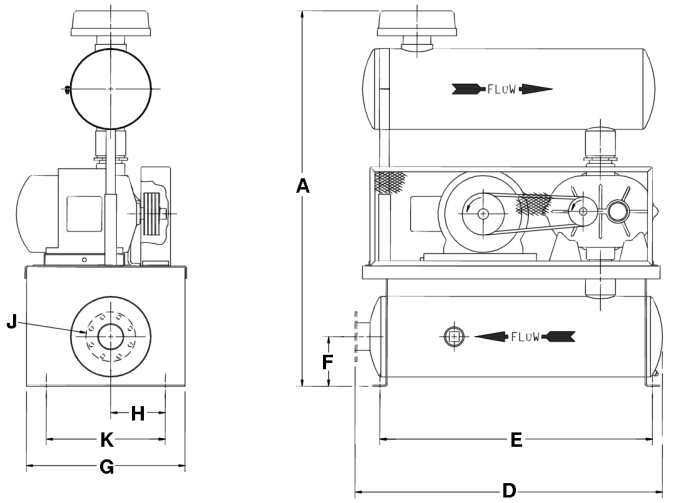
Accessory Kits
Available for your PneuPak, accessory kits provide you the ability to customize your PneuPak for your particular needs. Available accessory kits include:
- Pressure or vacuum relief valve kit with fittings required for installation
- Instrumentation kit including inlet filter restriction indicator and 0-15 PSIG discharge pressure gauge
- NEMA 4/12 control panel for wall mounting including:
  - Powder coated and gasketed steel enclosure
  - Circuit breaker disconnect with through-the-door operator
  - Control circuit transformer with fused windings
  - Magnetic motor starter with overloads and manual reset
  - Run light
  - On-Off-Auto selector switch

Quality Features
PneuPak rotary blower packages include the following quality features:
- CP Series rotary blower that includes features normally found only on premium design blowers such as:
  - Helical timing gears for quiet operation
  - Double row ball bearings on gear end of all models increases overall design bearing life by up to 50% versus other makes
  - Rotors with integrally cast shafts that allow larger shaft diameters and greater strength as compared to the competition
  - Every CP Series blower is factory tested to assure of the highest quality. While other manufacturers only perform sample testing, Tuthill Vacuum & Blower Systems goes the distance to make sure that your blower meets our rigid ISO 9001 registered quality standards.
- TEFC motor standard with 1.15 service factor
- Welded steel motor slide base
- Matched V-belt drive with 1.4 service factor
- OSHA belt guard with flow-through ventilation keeps belts running cool
- Integral mounting base with discharge silencer
- Low pressure drop inlet filter
- Easy and convenient maintenance
- Suitable for indoor or outdoor installation
- Shipped completely assembled for convenient installation*

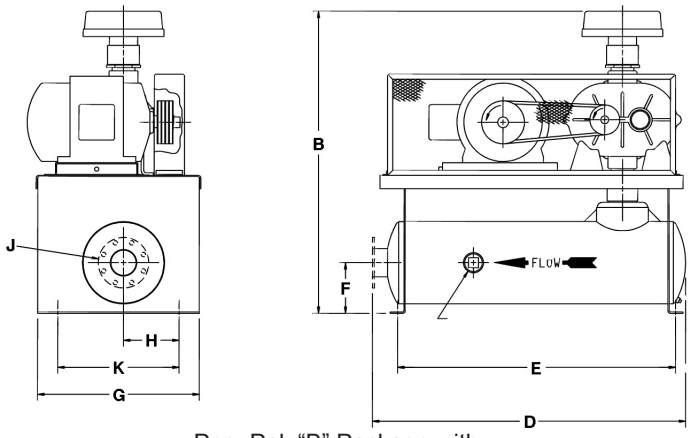
* Height consideration may require partial disassembly for shipment

Dimensions

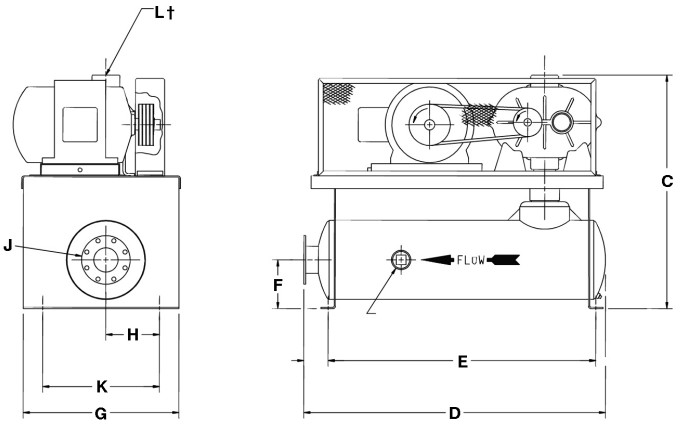
Values shown are approximate and should not be used for construction.
Certified drawings are available through your local Tuthill Springfield Sales Professional.



PneuPak "A" Package with
inlet filter/silencer, inlet silencer and discharge silencer



PneuPak "B" Package with
inlet filter/silencer and discharge silencer



PneuPak "C" Package with discharge silencer

Dimension Table

All dimensions are shown in inches

PneuPak Size	A*	B*	C*	D	E	F	G	H	J	K
13-20	45.13	35	24.75	30	25	5	19	4.50	2" NPT	12
33-20	49.13	37	26.75							
13-25	49.44	37.63	27.75	31	25.50	6	26	6	2½"NPT	18
33-25	53.44	39.63	29.75							
13-30	55.69	43.94	32.19	49.50	44	7	27	7.50	3" NPT	18
33-30	61.38	48.19	36.19							
13-40	71.13	52.94	41.94	50.38	44	8	30.50	8.56	4" NPT	20.50
33-40	75.75	55.94	44.94							
13-50	75.69	56.69	44.94	62	55	10	32	11	5" FLG	24
33-50	81.19	59.69	47.94							
13-60	84.44	57.94	48	69	62	12	33	12.50	6" FLG	24
33-60	91.44	60.94	51							
13-80	101.50	69	51.88	89	65.75	15	42	12	8" FLG	24
33-80	116.25	81.75	64.63							

* "A", "B" and "C" height dimensions shown are "not to exceed" values. Actual height may be lower, depending on blower model incorporated in your package. Certified prints are available from your local Tuthill Springfield Sales Professional.

† "L" dimension is blower inlet connection size. Please refer to COMPETITOR PLUS specification sheet for applicable blower inlet connection size.

PneuPak Sizes Available for Each Blower

Blowers that can be mounted in each PneuPak are shown to the right of the applicable PneuPak.

PneuPak Size	Blower Model	PneuPak Size	Blower Model	PneuPak Size	Blower Model	PneuPak Size	Blower Model
13-20 33-20	2002 2004 3003 3006 4002	13-30 33-30	3006 4005 4007 5003 6005	13-50 33-50	5009 6005 6008 7006	13-80 33-80	7011 7018
13-25 33-25	3003 3006 4002 4005 5003	13-40 33-40	4007 5006 5009 6005 7006	13-60 33-60	6008 6015 7006 7011		

Your Local Tuthill Vacuum Blower Systems Sales Professional:

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PUMP YOUR HEART INTO IT

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tuthillvacuumblower.com

ISO 9001

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11723921
		Catalog # :	01518ET3E254T-W22

Frame	: 254/6T	Locked rotor time	: 30s (cold) 17s (hot)
Output	: 15 HP (11 kW)	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 208-230/460 V	Altitude	: 1000 m.a.s.l.
Rated current	: 39.8-36.0/18.0 A	Protection degree	: IP55
L. R. Amperes	: 255-230/115 A	Cooling method	: IC411 - TEFC
LRC	: 6.4x(Code G)	Mounting	: F-1
No load current	: 11.7-13.6/6.80 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1765 rpm	Noise level[2]	: 64.0 dB(A)
Slip	: 1.94 %	Starting method	: Direct On Line
Rated torque	: 6.08 kgfm	Approx. weight[3]	: 142 kg
Locked rotor torque	: 229 %		
Breakdown torque	: 270 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 0.1104 kgm²		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	90.2	91.0	91.7	92.4
Power Factor	0.44	0.68	0.78	0.83

Foundation loads	
Max. traction	: 222 kgf
Max. compression	: 364 kgf

		Drive end	Non drive end
Bearing type	:	6309 C3	6209 C3
Sealing	:	V'Ring	V'Ring
Lubrication interval	:	20000 h	20000 h
Lubricant amount	:	13 g	9 g
Lubricant type	:	Mobil Polyrex EM	

Notes

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

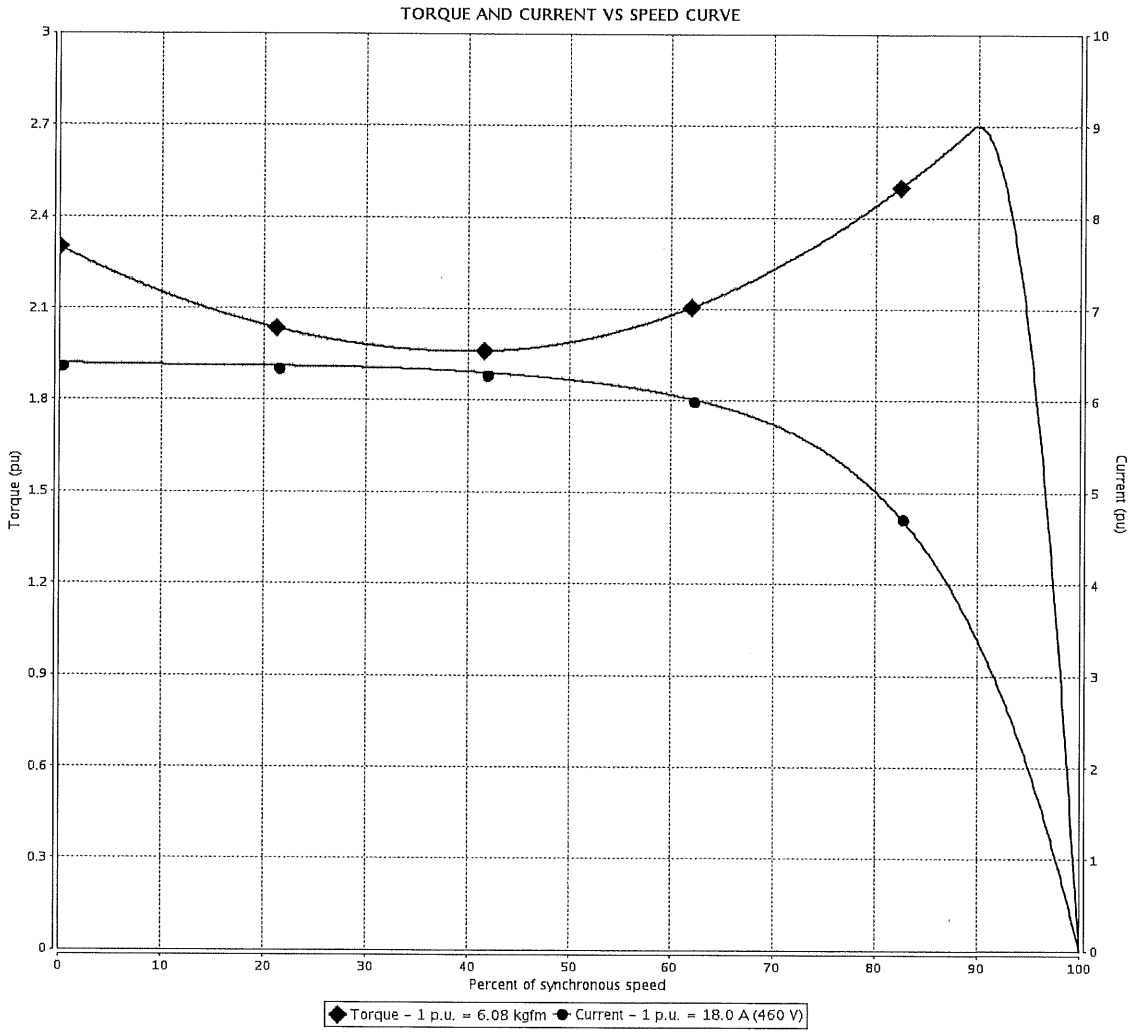
Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	15/10/2019		1 / 6	

TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11723921
		Catalog # :	01518ET3E254T-W22



Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 39.8-36.0/18.0 A	Moment of inertia (J)	: 0.1104 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 6.08 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B
Locked rotor time	: 30s (cold) 17s (hot)		

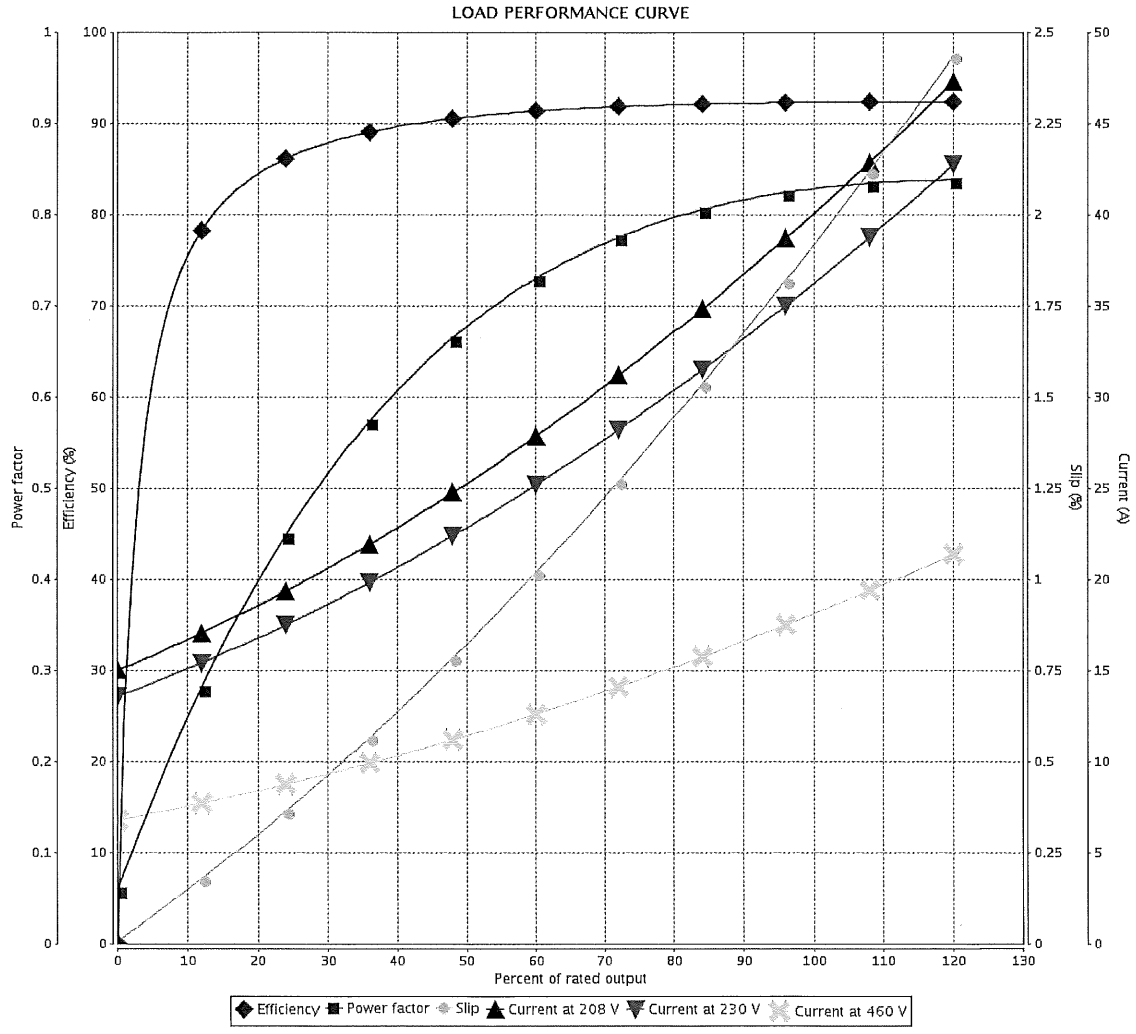
Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	15/10/2019		2 / 6	

LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11723921
		Catalog # :	01518ET3E254T-W22



Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 39.8-36.0/18.0 A	Moment of inertia (J)	: 0.1104 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 6.08 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11723921
		Catalog # :	01518ET3E254T-W22

Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 39.8-36.0/18.0 A	Moment of inertia (J)	: 0.1104 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 6.08 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B
Heating constant			
Cooling constant			

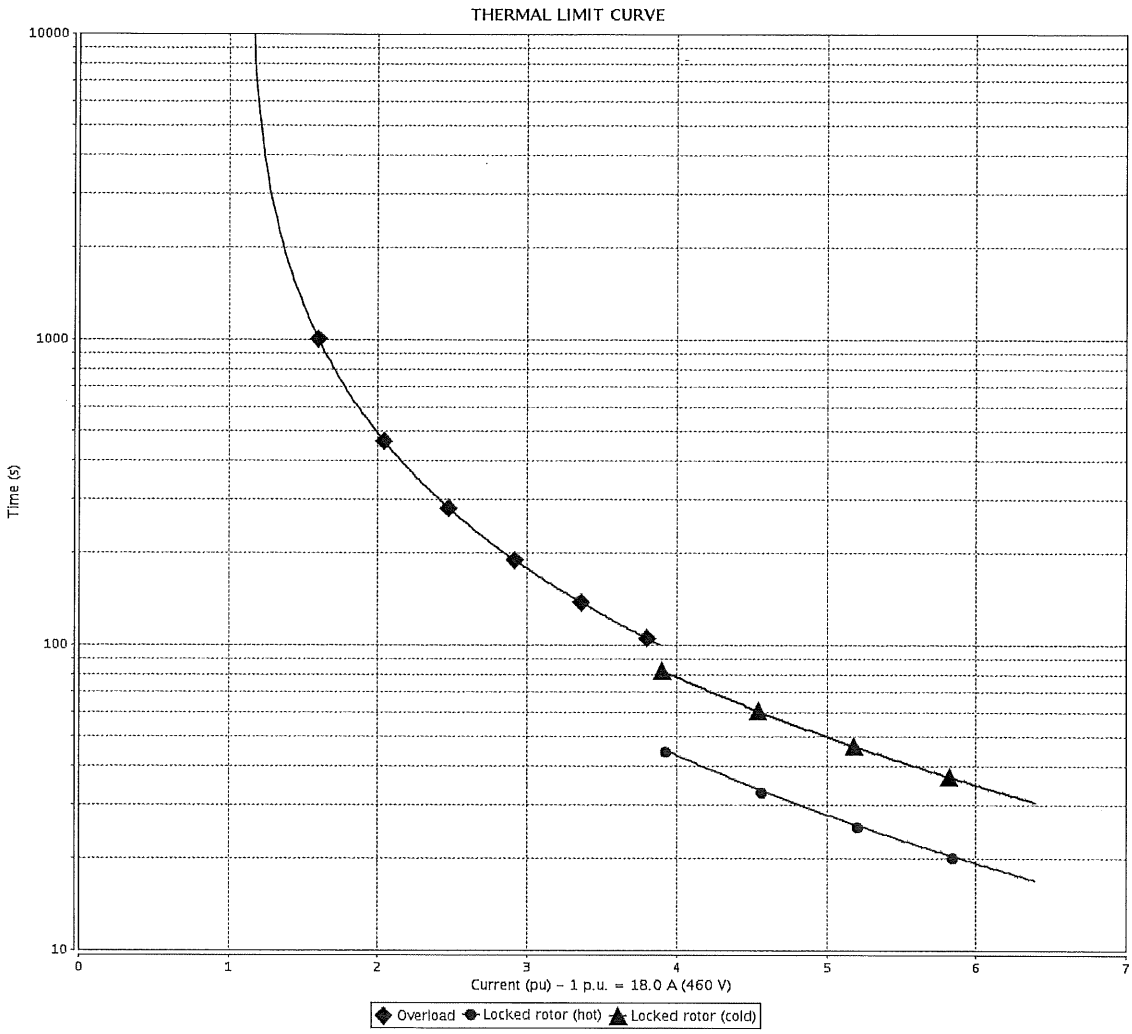
Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	15/10/2019		4 / 6	

THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



Rev.	Changes Summary	Performed	Checked	Date

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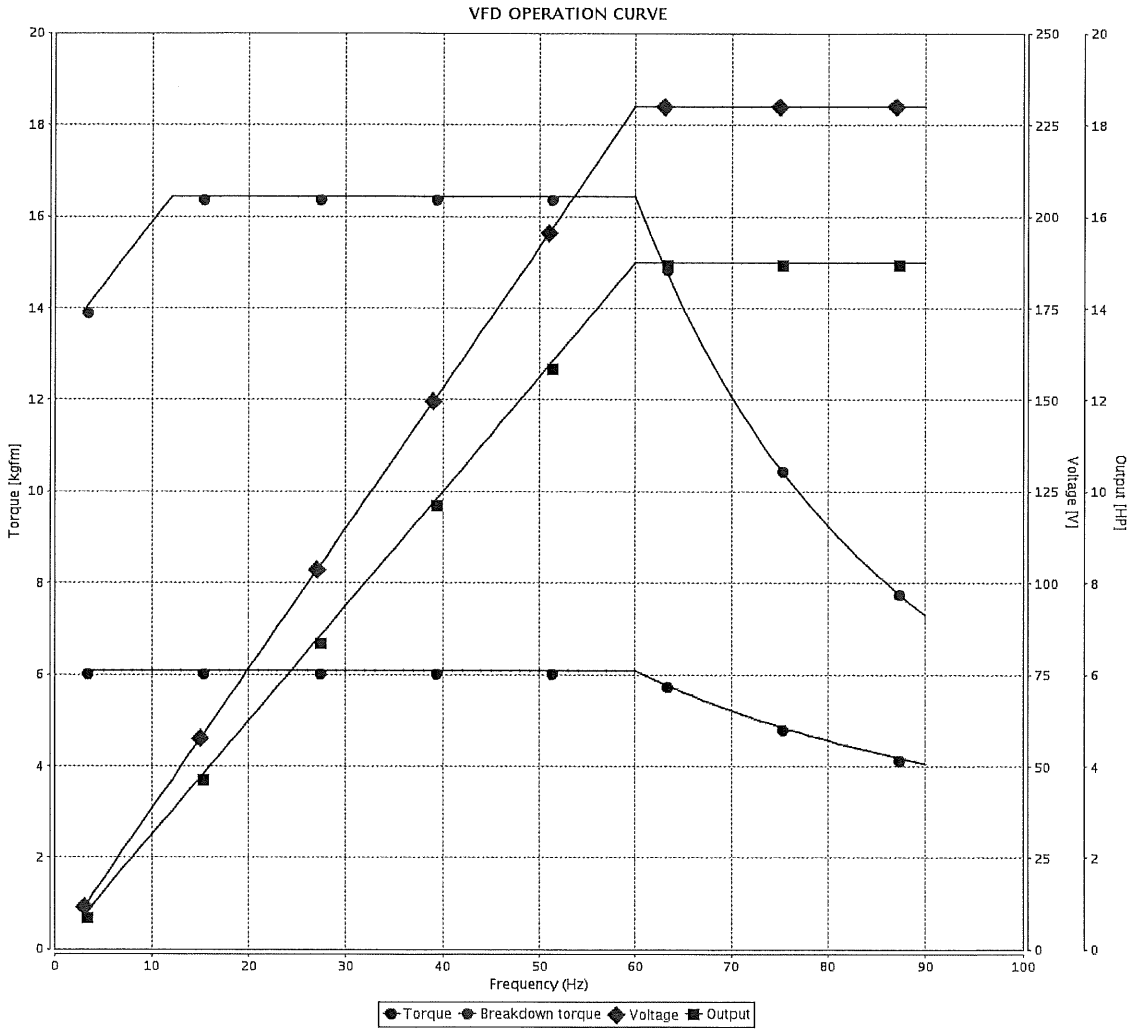
Checked by			Page	Revision
Date	15/10/2019		5 / 6	

VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

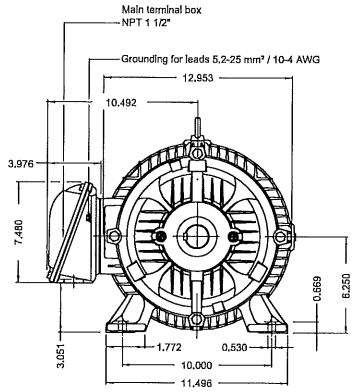
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11723921
		Catalog # :	01518ET3E254T-W22

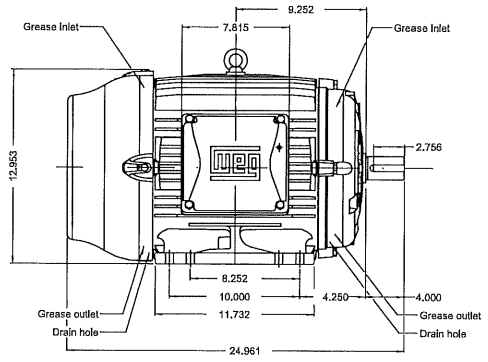


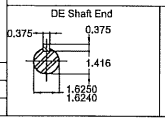
Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 39.8-36.0/18.0 A	Moment of inertia (J)	: 0.1104 kgm²
LRC	: 6.4	Duty cycle	: Cont.(S1)
Rated torque	: 6.08 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1765 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	15/10/2019		6 / 6	







Color RAL 5009
Painting plan 203A
Mounting B3R(D)

15 HP 04 Poles 60Hz

A

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	USERADMIN
CHECKED	
RELEASED	
REL DT.	

THREE PHASE W22 MOTOR - NEMA PREMIUM EFF
FRAME 254/6T IP55 TEFC

PREVIEW
WDD

WMO Jaragua do Sul Product Engineering

SHEET 1 / 1

Dimensions in inches

IME A3

MODEL 01518ET3E254T-W22
MADE IN MÉXICO
11723921

W22 NEMA PREMIUM®
CC029A
Inverter Duty Motor
Severe Duty

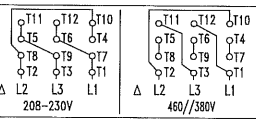
c UL us 3PT9 LISTED

FOR SAFE AREA
MOD.TE1BF0X0N

For 60Hz: Class I, Div 2, Gr. A, B, C and D – T3
Class I, Zone 2, IIC – T3
Class II, Div 2, Gr. F and G – T4
For 60Hz use on PWM, Gr. A, B, C, D and F,
VT 1000:1, CT 20:1, 1.0SF, T3A

C SP® US Energy Verified

PH 3	FR 254/6T	HP(kW) 15.0(11.0)		Hz 60
V 230/460	A 36.0/18.0		RPM 1765	DES B
NEMA NOM EFF	92.4 %	INS. CL. F ΔT 80 K		IP55
ENCL TEFC	DUTY CONT.		AMB. 40°C	
CODE G	PF 0.83	SF 1.25	SFA 45.0/22.5	
USABLE @208V 39.8 A		SF 1.15	SFA 45.8	
15HP 11kW 50Hz 380V 21.5A 1455RPM SF1.00 EFF 90.2% (IE2)				



MOBIL POLYREX EM
13 g 20000 h

ALT 1000 m.a.s.l.

313 Lbs

Tuthill

M-D Pneumatics™
Rotary Positive Displacement Blowers

CP Series

CP Series rotary blowers are designed to be interchangeable with equivalent sizes of Roots Universal RAI®, and many Sutorbilt® Legend® blowers. CP Series models are rated up to 15 PSIG discharge pressure or 16" Hg dry vacuum. All models have sight glasses and triple lip seals as standard features.

Reduced Noise Versions Available

CP Series standard models feature a bi-lobe design. Many models are available with tri-lobe rotors and a specially tuned housing to reduce blower noise.

Triple Lip Seals

Standard on all models, triple lip seals provide improved lubrication to extend the life of the seal up to 50% also resulting in longer bearing life.

Helical Gearing

CP Series blowers are timed with precision helical gears, keyed to the rotor shafts, not taper fit spur gears as offered by other manufacturers, which have greater backlash, can slip and lose timing. Helical gears are also quieter, reducing mechanical noise.

Stronger Bearings

All CP Series blowers include double-row ball bearings at the gear end, stronger than single row ball bearings offered by other manufacturers. Drive shaft bearing is cylindrical roller type for additional strength against side loading from V-belt drives. As a result of this superior design, CP Series blowers offer design bearing life as much as 50% greater than models offered by other manufacturers.

Rotors with Integral Shafts

CP Series blowers include precision machined ductile iron rotors with large, integrally cast shafts, not press fit and/or pinned shafts offered by other manufacturers, which can loosen over time and cause rotor clash.

Versatility

CP Series blowers can be field converted from horizontal to vertical flow, or vice versa, without any special tools or additional components.

Metric Availability

CP Series blowers are available with metric drive shaft and process connections.

Lubrication

Many CP Series models include dual oil splash lubrication at both the gear end and drive end of the blower. Splash lubrication provides for longer bearing and seal life through improved heat dissipation versus grease lubrication.

Material Specifications:

Housing: Cast iron
End Plates: Cast iron
End Cover: Cast iron
Rotors: Ductile iron
Shafts: Ductile iron, cast integrally with rotors
Bearings: Gear end - Double row ball, both rotors
Drive end - Cylindrical roller on drive rotor
Single row ball on driven rotor
Drive Shaft: Ductile iron, cast integrally with drive rotor
Gears: Heat treated alloy steel, helical cut
Seals: Lip seals on rotor shafts and drive shaft
Lubrication: Oil splash on gear end, grease on drive end
Models available with dual oil splash lubrication

All blowers are factory tested to meet ISO 9001 registered quality standards. Rotors are dynamically balanced to meet ISO1940 Grade 6.3 specifications.

Performance

P PSIA C C PSIA
specifications are subject to change without notice. All data are approximate. Request a quotation for your specific application.

Model	Lobe	RPM	6 psig		7 psig		8 psig		10 psig		12 psig		13 psig		14 psig		15 psig		16 psig		17 psig		18 psig		Max. Vacuum		
			CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	" Hg	CFM	BHP
2002	2-lobe	1750	8	0.9	6	1.0	5	1.1	2	1.4															9	7	0.7
2002	2-lobe	3600	38	1.8	36	2.1	35	2.3	32	2.8	29	3.3													14	28	2.1
2002	2-lobe	5275	64	2.7	63	3.1	61	3.4	59	4.2	56	4.9													15	53	3.2
2004	2-lobe	1750	24	1.6	21	1.9																			10	20	1.4
2004	2-lobe	3600	83	3.3	80	3.8																			15	65	4.0
2004	2-lobe	5275	137	4.9	134	5.6																			15	118	5.9
3002	2-lobe	1150	22	1.6	19	1.8	17	2.1																	10	18	1.3
3002	2-lobe	2700	94	3.8	92	4.3	89	4.9	85	6.0	81	7.1													16	72	4.8
3002	2-lobe	3600	136	5.0	134	5.7	131	6.5	127	7.9	123	9.4	121	10.1	119	10.9	118	11.6							16	114	6.4
3003	2-lobe	1150	30	2.0	27	2.4																			10	26	1.7
3003	2-lobe	2700	126	4.8	122	5.5	119	6.3	114	7.7	109	9.2													14	107	5.4
3003	2-lobe	3600	181	6.4	178	7.4	175	8.3	169	10.3	164	12.2													15	158	7.7
3003	3-lobe	1150	32	2.1	28	2.5																			10	27	1.8
3003	3-lobe	2700	132	5.0	129	5.8	126	6.6																	14	112	5.7
3003	3-lobe	3600	191	6.7	187	7.7	184	8.8	178	10.8	173	12.8													15	166	8.1
3006	2-lobe	1150	60	4.8	55	5.3																			11	49	4.5
3006	2-lobe	2700	218	11.3	213	12.5																			15	185	12.9
3006	2-lobe	3600	310	15.0	305	16.6																			15	277	17.2
3006	3-lobe	1150	58	6.0	53	6.5																			11	46	5.7
3006	3-lobe	2700	218	14.0	213	15.2																			15	183	15.7
3006	3-lobe	3600	310	18.7	305	20.3																			15	276	20.9
4002	2-lobe	850	18	1.5	15	1.7																			10	14	1.3
4002	2-lobe	1760	73	3.1	70	3.6	68	4.1	63	5.0	59	5.9	57	6.4											14	58	3.5
4002	2-lobe	3600	184	6.4	182	7.4	179	8.3	175	10.2	171	12.1	169	13.1	167	14.0	165	15.0							16	162	8.2
4005	2-lobe	850	40	2.9	35	3.3	30	3.8																	9	38	2.2
4005	2-lobe	1760	150	5.9	145	6.9	140	7.8	132	9.6															14	121	6.7
4005	2-lobe	3600	373	12.1	368	14.0	363	15.9	354	19.7															16	330	15.7
4005	3-lobe	850	44	3.5	40	3.9	36	4.3																	9	43	2.8
4005	3-lobe	1760	149	7.2	145	8.1	141	9.0	133	10.8															14	124	8.0
4005	3-lobe	3600	360	14.8	356	16.6	352	18.4	345	22.0															16	324	18.1
4007	2-lobe	850	54	3.7	47	4.3																			10	45	3.1
4007	2-lobe	1760	199	7.7	192	8.9																			14	160	8.8
4007	2-lobe	3600	492	15.8	486	18.3																			16	437	20.4
4007	3-lobe	850	59	4.2	53	4.8																			10	51	3.6
4007	3-lobe	1760	193	8.8	188	9.9																			14	162	9.7
4007	3-lobe	3600	466	17.9	460	20.2																			15	428	21.1
5003	2-lobe	700	41	2.6	36	3.0	33	3.4																	10	35	2.2
5003	2-lobe	1760	180	6.6	176	7.6	172	8.6	165	10.7	159	12.7	156	13.7	153	14.7	150	15.7							14	156	7.5
5003	2-lobe	2850	324	10.7	320	12.3	316	14.0	309	17.2	303	20.5	300	22.2	297	23.8	294	25.4							16	289	13.7
5006	2-lobe	700	68	4.3	61	4.9	55	5.6																	10	59	3.5
5006	2-lobe	1760	302	10.7	295	12.4	289	14.1	277	17.5	266	20.9	261	22.6											14	262	12.2
5006	2-lobe	2850	543	17.3	536	20.1	530	22.8	518	28.3	507	33.8	502	36.6											16	485	22.5
5006	3-lobe	700	65	4.6	57	5.3	51	6.0																	10	55	3.9
5006	3-lobe	1760	300	11.7	293	13.4	286	15.1	273	18.5	262	21.9	257	23.6											14	257	13.2
5006	3-lobe	2850	542	18.9	535	21.7	528	24.4	515	30.0	504	35.5	499	38.2											16	480	24.1
5009	2-lobe	700	130	6.1	122	7.1																			11	111	5.5
5009	2-lobe	1760	472	15.4	464	17.9																			14	427	17.6
5009	2-lobe	2850	824	25.0	816	29.0																			15	769	30.4
5009	3-lobe	700	116	6.8	107	7.8	98	8.8																	11	93	6.1
5009	3-lobe	1760	473	17.0	464	19.6	455	22.2																	14	417	19.2
5009	3-lobe	2850	841	27.5	831	31.7	822	35.9																	15	773	33.2
6005	2-lobe	700	91	4.9	84	5.6	78	6.4	67	7.9															12	68	4.8
6005	2-lobe	1760	352	12.3	345	14.2	339	16.1	328	19.9	318	23.6	313	25.5	309	27.4	304	29.3							16	296	15.8
6005	2-lobe	2350	497	16.4	490	19.0	484	21.5	473	26.5	463	31.6	458	34.1	454	36.6	449	39.1							16	442	21.1
6008	2-lobe	700	146	7.6	135	8.8	126	10.0	108	12.4															12	109	7.5
6008	2-lobe	1760	565	19.2	554	22.2	544	25.2	527	31.3	510	37.4	503	40.4	496	43.4									15	490	23.3
6008	2-lobe	2350	798	25.6	787	29.6	777	33.7	760	41.8	744	49.9	736	53.9	729	58.0									16	709	33.1

Performance continued

Model	Lobe	RPM	6 psig		7 psig		8 psig		10 psig		12 psig		13 psig		14 psig		15 psig		16 psig		17 psig		18 psig		Max. Vacuum		
			CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	" Hg	CFM	BHP
6015	2-lobe	700	273	13.9	254	16.2																			10	247	11.5
6015	2-lobe	1760	1058	35.0	1038	40.7																			14	943	40.0
6015	2-lobe	2350	1494	46.8	1475	54.4																			14	1380	53.4
7006	2-lobe	650	171	7.2	163	8.3	157	9.5	144	11.8	133	14.0	128	15.2											13	137	7.6
7006	2-lobe	1760	617	19.5	610	22.6	603	25.7	591	31.8	579	38.0	574	41.1	569	44.2	564	47.3							16	556	25.2
7006	2-lobe	2050	734	22.7	726	26.3	719	29.9	707	37.1	696	44.3	691	47.8	686	51.4	681	55.0							16	672	29.4
7011	2-lobe	650	322	12.9	310	15.0	298	17.1	277	21.3															13	264	13.7
7011	2-lobe	1760	1142	35.0	1129	40.6	1117	46.3	1096	57.6															16	1035	45.5
7011	2-lobe	2050	1356	40.7	1343	47.3	1331	53.9	1310	67.1															16	1249	53.0
7018	2-lobe	650	560	20.8																					10	536	17.1
7018	2-lobe	1760	1892	56.2																					12	1830	55.3
7018	2-lobe	2050	2240	65.5																					12	2178	64.4

Dimensions: Standard Models/6

Model Size	A	B	C	D	E	F	G1	G2	H	J1	J2	K	L1	L2	M	N1	N2	N3	P	R	S	T	U	V	Weight (lbs.)
2002	□□□□	□□□□	□□□□	□□□□	□□NPT	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	⅜□	□□□□□	□□
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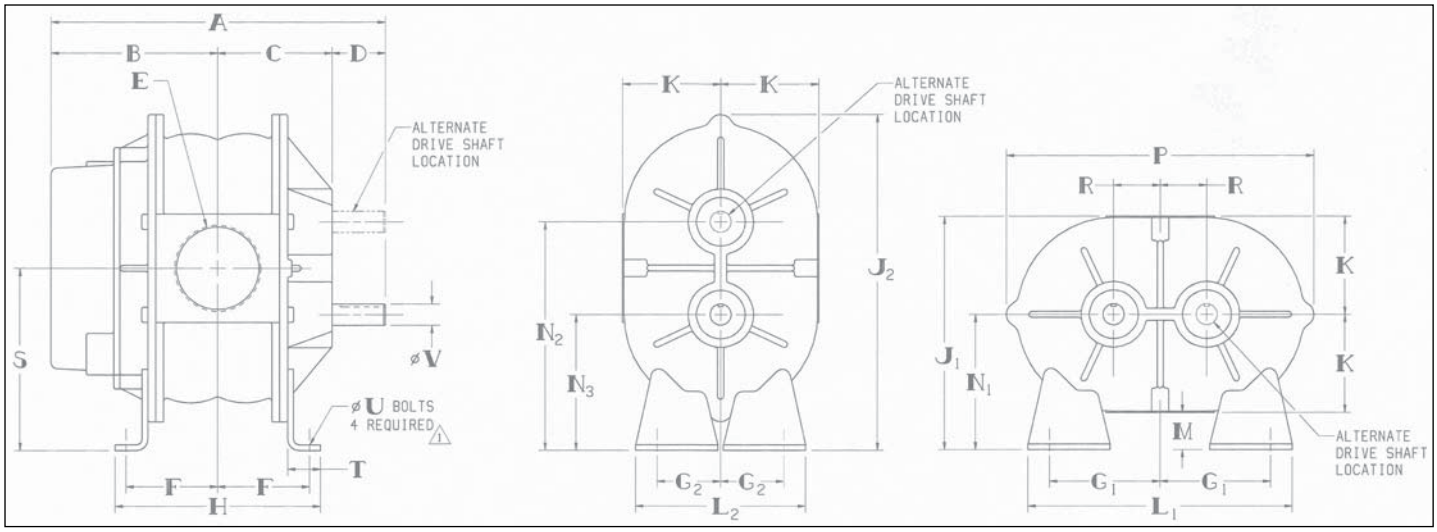

Dimensions: Splash Lube Models/7

Model Size	A	B	C	D	E	F	G1	G2	H	J1	J2	K	L1	L2	M	N1	N2	N3	P	R	S	T	U	V	Weight (lbs.)
3002 3003 3006	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□ □NPT □□NPT □□ □NPT	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□ □	□□□□	□□ □□ □□□
4002 4005 4007	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□ □□□□ □□□□	□□□□	□□ □NPT □□ □NPT □□NPT	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□ □□□□ □□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□□□□	□ □	□□□□	□□□ □□□ □□□
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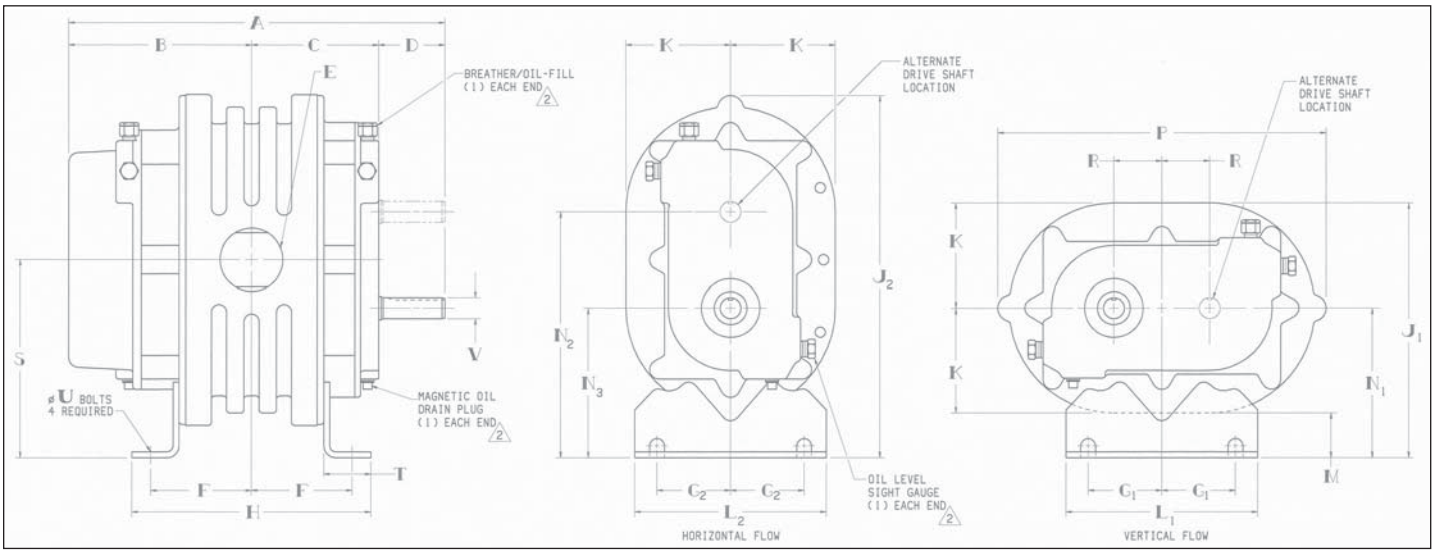


Values shown are approximate and should not be used for construction. Certified drawings are available through your local Tuthill Vacuum & Blower Systems Sales Professional.

The tri-lobe CP Series units have a cast-in noise reduction on the discharge port. This will reduce the sound level of the blower 3-5dB, or by half.

Your Local Tuthill Vacuum Blower Systems Sales Professional:

Tuthill
PUMP YOUR HEART INTO IT

Tuthill Vacuum & Blower Systems
4840 West Kearney Street
Springfield, Missouri USA 65803-8702
o 417.865.8715 800.825.6937 **f** 417.865.2950
tuthillvacuumblower.com

ISO 9001

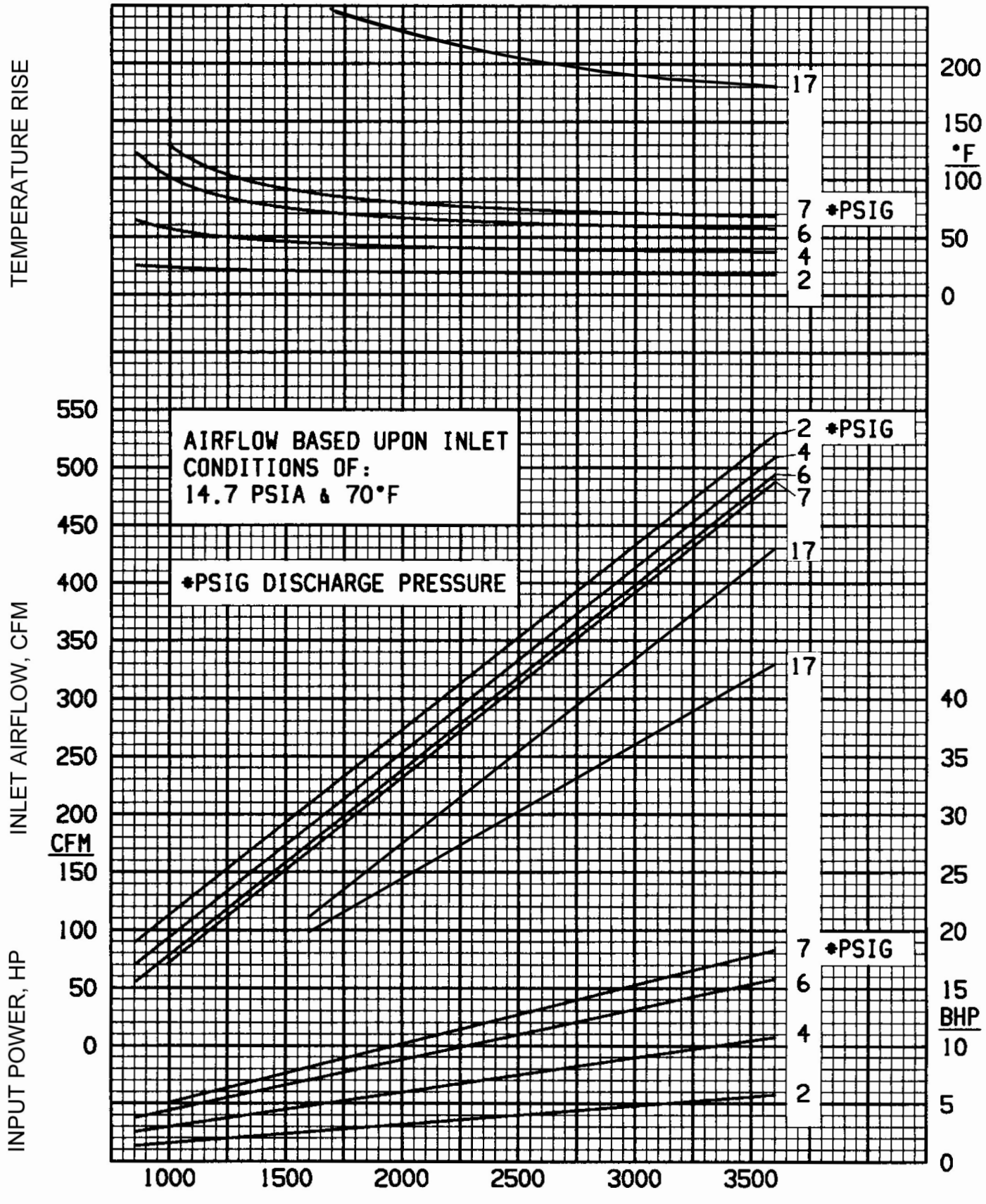
Tuthill
PUMP YOUR HEART INTO IT

Springfield, MO
USA
tuthillvacuumblower.com

C-1448

CP 4007 BI-LOBE BLOWER PRESSURE CURVE

0.160 CFR DISPL



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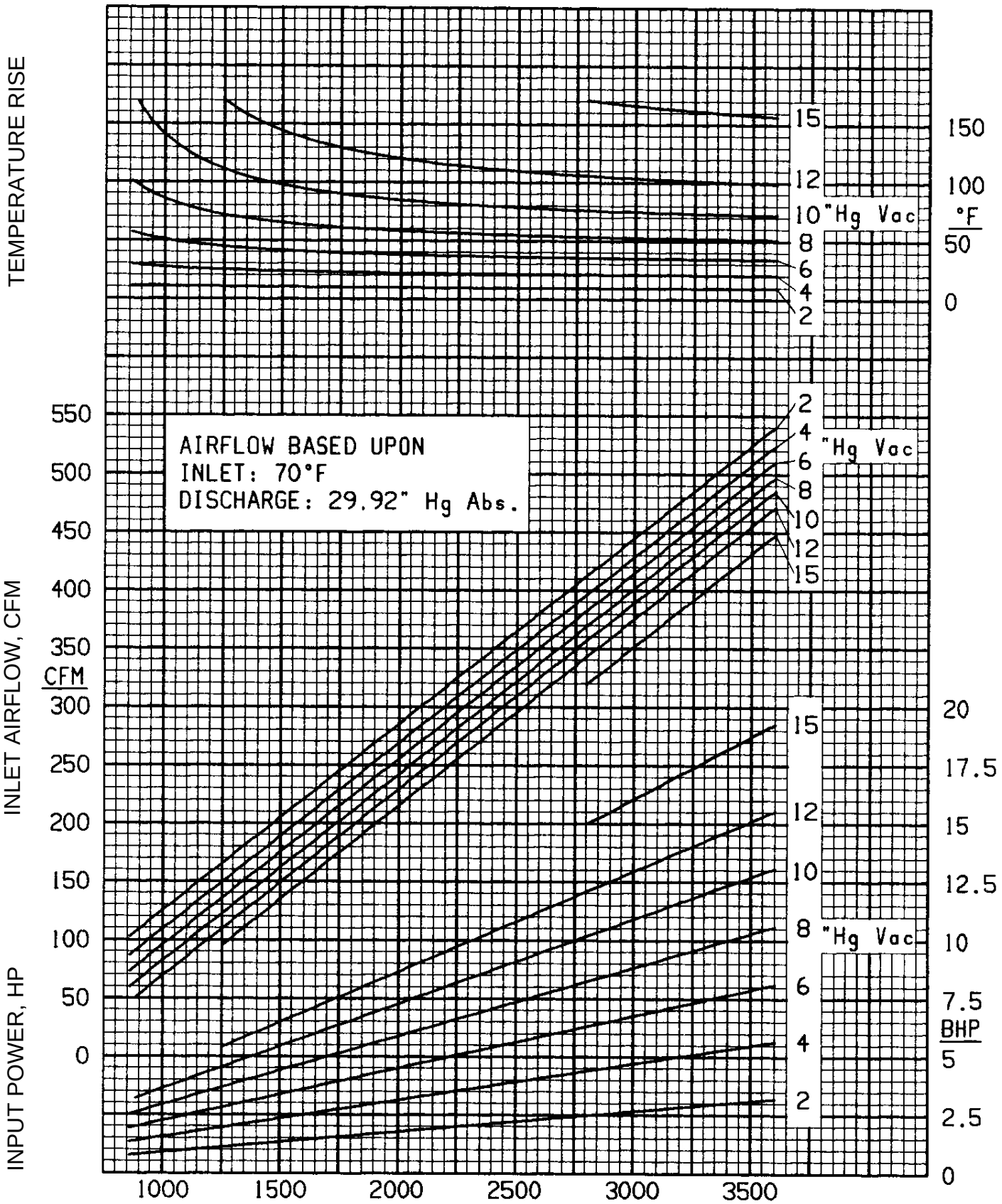
Tuthill
PUMP YOUR HEART INTO IT

Springfield, MO
USA
tuthillvacuumblower.com

C-1449

CP 4007 BI-LOBE BLOWER VACUUM CURVE

0.160 CFR DISPL



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Tuthill

Performance Datasheet

Customer	:	Quote number	: 816162
Customer reference	:	Size	: 33-30-A-4007 CP Series (2-lobe) PneuPak
Item	: 001		
Application	:	Based on curve number	: 0-4007
Material	: Cast Iron	Date last saved	: 23 Jul 2020 12:54 PM

Operating Conditions

Standard conditions :

(14.70 psi.a , 70.00 deg F , 0.00 %)

Condition	1	
System inlet volume flow	323.2	CFM
Flow at standard conditions , dry	230.0	SCFM
Mass flow	0.29	lbm/s
System inlet temperature	68.00	deg F
System inlet pressure	116.0	in H2O vac
Inlet pressure loss	0.51	psi
Product inlet pressure	130.2	in H2O vac
Product discharge pressure	1.69	psi.g
Discharge pressure loss	0.19	psi
System discharge pressure [p2]	1.50	psi.g
Product differential pressure	6.39	psi
System differential pressure [dp]	5.69	psi
Vacuum Relief Setting	144.0	in H2O vac
Actual system discharge volume	249.2	CFM

Site Conditions

Atmospheric pressure	14.70	psi.a
Elevation above sea level	0.00	ft
Ambient temperature	68.00	deg F
Relative humidity	36.00	%
Site Supply Frequency	60	Hz
Set inlet to ambient site conditions	No	

Gas Data

Type of gas	Air	
Molecular weight (MW)	28.84	
Specific gravity	0.996	
Specific heat (Cp)	0.2419	Btu/(lb.deg F)
Ratio of specific heat (k)	1.40	

Performance

Actual inlet volumetric flow	339.8	CFM
Power, shaft [Ps] *	13.48	hp
Inertial power	5.00	hp
Torque	0.49	hp/100 rpm
% of max torque	27.78	%
Quantity of units operating	1	
Speed	2753	rpm
% of max speed	76.47	%
Noise (with inlet and discharge silencers)	91	dB
Efficiency, volumetric [#,v]	77.14	%
Temperature rise	99.60	deg F
Discharge temperature	167.6	deg F
% of max temperature rise	34.34	%
% of max pressure rise	35.50	%

Vacuum Relief Condition

Power, shaft @ Vacuum Relief *	15.52	hp
Temperature rise @ Vacuum relief	130.6	deg F
Discharge temperature @ Vacuum Relief	198.6	deg F
% of max temperature rise @ Vacuum Relief	45.04	%
% of max pressure rise @ Vacuum Relief	41.12	%

**Power includes 5% loss for belt drive*

JE Gasho · 460 West Gay Street · West Chester, PA 19380-2851
phone: (610) 692-5650 · fax: (610) 692-5837 · gasho.org

Tuthill

Performance Datasheet

Customer	:	Quote number	: 816162
Customer reference	:	Size	: 33-30-A-4007 CP Series (2-lobe) PneuPak
Item	: 001		
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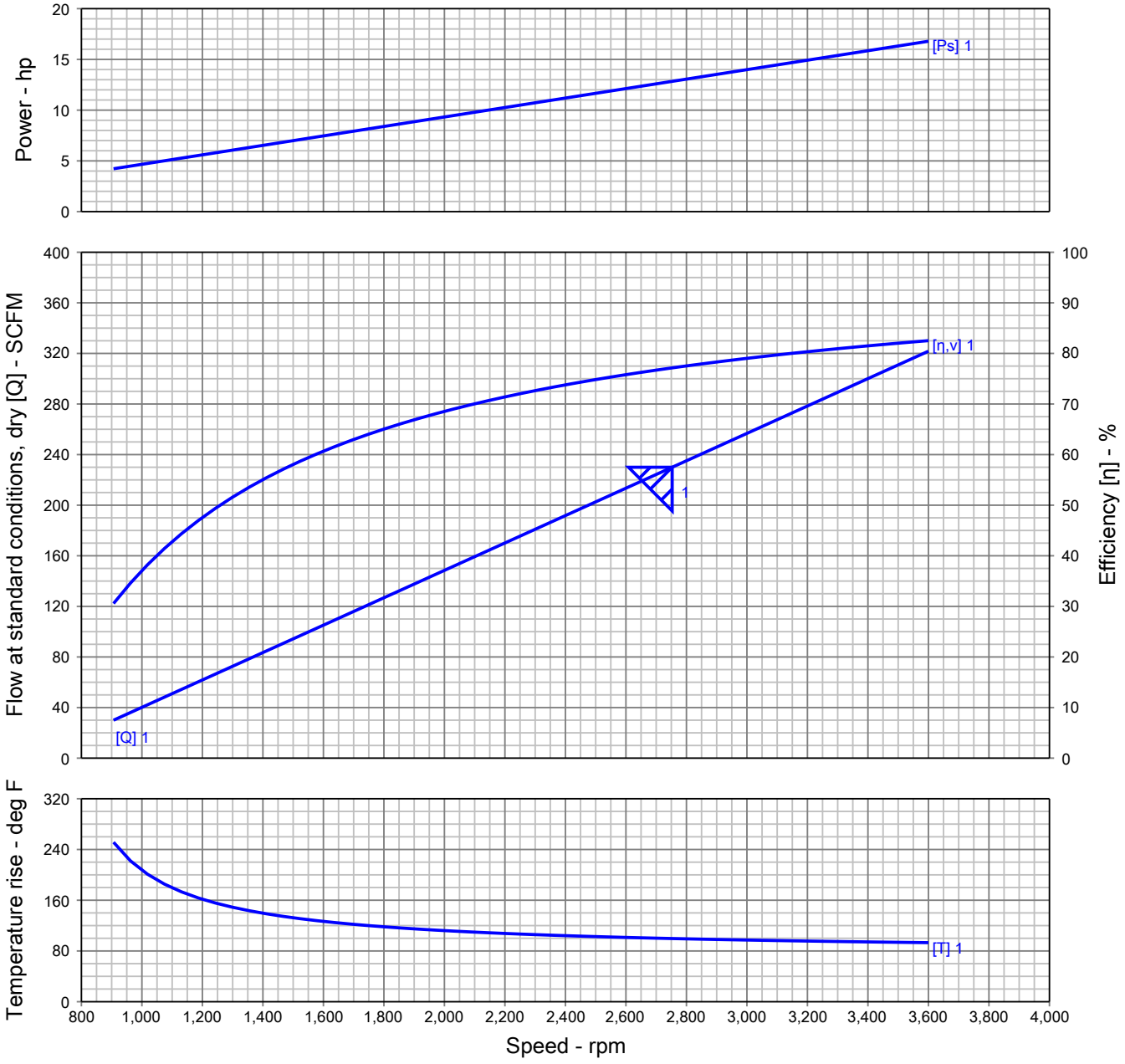

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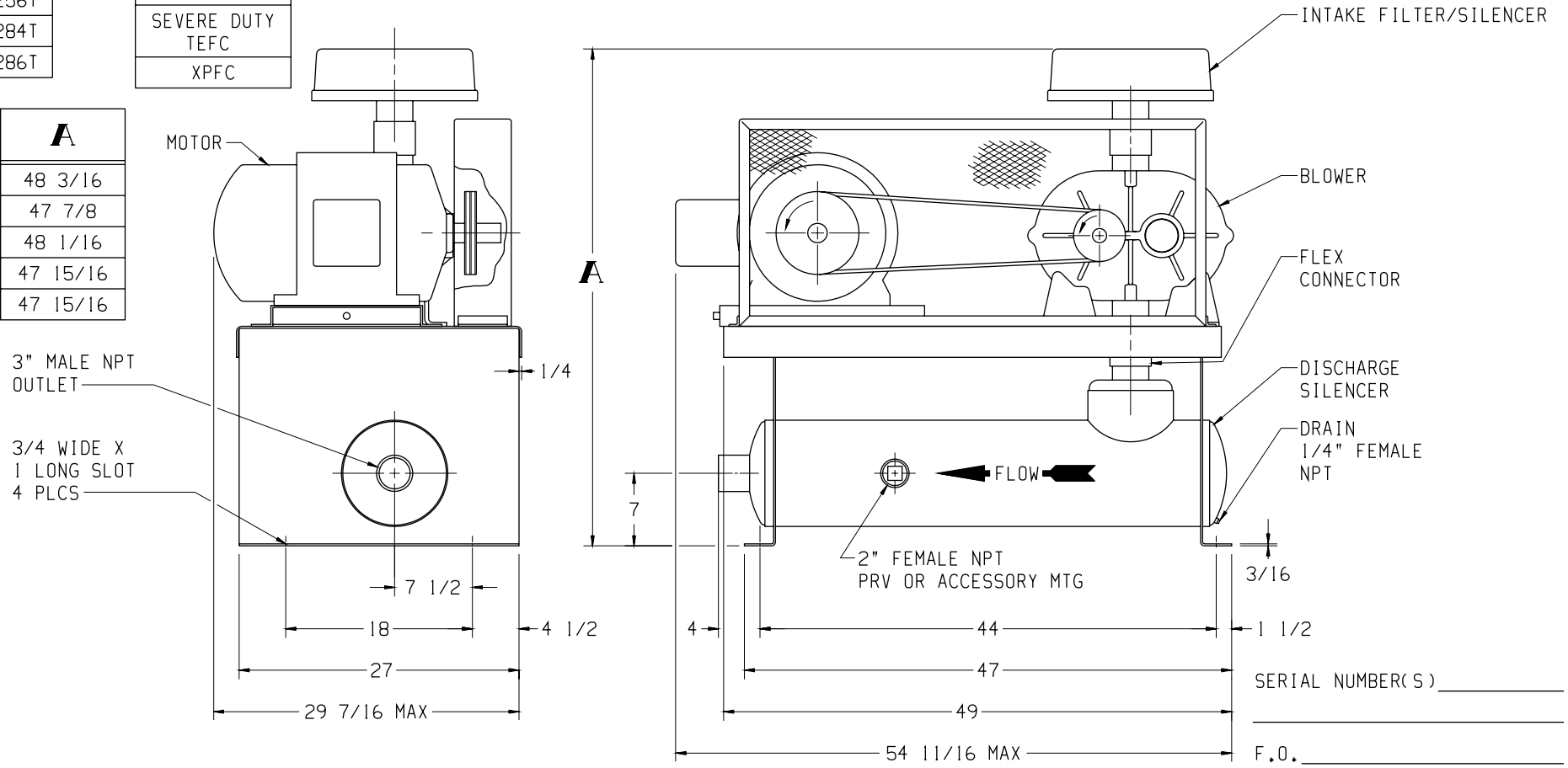
LTR	REVISION	DATE	DR	CH

MOTOR W/SLIDE BASE 1800 RPM, 230/460 V, 3 PH, 60 HZ		
HP	FRAME	TYPE
7 1/2	213T	ODP
10	215T	TEFC
15	254T	PREMIUM EFF TEFC
20	256T	SEVERE DUTY TEFC
25	284T	XPFC
30	286T	

BLOWER	A
3006	48 3/16
4005	47 7/8
4007	48 1/16
5003	47 15/16
6005	47 15/16



SERIAL NUMBER(S) _____

_____

F.O. _____

APPROXIMATE WEIGHT

BASE, SILENCER, FILTER, DRIVE, & GUARD	329 LBS
BLOWER	___ LBS
MOTOR & SLIDE BASE	___ LBS
TOTAL WEIGHT	___ LBS

Tuthill 800.825.6937

BASE MOUNTED OUTLINE PNEU-PAK-33-30-B

SIZE: C2

DR BD 4-4-02 CH _____

Electric Actuated Butterfly Valves

Ductile Iron Wafer Body ASME 150#
2" to 12" Pipe with EPS Positioner

SERIES
5671

Features

- EPS - Electronic Positioning System with 4-20mA input
- Wafer body valve with ISO5211 direct mount actuator
- 3-layer epoxy coated ductile iron body with 316 SS disc
- Unique wave line seat reduces torque and extends seal life
- Visual valve position indicator
- Rugged aluminum Type 4X weatherproof enclosure
- Heavy duty motors with overload protection
- Thermostatically controlled anti-condensation heater
- Manual override with end of travel mechanical stops
- Actuators CSA Listed per UL429 and CSA C22.2

Applications

EPDM seals typically used for on-off control of water and other media compatible with the materials of construction. NBR (Buna-N) seals typically used for air, oil, vacuum and other media compatible with the materials of construction. Multi-standard alignment holes, suitable for flanges: ANSI/ASME B16.5 Class 150/125, EN1092 PN10,PN16, BS10 Table D, E and JIS B2239 10K,16K. Actuators designed for 70% duty cycle.

Operation

Electric actuated valves with EPS- Electronic Positioning System provide an accurate valve positioning function whereby the movement of the actuator is controlled by either a field selectable 4-20mA input control signal. Any change in the control input signal results in a corresponding and proportional change in the position of the actuator (valve disc). Flow is adjustable anywhere between 0-100%. Unique electronic positioning module is fully potted to help protect the electronics from vibration/moisture resistance.

Construction

Valve Body	3-layer Epoxy/Epoxy/PUR coated ductile iron
Disc	316 stainless steel CF8M
Disc Seat/Liner	EPDM or NBR (Buna-N)
Stem/Stem Seals	420 SS / (2) v-rings same material as seat
Gear Drive	Heavy duty alloy steel/aluminum bronze, self locking
Actuator Enclosure	Aluminum, polyester powder painted, Type 4X, IP67
Visual Valve Position Indicator	Clear ABS cover with red/yellow open-closed indicator
Fasteners	Stainless Steel
EPS Module	Electronics mounted in potted ABS module

Description

Electric operated direct mount butterfly valves with epoxy- coated ductile iron wafer body are designed for commercial and industrial applications. Valve mounts between two standard ANSI/ASME Class 150 flanges and includes integral molded flange gaskets. Disc is precision machined 316SS. Two piece stem and disc design enhances the flow capacity and reduces turbulence. Rugged corrosion resistant electric actuator includes a manual override, auto calibration positioner module, thermostatically controlled anti-condensation heater, and over-torque protection.

Approvals

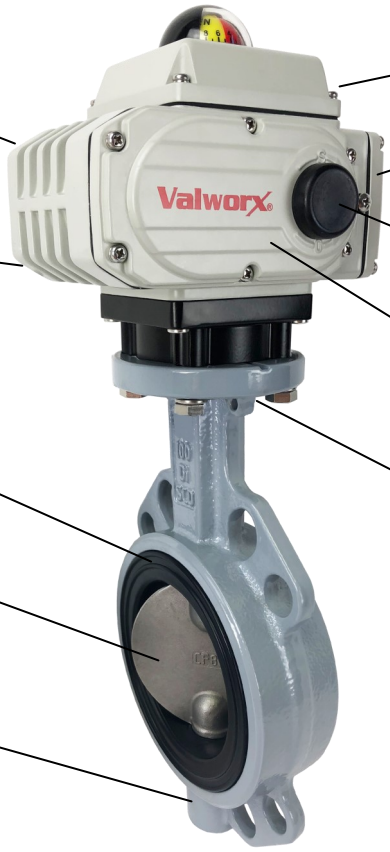
Actuators

- CSA Listed to:
  - UL429 and CSA C22.2 no 139
  - Type 4X, IP67 weatherproof enclosure
- CE conformance
  - ISO5211 Mounting

Valves

- Design complies with API-609, MSS SP-67
- Tests per API-598, AWWA C502-87
- CE according to PED 97/23/EC, ISO5208

Construction Features



Heavy duty integral motor design significantly reduces physical size of actuator

Rugged polyester powder coated aluminum corrosion resistant Type 4X weather-proof enclosure

Unique wave line seat reduces torque and extends seal life

316SS disc with 2-piece stem design enhances flow capacity, reduces pressure drop

Ductile iron body with 3-layer epoxy/epoxy/PUR coating

Anti-Condensation Heater

Terminal Box, wire directly to terminal strip, or via optional 1/2" NPT conduit adapters

Manual Override with protective cover

Self-locking all metal gear train, no additional brake required

Direct mount wafer butterfly valve with standard ISO5211 mount, no brackets required

Visual Valve Position Indicator

Pressure-Temperature Rating

Pressure Rating: 230 PSI (16 Bar), Vacuum 29in Hg, 145 PSI (10 Bar) 12" Size

Actuator Temperature Rating: -22 to +140° F (-30 to 60° C)

Valve Temperature Rating: EPDM seals 0 to 248° F (-18 to 120°C)

NBR (Buna-N) seals 5 to 185° F (-15 to 85°C)

EPS - Electronic Positioning System

Valve positioning and how it works?
Valworx electric actuators with EPS - Electronic Positioning System provide an accurate valve positioning function whereby the movement of the actuator is controlled by a 4-20mA input control signal. Any change in the control input signal results in a corresponding and proportional change in the position of the actuator (valve).

Unique electronic positioning module is fully potted to help protect the electronics from vibration/moisture resistance.

An internal microprocessor on the EPS circuit board continuously monitors the analog input and output signals and compares them to the physical position via a precision potentiometer feedback system, moving the actuator as required to balance the signals.

The EPS system is self-calibrating which virtually eliminates "hunting". The following functions are standard:

- Position monitoring output signal in same format as input. Ex: 4-20mA input, 4-20mA output
- Adjustable forward or reversing action.
- Sensitivity, Zero and Span adjustments
- Selectable fail mode: fail closed, fail open or stop in place (for loss of input command signal).
- Electric manual control with onboard selector switches
- Fault LED lights indicate valve jam or signal loss
- Electronic brake function

Specifications (English units)

Stock Number	Pipe Size (inch)	Orifice Size (inch)	Cv Flow Factor	Pressure Max.(PSI)	Cycle Time/90° (seconds)	Voltage	Current (amps)	Duty Cycle	Electrical Dwg.
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567102A	2	2.00	124	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567103A	2-1/2	2.50	247	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567104A	3	3.00	470	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567105A	4	4.00	929	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567107A	6	6.00	2243	230	30/25	110 VAC, 50/60Hz	0.73	70%	E
567008A	8	8.00	3584	230	45/37	110 VAC, 50/60Hz	1.27	70%	E
567009A	12	12.00	8498	145	45/37	110 VAC, 50/60Hz	1.27	70%	E
24 VDC ELECTRIC WAFER ACTUATED BUTTERLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567127A	2	2.00	124	230	30	DC24	1.0	70%	GE
567128A	2-1/2	2.50	247	230	30	DC24	1.0	70%	GE
567129A	3	3.00	470	230	30	DC24	1.0	70%	GE
567130A	4	4.00	929	230	30	DC24	1.0	70%	GE
567132A	6	6.00	2243	230	30	DC24	1.7	70%	GE
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, NBR (BUNA-N) SEALS EPS POSITIONER 4-20mA input									
567136A	2	2.00	124	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567137A	2-1/2	2.50	247	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567138A	3	3.00	470	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567139A	4	4.00	929	230	20/17	110 VAC, 50/60Hz	0.27	70%	E
567141A	6	6.00	2243	230	30/25	110 VAC, 50/60Hz	0.73	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, NBR (BUNA-N) SEALS EPS POSITIONER 4-20mA input									
567146A	2	2.00	124	230	30	DC24	1.0	70%	GE
567147A	2-1/2	2.50	247	230	30	DC24	1.0	70%	GE
567148A	3	3.00	470	230	30	DC24	1.0	70%	GE
567149A	4	4.00	929	230	30	DC24	1.0	70%	GE
567150A	6	6.00	2243	230	30	DC24	1.7	70%	GE

• Cv is the GPM of water at 60° F that will pass through the valve with 1 PSI pressure drop

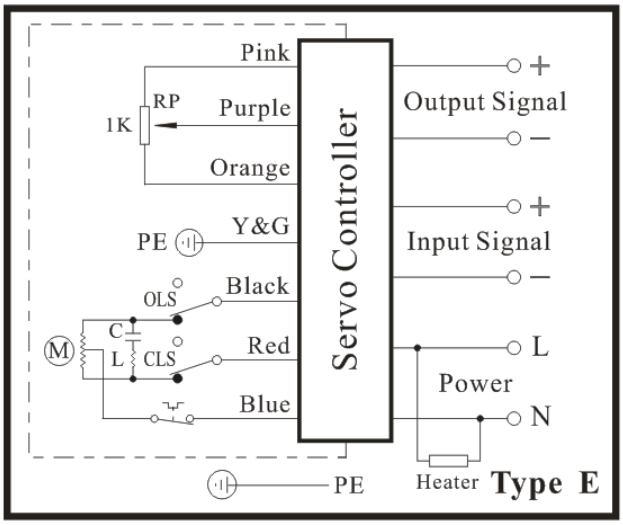
Specifications (Metric units)

Stock Number	Pipe Size (inch)	Orifice Size (mm)	Kv Flow Factor	Pressure Max.(Bar)	Cycle Time/90° (seconds)	Voltage	Current (amps)	Duty Cycle	Electrical Dwg.
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567102A	2	50	107	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567103A	2-1/2	65	212	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567104A	3	80	404	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567105A	4	100	799	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567107A	6	150	1929	16	30/25	110 VAC, 50/60Hz	0.73	70%	E
567008A	8	200	3100	16	45/37	110 VAC, 50/60Hz	1.27	70%	E
567009A	12	300	7350	10	45/37	110 VAC, 50/60Hz	1.27	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, EPDM SEALS EPS POSITIONER 4-20mA input									
567127A	2	50	107	16	30	DC24	1.0	70%	GE
567128A	2-1/2	65	212	16	30	DC24	1.0	70%	GE
567129A	3	80	404	16	30	DC24	1.0	70%	GE
567130A	4	100	799	16	30	DC24	1.0	70%	GE
567132A	6	150	1929	16	30	DC24	1.7	70%	GE
120 VAC ELECTRIC ACTUATED WAFER BUTTERFLY VALVE, NBR SEALS EPS POSITIONER 4-20mA input									
567136A	2	50	107	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567137A	2-1/2	65	212	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567138A	3	80	404	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567139A	4	100	799	16	20/17	110 VAC, 50/60Hz	0.27	70%	E
567141A	6	150	1929	16	30/25	110 VAC, 50/60Hz	0.73	70%	E
24 VDC ELECTRIC ACTUATED WAFER BUTTERLY VALVE, NBR SEALS EPS POSITIONER 4-20mA input									
567146A	2	50	107	16	30	DC24	1.0	70%	GE
567147A	2-1/2	65	212	16	30	DC24	1.0	70%	GE
567148A	3	80	404	16	30	DC24	1.0	70%	GE
567149A	4	100	799	16	30	DC24	1.0	70%	GE
567150A	6	150	1929	16	30	DC24	1.7	70%	GE

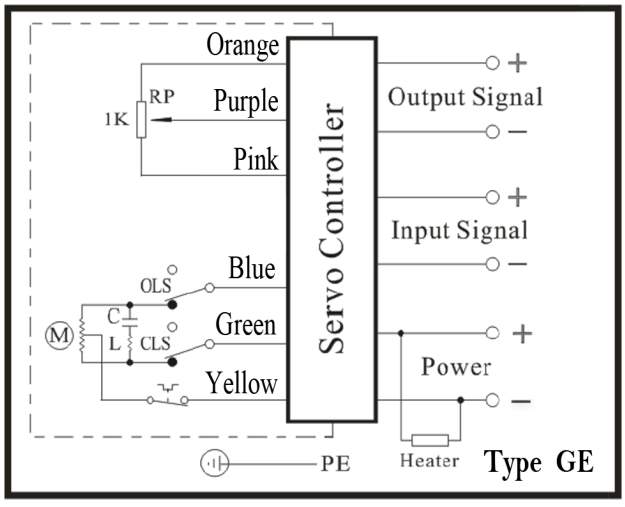
• Kv = The number of m^3 per hour of 20° C water at 1 bar pressure drop

Electrical Wiring

Valves with EPS Positioners
AC Voltages



Valves with EPS Positioners
DC Voltages



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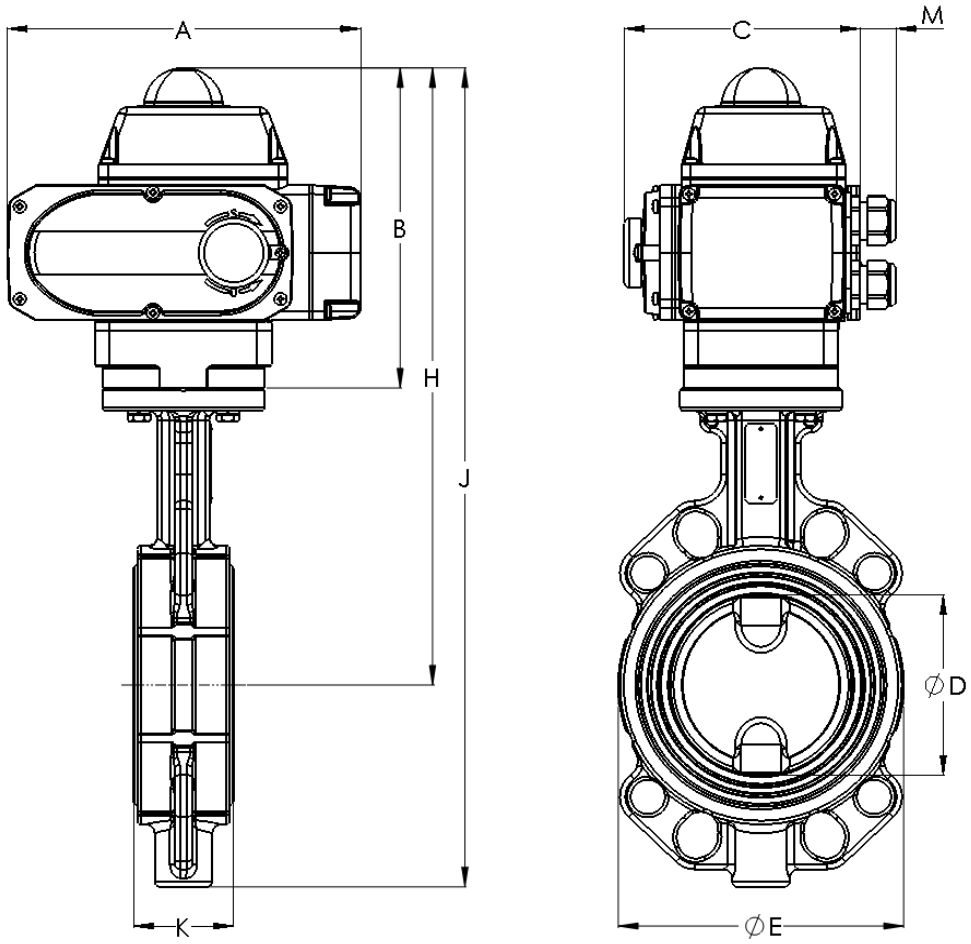


Suitable between flanges:

- ANSI/ASME B16.5 CLASS150
- ANSI/ASME B16.1 CLASS125
- EN1092 PN10, PN16
- JIS B 2239 10K, 16K
- BS 10 Table D, Table E

Pipe Size		A	B	C	D	E	H	J	K	M	Weight (AC/DC)
2	inch	6.34	7.09	4.65	1.97	3.90	12.05	15.04	1.81	0.98	10.8 / 13.3 lb
DN50	mm	161	180	118	50	99	306	382	46	25	4.9 / 6.0 kg
2-1/2	inch	6.34	7.09	4.65	2.56	4.46	12.36	15.59	1.93	0.98	11.8 / 14.3 lb
DN65	mm	161	180	118	65	113	314	396	49	25	5.4 / 6.4 kg
3	inch	6.34	7.09	4.65	3.15	5.07	13.27	17.03	1.93	0.98	13.7 / 16.2 lb
DN80	mm	161	180	118	80	129	337	432.5	49	25	6.2 / 7.3 kg
4	inch	6.34	7.09	4.65	3.94	6.17	13.66	18.54	2.20	0.98	17.3 / 19.8 lb
DN100	mm	161	180	118	100	157	347	471	56	25	7.8 / 9.0 kg
6	inch	10.08	8.50	6.30	5.91	8.39	16.50	22.24	2.32	0.98	37.2 / 37.2 lb
DN150	mm	256	216	160	150	213	419	565	59	25	16.9 / 16.9 kg
8	inch	10.08	8.50	6.30	7.87	10.67	17.48	24.25	2.36	0.98	48.9 lb
DN200	mm	256	216	160	200	271	444	616	60	25	22.2 kg
12	inch	10.08	8.50	6.30	11.81	15.0	19.9	29.4	3.07	0.98	79.4 lb
DN300	mm	256	216	160	300	381	505	747	78	25	36 kg

PROCO

The Expansion Joint and Check Valve People

Molded Spherical Joints Style 240/242

Proco Style 240/242 Molded Spherical Joints

Proco Style 240/242 Spherical Molded Expansion Joints are designed for piping systems to absorb pipe movements, relieve stress, reduce system noise/vibration, compensate for misalignment/offset and to protect rotating mechanical equipment against start-up surge forces.

The molded style 240 single sphere and 242 twin sphere designed bellows are inherently stronger than the conventional hand-built style spool arch type. Internal pressure within a "sphere" is exerted in all directions, distributing forces evenly over a larger area. The spherical design "flowing arch" reduces turbulence and sediment buildup.

Features and Benefits:

Absorbs Directional Movement

Thermal movements appear in any rigid pipe system due to temperature changes. The Style 240 and Style 242 spherical arch expansion joints allow for axial compression or axial extension, lateral deflection as well as angular movement. (Note: Rated movements in this publication are based on single plane movements. Multiple movement conditions are based on a multiple movement calculation. Contact Proco for information when designing multiple pipe movements.)

Easy Installation with Rotating Metallic Flanges

The floating metallic flanges freely rotate on the bellows, compensating for mating flange misalignment, thus speeding up installation time. Gaskets are not required with the Style 240 or Style 242, provided the expansion joints are mated against a flat face flange as required in the installation instructions.

Flange Materials/Drilling

The Proco Style 240 and Style 242 molded expansion joints are furnished complete with plated carbon steel flanges for corrosion protection. 304 or 316 stainless steel flanges are available upon request as well as ANSI 250/300 lb., BS-10, DIN PN10 & PN16 and JIS-10K drilling.

Absorbs Vibration, Noise and Shock

The Proco Style 240 and Style 242 molded expansion joints effectively dampen and insulate downstream piping against the transmission of noise and vibration generated by mechanical equipment. Noise and vibration caused by equipment can cause stress in pipe, pipe guides, anchors and other equipment downstream. Water hammer and pumping impulses can also cause strain, stress or shock to a piping system. Install the Style 240 or Style 242 molded expansion joints to help compensate for these system pressure spikes.

Wide Service Range with Low Cost

Engineered to operate up to 300 PSIG or 265°F, the Proco Style 240 and Style 242 can be specified for a wide range of piping requirements. Compared to conventional hand-built spool type joints, you will invest less money when specifying the mass-produced, consistent high quality, molded single or twin sphere expansion joints.

Material Identification

All Style 240 or Style 242 molded expansion joints have branded elastomer designations. Neoprene Tube/Neoprene Cover (NN) and Nitrile Tube/Neoprene Cover (NP) elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F1123-87. 240C/NP-9 joints have ABS certification.

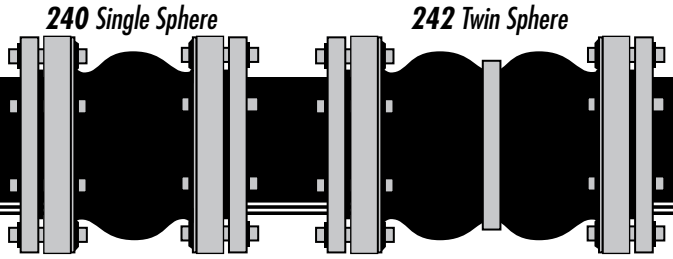
Large Inventory

Proco Products, Inc. maintains one of the largest inventories of rubber expansion joints in the world. Please contact us for price and availability.

Table 1: Available Styles • Materials

For Specific Elastomer Recommendations, See: **PROCO** "Chemical To Elastomer Guide"

240-A	240-C	240-AV,D,E,M [11]	242-A,B,C	PROCO Material Code	Cover Elastomer [1]	Tube Elastomer [2]	Max-imum Operating Temp. °F	Identifying Color Band/Label
		X	X	/BB[3]	Chlorobutyl	Chlorobutyl	250°	Black
		X	X	/EE[2,3,7]	EPDM	EPDM	250°	Red
X	X			/EE[2,3,4]	EPDM	FDA-EPDM	250°	Red
		X		/EQ[2,3]	EPDM	FDA-EPDM	250°	Red
X	X			/EE-9[3,5]	EPDM	EPDM	265°	DBL Red
	X			/HH	CSM	CSM	212°	Green
		X	X	/NH	Neoprene	CSM	212°	Green
	X			/NJ[2]	Neoprene	FDA-Nitrile	212°	White
	X	X	X	/NN[7]	Neoprene	Neoprene	225°	Blue
X	X	X	X	/NP	Neoprene	Nitrile	212°	Yellow
X	X			/NP-9[6]	Neoprene	Nitrile-ABS	212°	DBL Yellow



Protecting Piping and Equipment Systems from Stress/Motion

Notes: All Products are reinforced with Nylon Tire Cord, except 240-A and 240-C which are reinforced with Polyester.

1. *All NN & NP elastomer designated joints meet the Coast Guard Requirements and conform to ASTM F 1123-87 and are marked accordingly.*
2. *Branding Label will be marked as "Food Grade".*
3. *BB, EE or EE-9 are good for 300°F blower service at 20 PSI or less.*
4. *240-A & 240-C expansion joints have black EPDM tube, but are FDA compliant.*
5. *EE-9 joints are peroxide cured.*
6. *NP-9 joints have ABS certification.*
7. *Elastomers are in accordance with NSF/ANSI 372, File MH47689 Und. Lab. Classified.*
8. *All elastomers above are not intended for steam service.*
9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*
10. *For 240A & 240C Rubber Joints, Vacuum Support devices are available. Published movements will be reduced by approximately 50% for this option.*
11. *Series 240AV,D,E&M + 242A,B&C In Elastomers EPDM & Neoprene are all listed for low lead content in accordance with NSF/ANSI 372*

Information subject to change without notice.

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	5.00	240-C	1.063	1.250	1.188	45	4.43	225	26	4.25	3.13	4	0.625	1/2-13 UNC	3.8	3.3
	6.00	240-AV	0.500	0.375	0.500	37										
1.25 (32)	3.74	240-D	0.312	0.188	0.312	45	6.34	225	26	4.63	3.5	4	0.625	—	4.6	3.3
	5.00	240-C	1.063	1.250	1.188	17		235	21				0.625	—	5.0	
	5.00	240-E	0.500	0.375	0.500	31		225	26				0.625	—	5.0	
	6.00	**240-AV**	0.500	0.375	0.500	31		225	26				0.625	1/2-13 UNC	5.0	
1.5 (40)	3.74	240-D	0.375	0.188	0.312	14	6.49	225	26	5.0	3.88	4	0.625	—	5.4	4.6
	4.00	240-M	0.375	0.188	0.312	14		225	26				0.625	—	5.5	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.625	—	5.1	
	5.00	240-E	0.500	0.375	0.500	27		225	26				0.625	—	6.0	
	6.00	**240-AV**	0.500	0.375	0.500	27		225	26				0.625	1/2-13 UNC	6.1	
2 (50)	4.00	240-M	0.375	0.188	0.312	11	7.07	225	26	6.0	4.75	4	0.750	—	8.3	6.3
	4.13	240-D	0.375	0.188	0.312	11		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	5.00	240-C	1.063	1.250	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	5.00	240-E	0.375	0.375	0.500	20		225	26	6.0	4.75	4	0.750	—	8.5	6.3
	6.00	240-A	1.188	1.188	1.188	45		235	18	6.0	4.75	4	0.750	—	7.1	6.3
	6.00	**240-AV**	0.500	0.375	0.500	20		225	26	6.0	4.75	4	0.750	5/8-11 UNC	12.3	7.6
	6.00	Q-240-HW	0.500	0.375	0.500	20		300	26	6.5	5.0	8	0.750	—	11.0	7.6
2.5 (65)	4.00	240-M	0.375	0.188	0.375	8	11.05	225	26	7.0	5.5	4	0.750	—	12.0	7.6
	4.53	240-D	0.500	0.188	0.375	11		225	26				0.750	—	12.3	
	5.00	240-C	1.063	1.250	1.188	45		235	18				0.750	—	10.6	
	5.00	240-E	0.500	0.375	0.500	17		225	26				0.750	—	12.0	
	6.00	240-A	1.188	1.188	1.188	43		235	18				0.750	—	12.0	
	6.00	**240-AV**	0.500	0.375	0.500	17		225	26				0.750	5/8-11 UNC	12.3	
3 (80)	5.00	240-C	1.063	1.250	1.188	40	13.36	235	15	7.5	6.0	4	0.750	—	13.3	8.3
	5.00	240-E	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	5.12	240-D	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	—	14.0	8.3
	6.00	240-A	1.188	1.188	1.188	38		235	15	7.5	6.0	4	0.750	—	13.8	8.3
	6.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.0	8.3
	8.00	**240-AV**	0.500	0.375	0.500	14		225	26	7.5	6.0	4	0.750	5/8-11 UNC	15.0	8.7
	6.00	Q-240-HW	0.500	0.375	0.500	14		300	26	8.25	6.62	8	0.875	—	17.5	8.3
3.5 (90)	6.00	240-AV	0.500	0.375	0.500	12	18.67	225	26	8.5	7.0	8	0.750	5/8-11 UNC	17.6	7.4
4 (100)	5.00	240-C	1.063	1.250	1.188	32	22.69	235	15	9.0	7.5	8	0.750	—	16.5	7.4
	5.00	240-E	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.0	7.4
	5.32	240-D	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	—	17.1	7.4
	6.00	240-A	1.188	1.188	1.188	30		235	15	9.0	7.5	8	0.750	—	17.5	7.4
	6.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	18.3	7.4
	8.00	**240-AV**	0.750	0.500	0.500	14		225	26	9.0	7.5	8	0.750	5/8-11 UNC	19.3	7.8
	6.00	Q-240-HW	0.750	0.500	0.500	14		300	26	10.0	7.88	8	0.750	—	26.0	7.4
5 (125)	5.00	240-C	1.063	1.250	1.188	27	30.02	235	10	10.0	8.5	8	0.875	—	20.3	8.3
	5.00	240-E	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	—	22.0	8.3
	6.00	240-A	1.188	1.188	1.188	25		235	10	10.0	8.5	8	0.875	—	21.8	8.3
	6.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	22.8	8.3
	6.69	240-D	0.750	0.500	0.500	11		225	10	10.0	8.5	8	0.875	—	23.6	8.5
	8.00	**240-AV**	0.750	0.500	0.500	11		225	26	10.0	8.5	8	0.875	3/4-10 UNC	25.0	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	11		300	26	11.0	9.25	8	0.875	—	28.0	14.0

See Notes Page 4

Style 240 Single Sphere Performance Data

Table 2: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	240 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5,9]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
6 (150)	5.00	240-C	1.063	1.250	1.188	23	41.28	225	8	11.0	9.5	8	0.875	—	22.6	10.4
	5.00	240-E	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	26.0	10.4
	6.00	240-A	1.188	1.188	1.188	21		235	10	11.0	9.5	8	0.875	—	24.0	10.4
	6.00	**240-AV**	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	3/4-10 UNC	26.8	10.4
	7.09	240-D	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	—	29.0	10.6
	8.00	**240-AV**	0.750	0.500	0.500	9		225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.1	10.8
	6.00	Q-240-HW	0.750	0.500	0.500	9		300	26	12.5	10.62	12	0.875	—	39.0	10.4
8 (200)	5.00	240-C	1.063	1.188	1.188	17	63.62	235	8	13.5	11.75	8	0.875	—	35.5	13.4
	5.00	240-E	0.750	0.500	0.500	7		225	26	13.5	11.75	8	0.875	—	40.0	13.4
	6.00	240-A	1.188	1.188	1.188	16		235	8	13.5	11.75	8	0.875	—	38.5	13.4
	6.00	**240-AV**	0.750	0.500	0.500	7		225	26	13.5	11.75	8	0.875	3/4-10 UNC	40.6	13.4
	8.07	240-D	1.000	0.563	0.875	8		225	26	13.5	11.75	8	0.875	—	41.3	14.0
	6.00	Q-240-HW	0.750	0.500	0.500	7		300	26	15.0	13.00	12	1.000	—	70.0	13.4
10 (250)	5.00	240-C	1.063	1.188	1.188	14	103.87	235	6	16.0	14.25	12	1.000	—	49.3	21.0
	5.00	240-E	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	56.0	21.0
	8.00	240-A	1.188	1.188	1.188	13		145	6	16.0	14.25	12	1.000	—	53.6	21.3
	8.00	**240-AV**	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	56.6	21.3
	9.00	**240-AV**	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	57.0	22.0
	9.45	240-D	1.000	0.625	0.750	7		225	26	16.0	14.25	12	1.000	—	58.5	22.0
	10.00	**240-AV**	1.000	0.625	0.875	7		225	26	16.0	14.25	12	1.000	7/8-9 UNC	60.5	26.5
	8.00	Q-240-HW	1.000	0.625	0.750	7		275	26	17.5	15.25	16	1.125	—	56.0	22.0
12 (300)	5.00	240-C	1.063	1.250	1.188	12	137.89	235	6	19.0	17.0	12	1.000	—	73.4	26.5
	5.00	240-E	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	—	74.0	26.5
	8.00	240-A	1.188	1.188	1.188	11		145	6	19.0	17.0	12	1.000	—	80.0	27.0
	8.00	**240-AV**	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	7/8-9 UNC	83.0	27.0
	9.00	**240-AV**	1.000	0.625	0.750	6		225	26	19.0	17.0	12	1.000	7/8-9 UNC	88.0	27.0
	10.24	240-D	1.000	0.625	0.875	6		225	26	19.0	17.0	12	1.000	—	89.0	28.0
	8.00	Q-240-HW	1.000	0.625	0.750	6		275	26	20.5	17.75	16	1.250	—	100.0	27.0
14 (350)	8.00	240-C	1.000	1.063	1.188	8	182.65	232	6	21.0	18.75	12	1.125	—	112.0	28.0
	8.00	**240-AV**	1.000	0.625	0.750	6		150	26				1.125	—	115.0	28.0
16 (400)	8.00	240-C	1.000	1.063	1.188	8	240.53	232	6	23.5	21.25	16	1.125	—	136.0	26.8
	8.00	240-HW	1.000	0.625	0.750	4		175	26				1.125	—	186.0	26.8
	8.00	**240-AV**	1.000	0.625	0.750	4		125	26				1.125	—	165.0	26.8
	9.00	240-M	1.000	0.625	0.750	4		125	26				1.125	—	168.0	27.0
	10.43	240-D	1.000	0.625	0.875	4		125	26				1.125	—	170.0	27.0
18 (450)	8.00	240-HW	1.000	0.625	0.750	4	298.65	175	26	25.0	22.75	16	1.250	—	209.0	31.4
	8.00	**240-AV**	1.000	0.625	0.750			125	26				1.250	—	168.0	31.4
	9.00	240-M	1.000	0.625	0.750			125	26				1.250	—	169.0	33.1
	10.43	240-D	1.000	0.625	0.875			125	26				1.250	—	170.0	33.1
20 (500)	8.00	240-C	1.000	1.063	1.188	6	363.05	145	6	27.5	25.00	20	1.250	—	154.0	32.4
	8.00	240-HW	1.000	0.625	0.750	3		175	26				1.250	—	234.0	32.4
	8.00	**240-AV**	1.000	0.625	0.750	3		125	26				1.250	—	170.0	32.4
	9.00	240-M	1.000	0.625	0.750	3		125	26				1.250	—	173.0	34.1
	10.43	240-D	1.000	0.625	0.875	3		125	26				1.250	—	175.0	34.1
24 (600)	8.00	240-C	1.000	1.063	1.188	5	510.70	145	6	32.5	29.5	20	1.375	—	214.0	44.0
	10.00	**240-AV**	1.000	0.625	0.750	3		110	26				1.375	—	255.0	45.5
	10.00	240-HW	1.000	0.625	0.750	3		160	26				1.375	—	297.0	45.5
	10.47	240-D	1.000	0.625	0.875	3		110	26				1.375	—	265.0	46.0
30 (750)	10.00	**240-AV**	1.000	0.625	0.750	2	779.31	110	26	38.75	36.0	28	1.375	—	295.0	57.0

See Notes Page 4

NOTES:

Standard Proco Style 240-AV Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-240-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 240AV/NN and 240-D/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expasion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

9. *For PTFE lined single sphere see www.procoproducts.com/ptfelined.html*

"Effective Area"

Thrust Factor=

$$T = \frac{\pi}{4}(D)^2 (P)$$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

Style 242 Twin Sphere Performance Data

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1 (25)	10.00	242-C	2.000	1.188	1.750	45	4.43	225	26	4.25	3.13	4	0.625	—	5.2	3.6
1.25 (32)	7.0	**242-A**	2.000	1.188	1.750	45	6.34	225	26	4.63	3.5	4	0.625	1/2-13 UNC	5.3	3.5
	7.0	242-HA						300					0.625	—	6.5	3.5
	10.00	242-C						225					0.625	—	6.2	3.6
1.5 (40)	6.00	242-B	2.000	1.188	1.750	45	6.49	225	26	5.0	3.88	4	0.625	—	6.1	4.6
	6.00	242-HB						300					0.625	—	7.6	4.6
	7.00	**242-A**						225					0.625	1/2-13 UNC	6.8	4.8
	7.00	242-HA						300					0.625	—	8.3	4.8
	10.00	242-C						225					0.625	—	7.7	5.1
2 (50)	6.00	242-B	2.000	1.188	1.750	45	7.07	225	26	6.0	4.75	4	0.750	—	9.0	6.6
	7.00	**242-A**						225		6.0	4.75	4	0.750	—	9.0	7.0
	10.00	242-C						235		6.0	4.75	4	0.750	5/8-11 UNC	10.2	7.3
	6.00	Q-242-HB						300		6.0	4.75	4	0.750	—	10.5	6.6
	7.00	Q-242-HA						300		6.5	5.00	8	0.750	—	10.5	7.0
2.5 (65)	6.00	242-B	2.000	1.188	1.750	43	11.05	225	26	7.0	5.5	4	0.750	—	12.9	7.6
	7.00	**242-A**						225					0.750	—	13.3	8.0
	10.00	242-C						225					0.750	5/8-11 UNC	14.5	8.4
	6.00	Q-242-HB						300					0.750	—	15.3	7.6
	7.00	Q-242-HA						300					0.750	—	15.8	8.0
3 (80)	7.00	**242-A**	2.000	1.188	1.750	38	13.36	225	26	7.5	6.0	4	0.750	5/8-11 UNC	14.3	8.6
	9.00	242-B						225		7.5	6.0	4	0.750	—	15.2	9.0
	10.00	242-C						225		7.5	6.0	4	0.750	—	15.8	9.1
	12.00	242-C						225		7.5	6.0	4	0.750	—	16.0	9.9
	7.00	Q-242-HA						300		8.25	6.62	8	0.875	—	18.2	8.6
4 (100)	9.00	**242-A**	2.000	1.375	1.562	34	22.69	225	26	9.0	7.5	8	0.750	5/8-11 UNC	20.3	8.0
	10.00	242-C						225		9.0	7.5	8	0.750	—	21.3	8.2
	12.00	242-C						225		9.0	7.5	8	0.750	—	22.0	8.2
	9.00	Q-242-HA						300		10.0	7.88	8	0.750	3/4-10 UNC	26.4	8.0
5 (125)	9.00	**242-A**	2.000	1.375	1.562	29	30.02	225	26	10.0	8.5	8	0.875	—	24.5	8.3
	10.00	242-C						225		10.0	8.5	8	0.875	—	25.5	9.1
	12.00	242-C						225		10.0	8.5	8	0.875	—	26.0	9.1
	9.00	Q-242-HA						300		11.0	9.25	8	0.875	—	31.4	8.3
6 (150)	9.00	**242-A**	2.000	1.375	1.562	25	41.28	225	26	11.0	9.5	8	0.875	3/4-10 UNC	29.5	11.7
	10.00	242-C						225		11.0	9.5	8	0.875	—	30.5	11.9
	12.00	242-C						225		11.0	9.5	8	0.875	—	31.0	12.0
	14.00	242-C						225		11.0	9.5	8	0.875	—	32.0	12.0
	9.00	Q-242-HA						300		12.5	10.62	12	0.875	—	38.6	11.7
8 (200)	9.00	242-B	2.375	1.375	1.375	19	63.62	225	26	13.5	11.75	8	0.875	—	42.3	14.5
	10.00	242-C						225		13.5	11.75	8	0.875	—	43.4	15.0
	12.00	242-C						225		13.5	11.75	8	0.875	—	44.0	15.2
	13.00	**242-A**						225		13.5	11.75	8	0.875	—	43.8	15.4
	14.00	242-C						225		13.5	11.75	8	0.875	3/4-10 UNC	46.0	16.0
	9.00	Q-242-HB						300		15.0	13.0	12	1.000	—	55.4	14.5
	13.00	Q-242-HA						300		15.0	13.0	12	1.000	—	57.5	15.4
10 (250)	12.00	242-B	2.375	1.375	1.375	15	103.87	225	26	16.0	14.25	12	1.000	—	64.1	23.5
	13.00	**242-A**						225		16.0	14.25	12	1.000	—	65.5	24.5
	14.00	242-C						225		16.0	14.25	12	1.000	7/8-9 UNC	66.7	24.5
	12.00	Q-242-HB						275		17.5	15.25	16	1.125	—	86.5	23.5
	13.00	Q-242-HA						275		17.5	15.25	16	1.125	—	88.4	24.5

See Notes Page 6

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL Pipe Size I.D.	Neutral Length	PROCO Style Number [1]	242 Movement Capability: From Neutral Position (Non-Concurrent) [2]					Pressure [4]		Standard Flange Drilling Dimensions [8]					Weight in lbs	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust Factor [3]	Positive PSIG [5]	Vacuum [6] Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole [7] Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
12 (300)	12.00	242-B	2.375	1.375	1.375	13	137.89	225	26	19.0	17.00	12	1.000	—	94.0	30.0
	13.00	**242-A**						225		19.0	17.00	12	1.000	—	95.0	31.0
	14.00	242-C						225		19.0	17.00	12	1.000	7/8-9 UNC	99.1	31.0
	12.00	Q-242-HB						275		20.5	17.75	16	1.250	—	110.0	30.0
	13.00	Q-242-HA						275		20.5	17.75	16	1.250	—	110.0	31.0
14 (350)	13.75	**242-A**	1.750	1.118	1.118	9	182.65	150	26	21.0	18.75	12	1.125	—	142.0	32.0
16 (400)	12.00	242-C	1.750	1.118	1.118	8	240.53	125	26	23.5	21.25	16	1.125	—	154.0	28.8
	12.00	242-HC						175					1.125	—	190.0	28.8
	13.75	**242-A**						125					1.125	—	162.0	30.8
	13.75	242-HA						175					1.125	—	200.2	30.8
18 (450)	12.00	242-C	1.750	1.118	1.118	7	298.65	125	26	25.0	22.75	16	1.250	—	168.0	35.1
	13.75	**242-A**						125					1.250	—	176.0	36.1
	13.75	242-HA						175					1.250	—	211.2	36.1
20 (500)	12.00	242-C	1.750	1.118	1.118	7	363.05	125	26	27.5	25.0	20	1.250	—	202.0	35.0
	13.75	**242-A**						125					1.250	—	212.0	35.5
	13.75	242-HA						175					1.250	—	212.0	35.5
24 (600)	12.00	242-C	1.750	1.118	1.118	5	510.70	110	26	32.5	29.5	20	1.375	—	220.0	47.0
	13.75	**242-A**						110					1.375	—	250.0	48.0
	13.75	242-HA						160					1.375	—	296.2	48.0
30 (750)	12.00	242-C	1.750	1.118	1.118	4	779.31	110	26	38.75	36.0	28	1.375	—	300.0	62.0

NOTES:

Standard Proco Style 242-A Expansion Joints shown in Bold Type are considered Standards and are inventoried in large quantities.

1. *"HW" denotes Heavy Weight Construction. For sizes 2" I.D. thru 12" I.D., Proco will only offer these items with 300 lb. drilling and are denoted by Q-242-HW. All Q-240-HW units will only be sold with control units.*

2. *Concurrent Movements - Concurrent movements are developed when two or more movements in a pipe system occur at the same time. If multiple movements exceed single arch design there may be a need for an additional arch. To perform calculation for concurrent movement when a pipe system design has more than one movement, please use the following formula:*

$$\frac{\text{Actual Axial Compression}}{\text{Rated Axial Compression}} + \frac{\text{Actual Axial Extension}}{\text{Rated Axial Extension}} + \frac{\text{Actual Lateral (X)}}{\text{Rated Lateral (X)}} + \frac{\text{Actual Lateral (Y)}}{\text{Rated Lateral (Y)}} = / < 1$$

Calculation must be equal to or less than 1 for expansion joint to operate within concurrent movement capability.

3. *Calculation of Thrust (Thrust Factor). When expansion joints are installed in the pipeline, the static portion of the thrust is calculated as a product of the area of the I.D. of the arch of the expansion joint times the maximum pressure (design, test or surge) that will occur in the line. The result is a force expressed in pounds.* ***Take design, surge or test pressure X thrust factor to calculate end thrust.***

"Effective Area"

Thrust Factor=

$T = \frac{\pi}{4} (D)^2 (P)$

T= Thrust
P= PSI (Design, Test or Surge)
D= Arch I.D.

4. *Pressure rating is based on 170°F operating temperature. The pressure rating is reduced at higher temperatures.*

5. *Pressures shown at maximum "operating pressure". Test pressure is 1.5 times "operating pressure". Burst pressure is 4 times "operating pressure". If factory hydro-test is required, an additional joint per size must be purchased and tested. Once hydro-tested this joint may not be sent to field for installation as the beaded end will have taken a (compressed) set and can not be reused.*

6. *Vacuum rating is based on neutral installed length, without external load. Products should not be installed in extension for vacuum applications. Flattening of the arch in extended mode will cause the arch to collapse.*

7. *Style 242A/NN (neoprene elastomer only) expansion joints 1.0" I.D. thru 12" I.D. are available with tapped (threaded) holes and must be specified at time of order.*

8. *In addition to standard 150 lb. drilled flanges, Proco can provide expansion joints listed above in 300 lb. drilling, BS-10 (British) drilling, Metric PN10 and PN16 drilling and JIS 10kg/cm drilling.*

Style 240/242 Drilling Chart

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	American 125/150# Conforms to ANSI B16.1 and B16.5						American 250/300# Conforms to ANSI B16.1 and B16.5					British Standard 10:1962 Conforms to BS 10 Table E				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Drilled Hole Size	Threaded Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.55 (14.0)	4.25 (108.0)	3.13 (79.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	4.88 (124.0)	3.5 (88.9)	4	0.75 (19.1)	0.59 (15.0)	4.5 (114.0)	3.25 (82.6)	4	0.62 (15.9)
1.25 (32)	0.55 (14.0)	4.63 (118.0)	3.5 (88.9)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	5.25 (133.0)	3.88 (98.4)	4	0.75 (19.1)	0.59 (15.0)	4.75 (121.0)	3.44 (87.3)	4	0.62 (15.9)
1.5 (40)	0.55 (14.0)	5.0 (127.0)	3.88 (98.4)	4	0.62 (15.9)	1/2 - 13 UNC	0.63 (16.0)	6.12 (156.0)	4.50 (114.3)	4	0.88 (22.2)	0.59 (15.0)	5.25 (133.0)	3.88 (98.4)	4	0.62 (15.9)
2 (50)	0.63 (16.0)	6.0 (152.0)	4.75 (120.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	6.50 (165.0)	5.00 (127.0)	8	0.75 (19.1)	0.63 (16.0)	6.0 (152.0)	4.5 (114.3)	4	0.75 (19.1)
2.5 (65)	0.71 (18.0)	7.0 (178.0)	5.5 (139.7)	4	0.75 (19.1)	5/8 - 11 UNC	0.71 (18.0)	7.5 (191.0)	5.88 (149.2)	8	0.88 (22.2)	0.71 (18.0)	6.5 (165.0)	5.0 (127.0)	4	0.75 (19.1)
3 (80)	0.71 (18.0)	7.5 (191.0)	6.0 (152.4)	4	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	8.25 (210.0)	6.62 (168.2)	8	0.88 (22.2)	0.71 (18.0)	7.25 (184.0)	5.75 (146.1)	4	0.75 (19.1)
3.5 (90)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	9.0 (229.0)	7.25 (184.2)	8	0.88 (22.2)	0.71 (18.0)	8.0 (203.0)	6.5 (165.1)	8	0.75 (19.1)
4 (100)	0.71 (18.0)	9.0 (229.0)	7.5 (190.5)	8	0.75 (19.1)	5/8 - 11 UNC	0.79 (20.0)	10.0 (254.0)	7.88 (200.0)	8	0.88 (22.2)	0.71 (18.0)	8.5 (216.0)	7.0 (177.8)	8	0.75 (19.1)
5 (125)	0.79 (20.0)	10.0 (254.0)	8.5 (215.9)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.0)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)	0.79 (20.0)	10.0 (254.0)	8.25 (209.6)	8	0.75 (19.1)
6 (150)	0.87 (22.0)	11.0 (279.0)	9.5 (241.3)	8	0.88 (22.2)	3/4 - 10 UNC	0.87 (22.2)	12.5 (318.0)	10.62 (269.9)	12	0.88 (22.2)	0.87 (22.2)	11.0 (279.0)	9.25 (235.0)	8	0.88 (22.2)
8 (200)	0.87 (22.0)	13.5 (343.0)	11.75 (298.5)	8	0.88 (22.2)	3/4 - 10 UNC	0.95 (24.0)	15.0 (381.0)	13.0 (330.2)	12	1.00 (25.4)	0.87 (22.2)	13.25 (337.0)	11.5 (292.1)	8	0.88 (22.2)
10 (250)	0.95 (24.0)	16.0 (406.0)	14.25 (362.0)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	17.5 (445.0)	15.25 (387.4)	16	1.13 (28.6)	0.95 (24.0)	16.0 (406.0)	14.0 (355.6)	12	0.88 (22.2)
12 (300)	0.95 (24.0)	19.0 (483.0)	17.0 (431.8)	12	1.00 (25.4)	7/8 - 9 UNC	1.02 (26.0)	20.5 (521.0)	17.75 (450.9)	16	1.25 (31.8)	0.95 (24.0)	18.0 (457.0)	16.0 (406.4)	12	1.00 (25.4)
14 (350)	1.02 (26.0)	21.0 (533.0)	18.75 (476.3)	12	1.13 (28.6)	1 - 8 UNC	1.10 (28.0)	23.0 (584.0)	20.25 (514.4)	20	1.25 (31.8)	1.02 (26.0)	20.75 (527.0)	18.5 (469.9)	12	1.00 (25.4)
16 (400)	1.10 (28.0)	23.5 (597.0)	21.25 (539.8)	16	1.13 (28.6)	1 - 8 UNC	1.18 (30.0)	25.5 (648.0)	22.5 (571.5)	20	1.38 (34.9)	1.10 (28.0)	22.75 (578.0)	20.5 (520.7)	12	1.00 (25.4)
18 (450)	1.18 (30.0)	25.0 (635.0)	22.75 (577.9)	16	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	28.0 (711.0)	24.75 (628.7)	24	1.38 (34.9)	1.18 (30.0)	25.25 (641.0)	23.0 (584.2)	16	1.00 (25.4)
20 (500)	1.18 (30.0)	27.5 (699.0)	25.0 (635.0)	20	1.25 (31.8)	1 1/8 - 7 UNC	1.18 (30.0)	30.5 (775.0)	27.0 (685.8)	24	1.38 (34.9)	1.18 (30.0)	27.75 (705.0)	25.25 (641.4)	16	1.00 (25.4)
24 (600)	1.18 (30.0)	32.06 (813.0)	29.5 (749.3)	20	1.38 (34.9)	1 1/4 - 7 UNC	1.18 (30.0)	36.0 (914.0)	32.0 (812.8)	24	1.62 (41.3)	1.18 (30.0)	32.5 (826.0)	29.75 (755.7)	16	1.25 (31.8)
30 (750)	1.26 (32.0)	38.75 (984.0)	36.0 (914.4)	28	1.38 (34.9)	1 1/4 - 7 UNC	1.26 (32.0)	43.0 (1092.0)	39.25 (997.0)	28	2.00 (50.8)	1.26 (32.0)	39.25 (997.0)	36.5 (927.1)	20	1.38 (34.9)

Table 4: Flange Drilling

NOMINAL Pipe Size Inch (mm)	Metric Series Conforms to I.S.O. 2084-1974 Table PN10 Holes to I.S.O. /R-273					Metric Series Conforms to I.S.O. 2084-1974 Table PN16 Holes to I.S.O. /R-273					J.I.S. Standard B-2212 Conforms to J.I.S. 10Kg/cm				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 (25)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.63 (16.0)	4.53 (115.0)	3.35 (85.0)	4	0.55 (14.0)	0.59 (15.0)	4.92 (125.0)	3.54 (90.0)	4	0.75 (19.0)
1.25 (32)	0.63 (16.0)	5.51 (140.0)	3.94 (85.0)	4	0.71 (18.0)	0.63 (16.0)	5.51 (140.0)	3.94 (100.0)	4	0.71 (18.0)	0.59 (15.0)	5.31 (135.0)	3.94 (100.0)	4	0.75 (19.0)
1.5 (40)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.63 (16.0)	5.91 (150.0)	4.33 (110.0)	4	0.71 (18.0)	0.59 (15.0)	5.51 (140.0)	4.13 (105.0)	4	0.75 (19.0)
2 (50)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.71 (18.0)	6.50 (165.0)	4.92 (125.0)	4	0.71 (18.0)	0.63 (16.0)	6.10 (155.0)	4.72 (120.0)	4	0.75 (19.0)
2.5 (65)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.71 (145.0)	4	0.71 (18.0)	0.71 (18.0)	6.89 (175.0)	5.51 (140.0)	4	0.75 (19.0)
3 (80)	0.79 (20.0)	7.87 (200.0)	6.3 (160.0)	8	0.71 (18.0)	0.79 (20.0)	7.87 (200.0)	6.30 (160.0)	8	0.71 (18.0)	0.71 (18.0)	7.28 (185.0)	5.91 (150.0)	8	0.75 (19.0)
3.5 (90)	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	0.71 (18.0)	7.68 (195.0)	6.30 (160.0)	8	0.75 (19.0)
4 (100)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.79 (20.0)	8.66 (220.0)	7.09 (180.0)	8	0.71 (18.0)	0.71 (18.0)	8.27 (210.0)	6.89 (175.0)	8	0.75 (19.0)
5 (125)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.87 (22.0)	9.84 (250.0)	8.27 (210.0)	8	0.71 (18.0)	0.79 (20.0)	9.84 (250.0)	8.27 (210.0)	8	0.91 (23.0)
6 (150)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.22 (285.0)	9.45 (240.0)	8	0.87 (22.0)	0.87 (22.0)	11.02 (280.0)	9.45 (240.0)	8	0.91 (23.0)
8 (200)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	8	0.87 (22.0)	0.87 (22.0)	13.39 (340.0)	11.61 (295.0)	12	0.87 (22.0)	0.87 (22.0)	12.99 (330.0)	11.42 (290.0)	12	0.91 (23.0)
10 (250)	1.02 (26.0)	15.55 (395.0)	13.78 (350.0)	12	0.87 (22.0)	1.02 (26.0)	15.94 (405.0)	13.98 (355.0)	12	1.02 (26.0)	0.95 (24.0)	15.75 (400.0)	13.98 (355.0)	12	0.98 (25.0)
12 (300)	1.02 (26.0)	17.52 (445.0)	15.75 (400.0)	12	0.87 (22.0)	1.02 (26.0)	18.11 (460.0)	16.14 (410.0)	12	1.02 (26.0)	0.95 (24.0)	17.52 (445.0)	15.75 (400.0)	16	0.98 (25.0)
14 (350)	1.10 (28.0)	19.88 (505.0)	18.11 (460.0)	16	0.87 (22.0)	1.10 (28.0)	20.47 (520.0)	18.50 (470.0)	16	1.02 (26.0)	1.02 (26.0)	19.29 (490.0)	17.52 (445.0)	16	0.98 (25.0)
16 (400)	1.18 (30.0)	22.24 (565.0)	20.28 (515.0)	16	1.02 (26.0)	1.18 (30.0)	22.83 (580.0)	20.67 (525.0)	16	1.18 (30.0)	1.10 (28.0)	22.05 (560.0)	20.08 (510.0)	16	1.06 (27.0)
18 (450)	1.18 (30.0)	24.21 (615.0)	22.24 (565.0)	20	1.02 (26.0)	1.18 (30.0)	25.20 (640.0)	23.03 (585.0)	20	1.18 (30.0)	1.18 (30.0)	24.41 (620.0)	22.24 (565.0)	20	1.06 (27.0)
20 (500)	1.18 (30.0)	26.38 (670.0)	24.41 (620.0)	20	1.02 (26.0)	1.18 (30.0)	28.15 (715.0)	25.59 (650.0)	20	1.30 (33.0)	1.18 (30.0)	26.57 (675.0)	24.41 (620.0)	20	1.06 (27.0)
24 (600)	1.18 (30.0)	30.71 (780.0)	28.54 (725.0)	20	1.18 (30.0)	1.18 (30.0)	33.07 (840.0)	30.31 (770.0)	20	1.42 (36.0)	1.18 (30.0)	31.30 (795.0)	28.74 (730.0)	24	1.30 (33.0)
30 (750)	1.26 (32.0)	37.99 (965.0)	35.43 (900.0)	24	1.30 (33.0)	1.26 (32.0)	38.19 (970.0)	35.43 (900.0)	24	1.42 (36.0)	1.26 (32.0)	38.19 (970.0)	35.07 (900.0)	24	1.30 (33.0)

Drilling Chart for Bolting Requirements

Table 5:	Standard Drilling for PROCO Rubber Expansion Joints					Thickness of Materials for PROCO Rubber Expansion Joints			Control Unit Plate Detail	
	Flange Dimensions [2]					Material Thickness [1] for Bolt Length Requirements				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Flange O.D. Inch / (mm)	Bolt Circle Inch / (mm)	Number Of Holes	Size Of Holes Inch / (mm)	Bolt Hole Thread	Nominal Flange/ Beaded End Thickness Inch / (mm) (Approx. Value)	Adjacent Mating [3] Flange Thickness	Max. Control [4] Rod Plate Thickness Inch / (mm)	Control Rod [6] Plate O.D. Inch / (mm)	Maxi-mum [7] Rod Diameter Inch / (mm)
1 (25)	**4.25 (108.0)**	**3.13** (79.50)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)	CUSTOMER TO SPECIFY MATING FLANGE THICKNESS	**0.375** (9.53)	**8.375** (215.9)	**0.625** (15.9)
1.25 (32)	**4.63** (118.0)	**3.5** (88.90)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)		**0.375** (9.53)	**8.750** (222.3)	**0.625** (15.9)
1.5 (40)	**5.0** (127.0)	**3.88** (98.55)	**4**	**0.625** (15.87)	**1/2-13 UNC**	**1.25** (31.75)		**0.375** (9.53)	**9.125** (231.8)	**0.625** (15.9)
2 (50)	**6.00** (152.00)	**4.75** (120.65)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**10.125** (257.2)	**0.625** (15.9)
2.5 (65)	**7.00** (178.00)	**5.50** (139.70)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**11.125** (282.6)	**0.625** (15.9)
3 (80)	**7.50** (191.00)	**6.00** (152.40)	**4**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**11.625** (295.3)	**0.625** (15.9)
3.5 (90)	**8.5** (216.0)	**7.0** (177.80)	**8**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**12.625** (320.7)	**0.625** (15.9)
4 (100)	**9.00** (229.00)	**7.50** (190.50)	**8**	**0.750** (19.05)	**5/8-11 UNC**	**1.25** (31.75)		**0.375** (9.53)	**13.125** (333.4)	**0.625** (15.9)
5 (125)	**10.00** (254.00)	**8.50** (215.90)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.500** (12.70)	**14.125** (358.8)	**0.625** (15.9)
6 (150)	**11.00** (279.00)	**9.50** (241.30)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.500** (12.70)	**15.125** (384.2)	**0.625** (15.9)
8 (200)	**13.50** (343.00)	**11.75** (298.45)	**8**	**0.875** (22.23)	**3/4-10 UNC**	**1.50** (38.10)		**0.750** (19.05)	**19.125** (485.8)	**1.000** (25.4)
10 (250)	**16.00 (406.00)**	**14.25** (361.95)	**12**	**1.000** (25.40)	**7/8-9 UNC**	**1.50** (38.10)		**0.750** (19.05)	**21.625** (549.3)	**1.000** (25.4)
12 (300)	**19.00** (483.00)	**17.00** (431.80)	**12**	**1.000** (25.40)	**7/8-9 UNC**	**1.50** (38.10)		**0.750** (19.05)	**24.625** (625.5)	**1.000** (25.4)
14 (350)	**21.00** (533.00)	**18.75** (476.25)	**12**	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**26.625** (676.3)	**1.000** (25.4)
16 (400)	**23.50** (597.00)	**21.25** (539.75)	**16**	**1.125** (28.58)	—	**1.75** (44.45)		**0.750** (19.05)	**30.125** (765.2)	**1.250** (31.8)
18 (450)	**25.00** (635.00)	**22.75** (577.85)	**16**	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**31.625** (803.3)	**1.250** (31.8)
20 (500)	**27.50** (699.00)	**25.00** (635.00)	**20**	**1.250** (31.75)	—	**2.00** (50.80)		**0.750** (19.05)	**34.125** (866.8)	**1.250** (31.8)
24 (600)	**32.00** (813.00)	**29.50** (749.30)	**20**	**1.375** (34.93)	—	**2.00** (50.80)		**1.000** (25.40)	**38.625** (981.1)	**1.250** (31.8)
30 (750)	**38.75** (984.00)	**36.00** (914.40)	**28**	**1.375** (34.93)	—	**2.00** (50.80)		**1.250** (31.75)	**46.375** (1177.9)	**1.500** (38.1)

Metric Conversion Formula: Nominal I.D.: in. x 25 = mm; Dimensions/ Thickness': in. x 25.4 = mm.

Notes:

1. *Limit/Control Rod length is determined by neutral length of rubber expansion joint, rated extension, control rod plate thickness, mating flange thickness and number of nuts. Consult PROCO for rod lengths.*
2. *Flange Dimensions shown are in accordance with ANSI B16.1 and ANSI B16.5 Class 125/150, AWWA C-207-07, Tbl 2 and 3 - Class D, Table 4 - Class E. Hole size shown is 1/8" larger than AWWA Standard.*
3. *Adjacent mating flange thickness is required to determine overall rod length and compression sleeve length (if required).*
4. *Plate thickness is based on a maximum width PROCO would use to design a Limit/Control Rod plate.*
5. *Flat Washers required at ring splits and are supplied by others.*
6. *Control rod plate O.D. installed dimension is based on a maximum O.D. Proco would supply.*
7. *Control rod diameter is based on a maximum diameter Proco would use to design a control rod.*

A - Flange/Beaded End Thickness (Approximated Figure)
B - Adjacent Mating Flange Thickness (By Others)
C - Control Unit Plate Thickness
D - Double Nut Thickness is determined by Control Rod Diameter
E - Control Rod Bolt Length is determined by A through E + OAL [1]
F - Control Rod Control Rod Plate O.D.
G - Maximum Rod Diameter

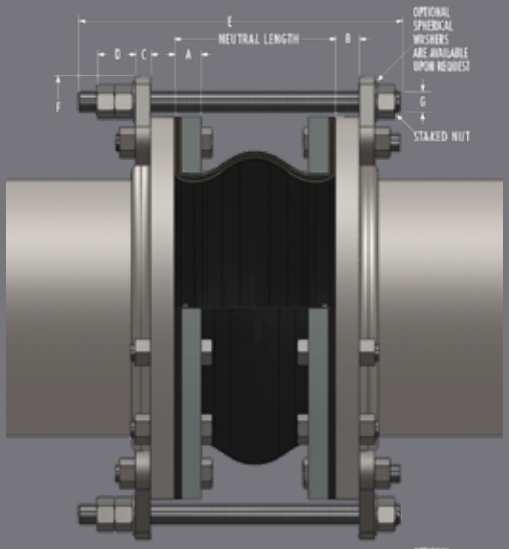


Figure 1
Style 240

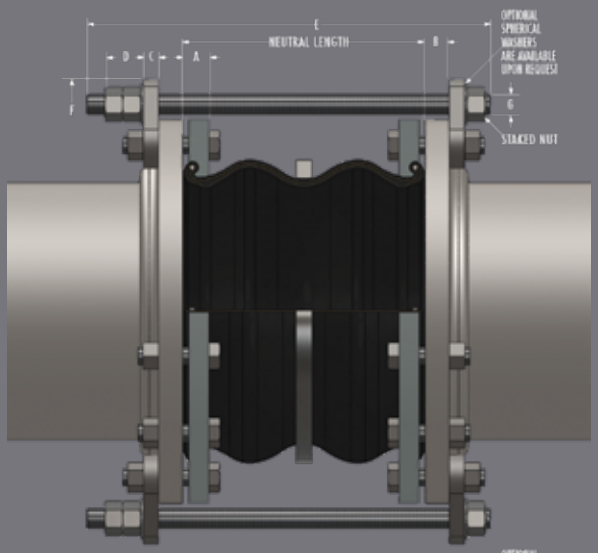


Figure 1
Style 242

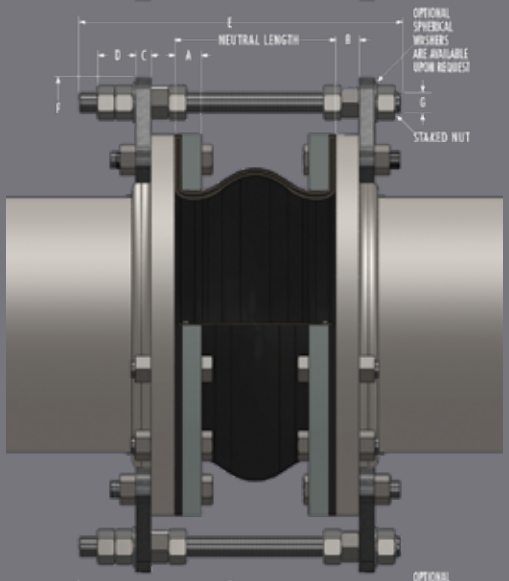


Figure 2
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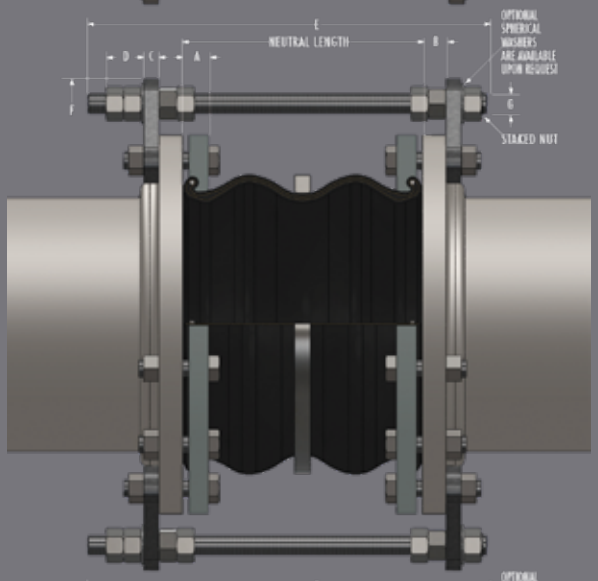


Figure 2
Style 242

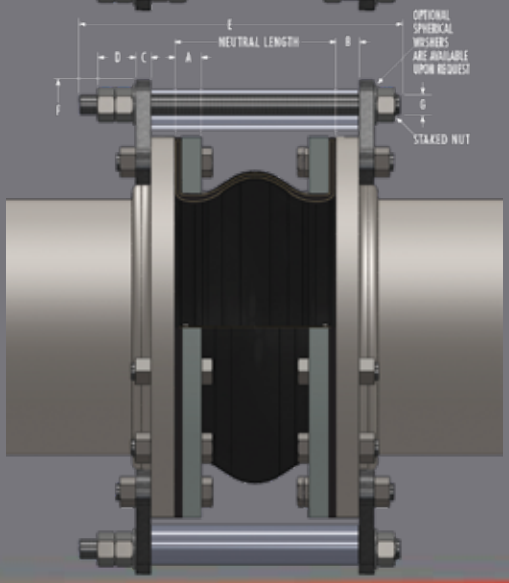


Figure 3
Style 240

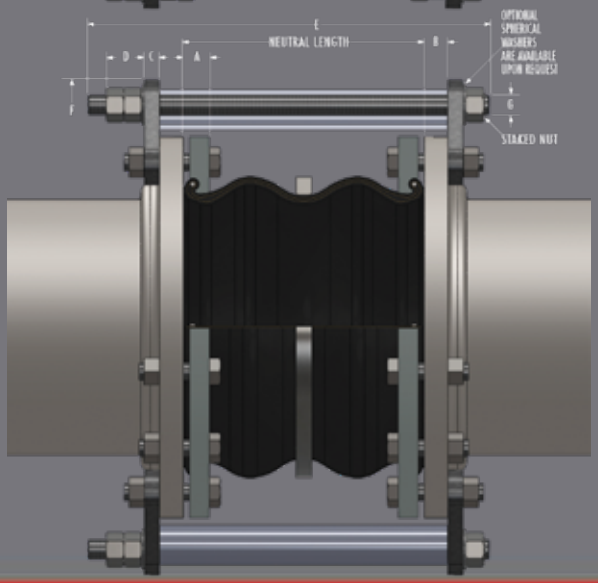


Figure 3
Style 242

Use of Control Units with Rubber Expansion Joints

Definition

A control unit assembly is a system of two or more control rod units (limit rods, tie rods or compression sleeves) placed across an expansion joint from flange to flange to minimize possible damage caused by excessive motion of a pipeline. The control unit assemblies can be set at the maximum allowable expansion and/or contraction of the rubber expansion joint. When used in this manner, control units are an additional safety factor and can minimize possible damage to adjacent equipment.

Rubber expansion joints should be installed between two fixed anchor points in a piping system. The pipe system must be rigidly anchored on both sides of the expansion joint to control expansion or contraction of the line. Piping anchors must be capable of withstanding the line thrusts generated by internal pressure or wide temperature fluctuations.

When proper anchoring cannot be provided, **CONTROL UNITS ARE REQUIRED.** For un-anchored piping systems nuts shall be tightened snug against rod plate to prevent over-extension due to pressure thrust created by expansion joint. Refer to "Thrust Factor" in Table 2, note 5 in this manual. Please also see Table 7 for number of control rods recommended based on maximum serge for test pressure of the system

Listed below are three (3) control unit configurations supplied by PROCO and are commonly used with rubber expansion joints in piping systems.

Figure 1

Known as a **LIMIT ROD**, this control unit configuration will allow an expansion joint to extend to a predetermined extension setting. Nuts shall be field-set to no more than the maximum allowable extension movement of a rubber expansion joint (unless used in an un-anchored system). Refer to Table 2 in this manual for allowable movement capabilities. Spherical washers can also be furnished (upon request) to combat any "nut-to-plate" binding during offset. ***Consult the systems engineer for proper nut settings prior to system operation.***

Figure 2

Known as a **LIMIT/CONTROL ROD**, this control unit configuration is used to allow specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint axial extension) movements. Nuts shall be field set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) or compression of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. Internal and external nuts can also be field-set to allow for no movement in the horizontal plane. This setting will allow the rubber to move laterally while keeping expansion joint thrust forces low on adjacent equipment. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Limit/Control rods with internal nuts must be specified at the time of inquiry. Consult the systems engineer for proper nut settings prior to system operation.***

Figure 3

Known as a **COMPRESSION SLEEVE**, this configuration is used to allow for specified pipe expansion (expansion joint axial compression) and pipe contraction (expansion joint extension) movements. Nuts shall be field-set to no more than the maximum allowable extension (unless used in an un-anchored pipe system) of a rubber expansion joint. Refer to Table 2 in this manual for allowable movement capabilities. PROCO will manufacture each compression sleeve to allow for no axial movement unless otherwise specified by the purchaser. Compression sleeves shall be field-trimmed to meet required allowable axial movement as set forth by system requirements. Spherical washers can also be furnished (upon request) to combat any potential "nut-to-plate" binding during offset. ***Consult the systems engineer for proper sleeve lengths prior to system operation.***

Important Control Unit Considerations

The number of rods, control rod diameters and control rod plate thicknesses are important considerations when specifying control units for an application. As a minimum, specifying engineers or purchasers shall follow the guidelines as set forth in Appendix C of the Fluid Sealing Association's Technical Handbook, Seventh Edition. PROCO engineers its control unit assemblies to system requirements. Our designs incorporate an allowable stress of 65% of material yield for each rod and plate (rod and plate material to be specified by purchaser). Therefore, it is important to provide pressure and temperature ratings to PROCO when requesting control units for rubber expansion joints. It is also important to provide adjacent mating flange thickness or mating specifications to ensure correct rod lengths are provided.

Installation Instructions for Limit Rods

1. Assemble expansion joint between pipe flanges in its manufactured face-to-face length.

2. Assemble control rod plates behind pipe flanges as shown. Flange bolts or all-thread studs through the control rod plate must be longer to accommodate the plate thickness. Control rod plates should be equally spaced around the flange. Depending upon the size and pressure rating of the system, 2, 3, 4, or more control/limit rods may be required. Refer to Table 4 in this manual or to the Fluid Sealing Association's Technical Handbook, Seventh Edition, for control rod pressure ratings.

3. Insert control/limit rods through top plate holes. Steel flat washers are to be positioned at outer plate surface.

4. If a single nut per unit is furnished, position this nut so that there is a gap between the nut and the steel flat washer. This gap is equal to the joint's maximum extension (commencing with the nominal face-to-face length). To lock this nut in position, either "stake" the thread in two places or tack weld the nut to the rod. If two nuts are supplied, the nuts will create a "jamming" effect to prevent loosening. (Nuts should be snug against the flat washer and control rod plate when piping system is un-anchored.)

Note: Consult the manufacturer if there are any questions as to the rated compression and elongation. These two dimensions are critical in setting the nuts and sizing the compression pipe sleeve (if supplied).

5. If there is a requirement for compression pipe sleeves, an ordinary pipe may be used, sized in length to allow the joint to be compressed to its normal limit.

6. If there is a requirement for optional spherical washers, these washers are to be positioned at the inner and/or outer plate surface and backed up by movable double nuts.

Figure 1
Style 240

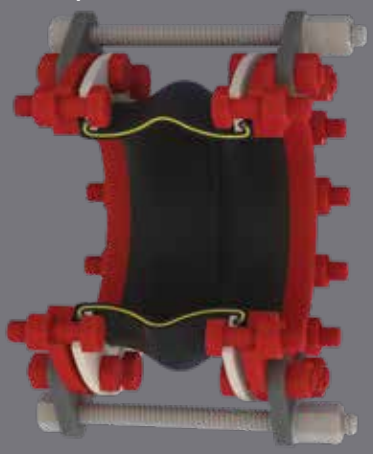
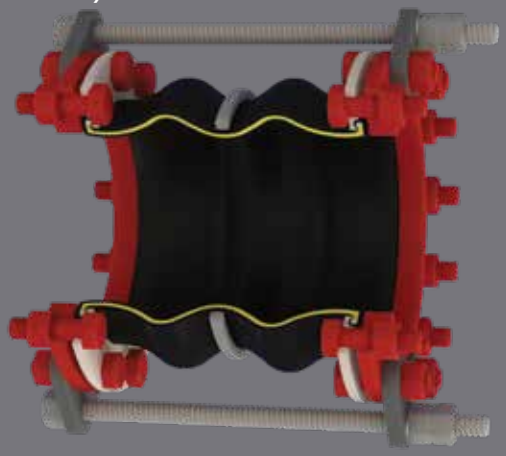


Figure 1
Style 242



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Style 240

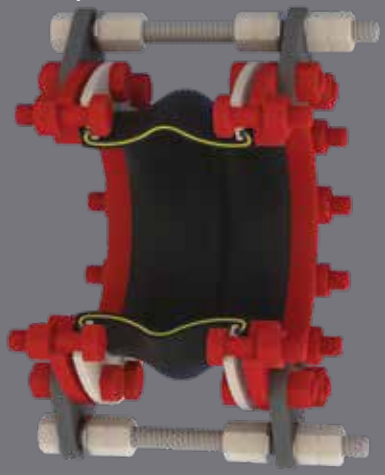
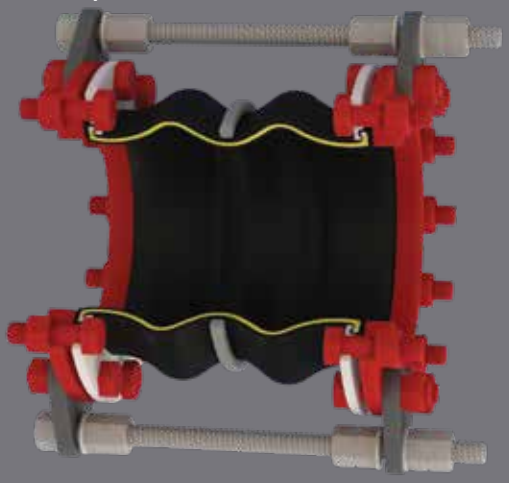


Figure 2
Style 242



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Style 240

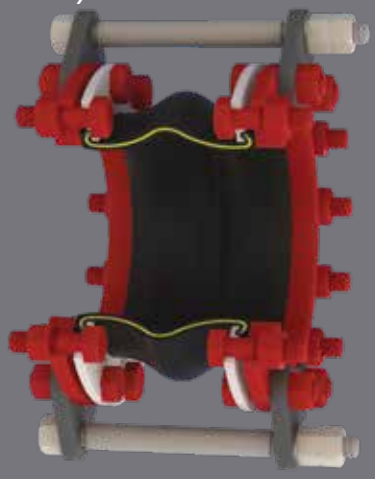


Figure 3
Style 242

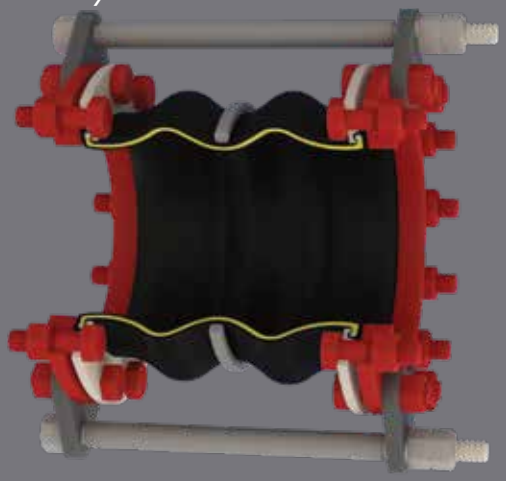


Table 6: Control Units/Anchored

Control Units must be installed when pressures (test • design • surge • operating) exceed rating below:

Pipe Size	Series 240 P.S.I.G.	Series 242 P.S.I.G.
1″ thru 4″	180	135
5″ thru 10″	135	135
12″ thru 14″	90	90
16″ thru 24″	45	45
30″	35	35

Table 7:

Nominal Pipe Size Expansion Joint I.D. Inch /(mm)		Maximum Surge or Test Pressure of the System — Number of Control Rods Recommended			
		2	4	6	8
1	(25)	949	•	•	•
1.25	(32)	830	•	•	•
1.5	(40)	510	•	•	•
2	(50)	661	•	•	•
2.5	(65)	529	•	•	•
3	(75)	441	•	•	•
4	(100)	311	622	•	•
5	(125)	235	470	•	•
6	(150)	186	371	•	•
8	(200)	163	326	•	•
10	(250)	163	325	488	•
12	(300)	160	320	481	•
14	(350)	112	223	335	•
16	(400)	113	227	340	453
18	(450)	94	187	281	375
20	(500)	79	158	236	315
24	(600)	74	147	221	294
30	(750)	70	141	211	281

Note:
Pressures listed above do not relate to the actual design pressure of the expansion joint products, but are the maximum surge or pressure for a specific control rod nominal pipe size.

Installation Instructions for Non-Metallic Expansion

1. Service Conditions:

Make sure the expansion joint rating for temperature, pressure, vacuum*, movements and selection of elastomeric materials match the system requirements. Contact the manufacturer if the system requirements exceed those of the expansion joint selected. (*Vacuum service for spherical rubber connectors: Vacuum rating is based on neutral installed length. These products should not be installed "extended" on vacuum applications.)

2. Alignment:

Expansion joints are not designed to make up for piping misalignment errors. Piping misalignment should be no more than 1/8" in any direction. Misalignment of an expansion joint will reduce the rated movements and can induce severe stress of the material properties, thus causing reduced service life or premature failure.

3. Anchoring:

Expansion joints should be located as close as possible to anchor points with proper pipe guides. Install expansion joints only on straight runs between anchors. It is recommended that control rods be installed on the expansion joint to prevent excessive movements from occurring due to pressure thrust of the line.

4. Pipe Support:

Piping must be supported so expansion joints do not carry any pipe weight.

5. Mating Flanges:

Install the expansion joint against the mating pipe flanges and install bolts so that the bolt head is against the expansion joint flange. Flange-to-flange dimension of the expansion joint must match the breech opening*. (*A spherical rubber connector must be pre-compressed 1/8" to 3/16" during installation in order to obtain a correct installed face-to-face dimension.)

Make sure the mating flanges are clean and are a flat-faced type. When attaching beaded end flange expansion joints to raised face flanges, the use of composite gaskets are required to prevent metal flange faces from cutting rubber bead during installation.

Never install expansion joints next to wafer type check or butterfly valves.

6. Bolting Torque:

Table 8 shows the recommended torque values for non-metallic expansion joints with beaded end type-flanges: Tighten bolts in stages by alternating around the flange. Use the recommended torque values in Table 8 to achieve a good seal. Never tighten an expansion joint to the point that there is metal-to-metal contact between the expansion joint flanges and the mating flanges. A slight bulge in the rubber beaded end should create a flush tight seal.
Note: Torque values are approximate due to mating flange surfaces, installation offsets, operating pressures and environmental conditions.

7. Storage:

Ideal storage is in a warehouse with a relatively dry, cool location. Store flanges face down on a pallet or wooden platform. Do not store other heavy items on top of the expansion joints. Ten year shelf life can be expected with ideal conditions. If storage must be outdoors, place on a wooden platform and joints should not be in contact with the ground. Cover with a tarpaulin.

8. Large Joint Handling:

Do not lift with ropes or bars through the bolt holes. If lifting through the bore, use padding or a saddle to distribute the weight. Make sure cables or forklift tines do not contact the rubber. Do not let expansion joints sit vertically on the edges of the flanges for any period of time.

9. Additional Tips:

A. Do not insulate/cover over a rubber expansion joint. This prevents inspection of the tightness of the joint bolting.
B. It is acceptable (but not necessary) to lubricate the expansion joint beaded end with a thin film of graphite dispersed in glycerin or water at time of installation to prevent damage.
C. Do not weld in the near vicinity of a non-metallic joint.
D. If expansion joints are to be installed underground, or will be submerged in water, contact manufacturer for specific recommendations.
E. If the expansion joint will be installed outdoors, make sure the cover material will withstand ozone, sunlight, etc.
F. Check the tightness of flanges two or three weeks after installation and retighten if necessary. Refer to Notes in Para 6. Bolting Torque.
G. Expansion joint installation should be conducted by an authorized and qualified pipe fitter.
H. While all Proco expansion joints are guaranteed for a period of one year and designed for many years of service, it is suggested that expansion joints be routinely inspected based on service conditions.

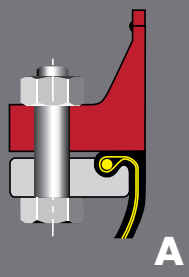
Warning: Expansion joints may operate in pipelines or equipment carrying fluids and/or gasses at elevated temperature and pressures and may transport hazardous materials. Precautions should be taken to protect personnel in the event of leakage or splash. Rubber joints should not be installed in areas where inspection is impossible. Make sure proper drainage is available in the event of leakage when operating personnel are not available.

Joints with Beaded End Flanges

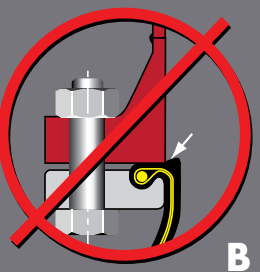
Table 8:	Bolt-Torque				
Nominal Pipe Size Expansion Joint I.D. Inch /(mm)	Step 1 FT-LBS (Nm)	Rest	Step 2 FT-LBS (Nm)	Rest	Step 3 FT-LBS (Nm)
1 (25)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.25 (32)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
1.5 (40)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2 (50)	18 (25)	30 Min	30 (40)	60 Min	45-60 (60-80)
2.5 (65)	18 (25)	30 Min	35 (50)	60 Min	50-60 (70-80)
3 (80)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
3.5 (90)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
4 (100)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
5 (125)	25 (35)	30 Min	45 (60)	60 Min	60-75 (80-100)
6 (150)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
8 (200)	30 (40)	30 Min	50 (70)	60 Min	60-75 (80-100)
10 (250)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
12 (300)	30 (40)	30 Min	50 (70)	60 Min	75-85 (100-115)
14 (350)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
16 (400)	30 (40)	30 Min	60 (80)	60 Min	75-95 (110-130)
18 (450)	30 (40)	30 Min	60 (80)	60 Min	90-95 (120-130)
20 (500)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
24 (600)	30 (40)	30 Min	65 (90)	60 Min	95-185 (130-250)
30 (750)	30 (40)	30 Min	65 (90)	60 Min	95-220 (130-300)

Note: Bolt torque based on new bolts and nuts

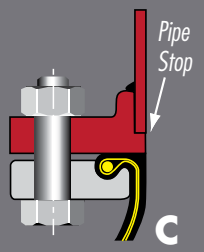
Right: Weld neck flanges with correct ID prevent damage to rubber.



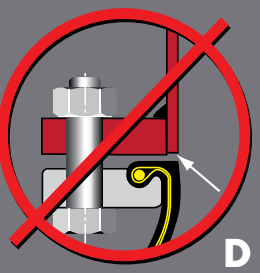
Wrong: Insure mating flange I.D. is flush with rubber.



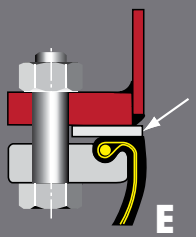
Right: Flanges with correct ID help prevent damage to rubber.



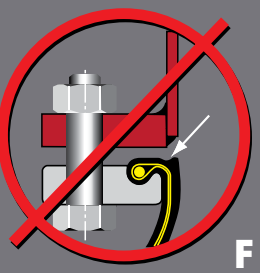
Wrong: Uneven end of pipe can cause damage to rubber.



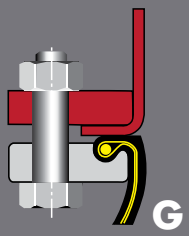
Right: In case of B, D, F an additional metal gasket can be used to prevent damage to rubber.



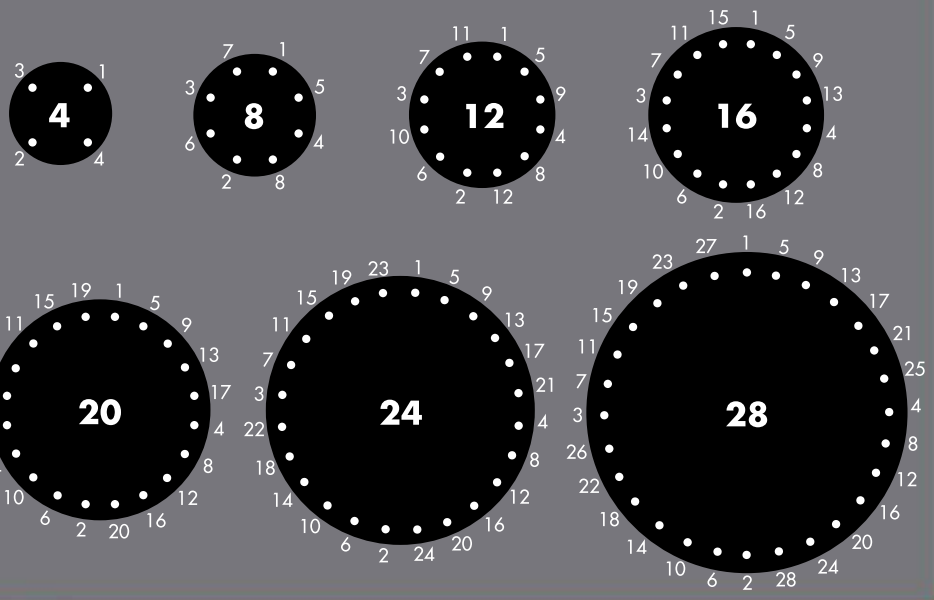
Wrong: Inner edge of flanges damages rubber.

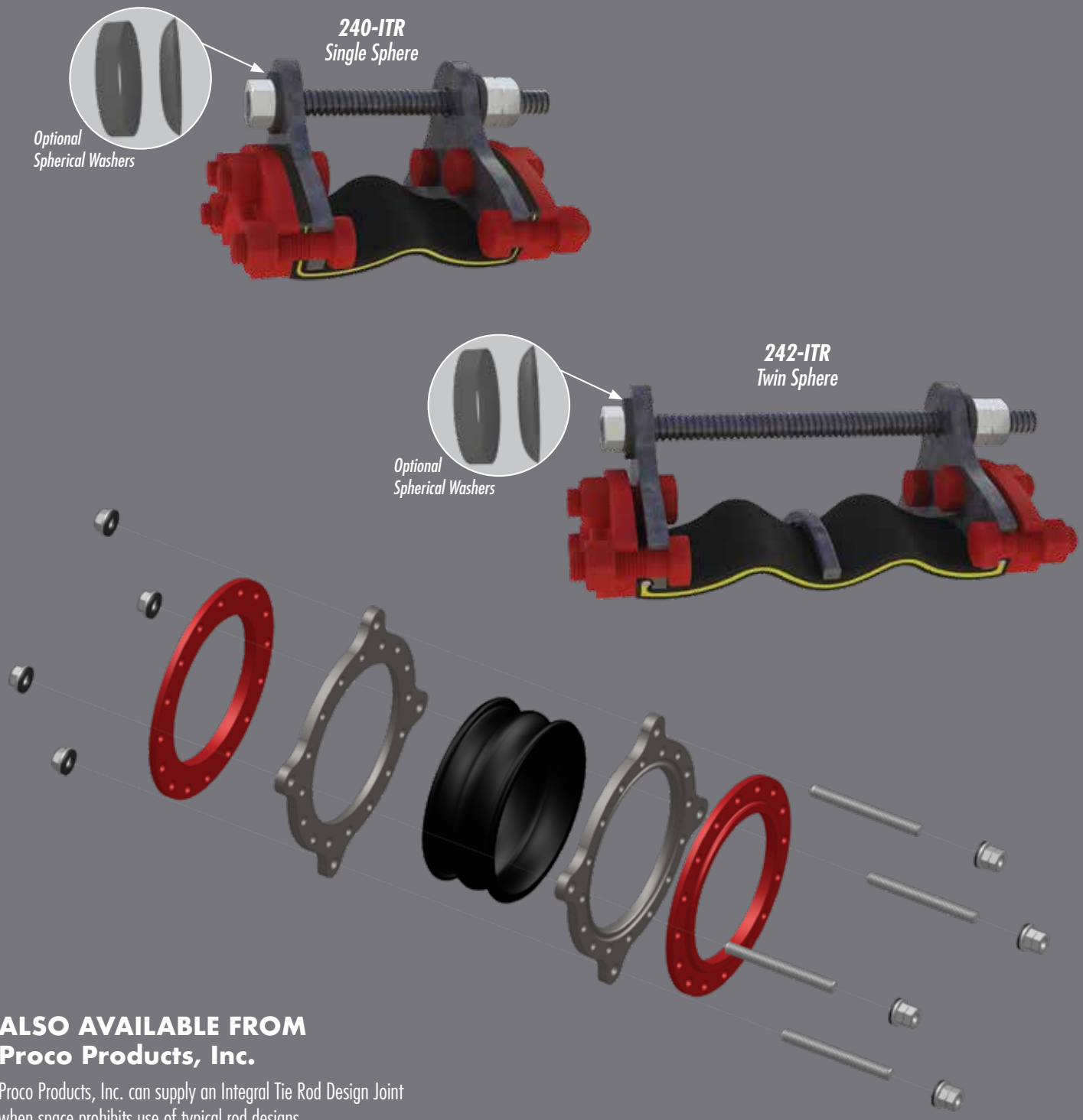


Right: Well rounded smooth edge prevents damage to rubber.



Tighten opposing nuts/bolts gradually according to the following sequence





ALSO AVAILABLE FROM
Proco Products, Inc.

Proco Products, Inc. can supply an Integral Tie Rod Design Joint when space prohibits use of typical rod designs.

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2431 North Wigwam Dr. (95205)
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95201-0590 • USA

Toll-Free Phone: (800) 344-3246 NATIONWIDE AND CANADA

Facsimile: (209) 943-0242

(209) 943-6088 INTERNATIONAL

email: sales@procoproducts.com

website: http://www.procoproducts.com

American Water Works Association

IDCO Industrial Distributor Co-op

NAHAD Charter Listed Member SAFETY - QUALITY - RELIABILITY

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REPRESENTED BY:

Revised 4/19

1 Willow Avenue
Oakdale, PA 15071
p. 724-703-3020
f. 724-703-3026

Title: EA Engineering ATTN: Alexander Spiller AOI-2

Report Basis

Flow Rate	230 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	160.000 ug/l
trichloroethylene	37.000 ug/l
cisdichloroethylene	210.000 ug/l
transdichloroethylene	19.000 ug/l

Report: 59.11 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 14.894 lbs./100 lbs. Carbon

Note: Contact TIGG Corporation if comments are needed on preferential adsorption of contaminants above.

Run 1

Report Basis

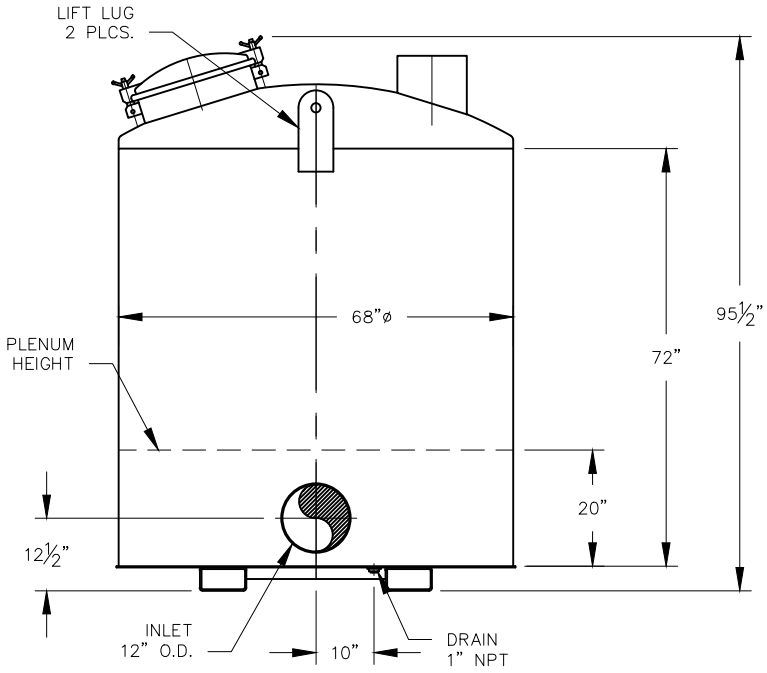
Flow Rate	230 CFM
Temperature	65 °F
Relative Humidity	50 %
Adsorption Pressure	1 ATM

Component	Inlet Concentration
perchloroethylene	160.000 ug/l
trichloroethylene	37.000 ug/l
cisdichloroethylene	210.000 ug/l
transdichloroethylene	19.000 ug/l

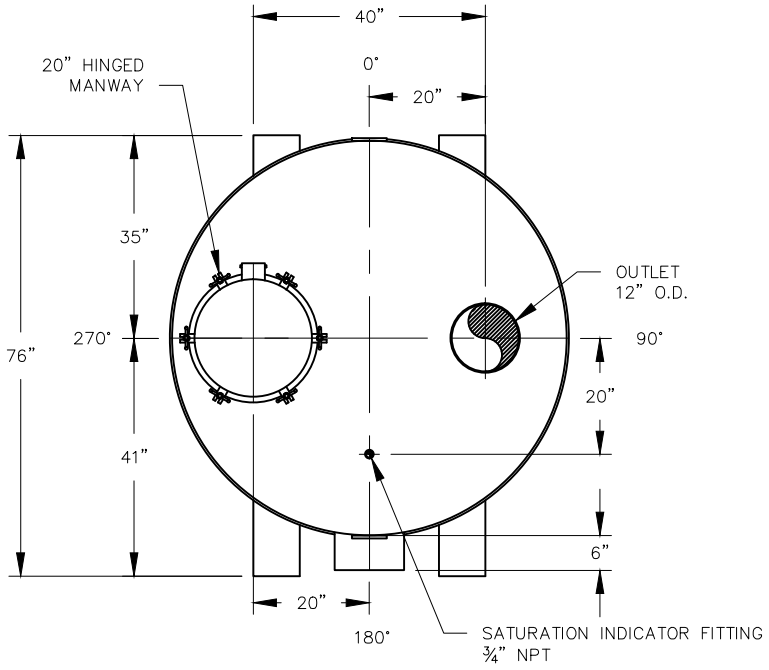
Band	Chemicals	Y	LBS/100 LBS Carbon	Overall LBS/100 LBS Carbon
1	perchloroethylene	0.27	35.765	35.765
	trichloroethylene	0.08	0.380	0.380
	cisdichloroethylene	0.60	0.219	0.219
	transdichloroethylene	0.05	0.012	0.012
	9.245 Pounds Carbon Per Day			
2	perchloroethylene	0.00	0.000	24.870
	trichloroethylene	0.27	18.012	5.751
	cisdichloroethylene	0.67	1.546	0.624
	transdichloroethylene	0.06	0.082	0.033
	13.294 Pounds Carbon Per Day			
3	perchloroethylene	0.00	0.000	5.816
	trichloroethylene	0.00	0.000	1.345
	cisdichloroethylene	0.93	9.773	7.633
	transdichloroethylene	0.07	0.458	0.359
	56.850 Pounds Carbon Per Day			
4	perchloroethylene	0.00	0.000	5.594
	trichloroethylene	0.00	0.000	1.294
	cisdichloroethylene	0.00	0.000	7.342
	transdichloroethylene	1.00	8.363	0.664
	59.105 Pounds Carbon Per Day			

Report: 59.11 lbs. activated carbon per day saturated at conditions

Average Loading at Saturation 14.894 lbs./100 lbs. Carbon



ELEVATION



PLAN

* STAINLESS STEEL BED RETENTION PLATE.
140°F WITH PE PLATE

VESSEL STANDARDS

VESSEL MATERIALS : SA-36	VESSEL ACCESS : 20" HINGED MANWAY
LINING : EPOXY	LIQUID DRAIN ASSEMBLY : 1" NPT W/ HDPE PLUG
EXTERIOR PAINT : EPOXY BASE W/ URETHANE TOP COAT	MAX. MEDIA FILL : 109 FT^3
HEAD THICKNESS : 3/16" NOM.	SHIP WT. EMPTY : 2000 LBS
SHELL THICKNESS : ¼" NOM.	MAX. OPERATING PRESSURE : 15 PSIG
INTERNALS : STAINLESS STEEL PLENUM	MAX. OPERATING TEMPERATURE. : 180°F

NO.	REVISION	BY	DATE
7	ADD LIFT LUGS	CB	4/27/11
6	UPDATE VESSEL STANDARDS	JB	8/24/10
5	CHANGE MANWAY TO HINGED STYLE	JB	9/12/06
4	REVISE CARBON FILL	JB	1/20/04
3	REMOVE VENT	JB	5/14/03
2	CHANGE EXTERIOR PAINT	JB	5/7/03
1	TITLE BLOCK	JB	1/10/03

PROJECT
N-2500-PDB

PROJ. NO. SALES
P.O. NO.

DRAWN BY	ZS
DESIGN BY	BL
CHKD. BY	BL
DATE	9/12/06
SCALE	NTS

TIGG corporation

PLAN & ELEVATION

N-2500-PDB-1001 REV. 7

TIGG 5CC 0408

Virgin Vapor Phase Coconut Based Activated Carbon

www.TIGG.com

DESCRIPTION

TIGG 5CC 0408 is a granular activated carbon made from coconut shell. The combination of high activity level and selective transport and adsorption pores accommodates adsorbates of varied molecular size. This activated carbon also contains the high energy adsorption pores which are vital to attaining ultra high removal of low molecular weight volatile organic compounds.

TYPICAL PROPERTIES	TIGG 5CC 0408
U.S. Sieve, 90 wt% min	4 x 8
CCl_4 Number, min	60
Iodine Number, mg/g, min	1150
Apparent Density, (dense packing)	
g/cc	0.41 – 0.42
lbs/ft^3	26
Moisture - wt% max (as packed)	3
Hardness No. - min	98

TYPICAL APPLICATIONS

This activated carbon can be used to:

- Capture solvents
- Remove VOC's from:
  - Tank vents
  - Air stripper off gas
  - Soil venting
  - Remediation of excavated soil

Standard packaging of the activated carbon is in 55 pound bags or 1100 pound supersacks.

Wet drained activated carbon adsorbs oxygen from the air. Therefore, when workers need to enter a vessel containing wet activated carbon, they should follow confined space/low oxygen level procedures. Activated carbon dust does not present an explosion hazard.

VALTERRA

Gate Valve, Valve Class Class 125, PVC, Slip Connection Type, Pipe Size - Valves 4"

Item # **4HGE5** Mfr. Model # **6401GR** Catalog Page # **2889** UNSPSC # **40141613**

Web Price

$129.50 / each

1 Add to Cart

+ Add to List |

Shipping Pick

Expected to arrive **Wed. Jul 01**

Ship To 32135 (Change)

Shipping Weight **4.1 lbs.**

Country of Origin **Mexico** | *Country of Origin is subject to change.*

Note: Product availability is real-time updated and adjusted continuously. The product will be reserved for you when you complete your order. More

How can we improve our Product Images?

Compare

Product Details

Quick-opening VALTERRA gate valve provides unrestricted flow for low-pressure tank and drain applications with liquids, gases, dry/bulk solids, and slurry. Body is tough PVC construction for durability and long life. Model also provides quick shutoff in low-pressure or vacuum lines. Valve can be easily disassembled for in-line servicing.

View Less

Technical Specs

Item	**Gate Valve**
Valve Class	**Class 125**
Body Material - Valves	**PVC**
Connection Type	**Slip**
Pipe Size - Valves	**4"**
Max. Water Pressure - CWP	**20 psi**
Valve Max. Fluid Temp.	**167 Degrees F**
Valve Stem Type	**Rising**

Top of Handle to Inlet Center	**9-15/16"**
Inlet to Outlet Length	**5-3/16"**
Stem Material	**304 Stainless Steel**
Bonnet Style	**Bonded**
Wedge Material	**304 Stainless Steel**
Handle Material	**Aluminum**
Handle Type	**Hand Wheel**
Standards	**MSS SP-70**

How can we improve our Technical Specifications?

Compliance and Restrictions

None

Alternate Search Terms

Shutoffs (4578) | Shutoff Valves (4466) | Gate Valves (435)

Customers Also Purchased

VALTERRA

Gate Valve, Valve Class Class 125, PVC, Slip Connection Type, Pipe Size - Valves 3"

Item # 4HGD9

Web Price

$53.50 / each

Qty 1 Add to Cart

MILWAUKEE VALVE

4" Cast Iron Double Acting Pneumatically Actuated Butterfly Valve With EPDM Seat Material

Item # 1WDY2

Web Price

$495.00 / each

Qty 1 Add to Cart

APOLLO

Ball Valve, Lead Free Brass, Inline, 2-Piece, Pipe Size 3", Tube Size 3"

Item # 20RE15

Web Price

$226.00 / each

Qty 1 Add to Cart

LASCO

PVC Tee, Socket x Socket x Socket, 4" Pipe Size - Pipe Fitting

Item # 22FL10

Web Price

$17.60 / each

Qty 1 Add to Cart

DAYTON

Brass Solenoid Valve Less Coil, 2-Way Valve Design, Normally Closed Valve Configuration

Item # 1A575

Web Price

$31.00 / each

Qty 1 Add to Cart

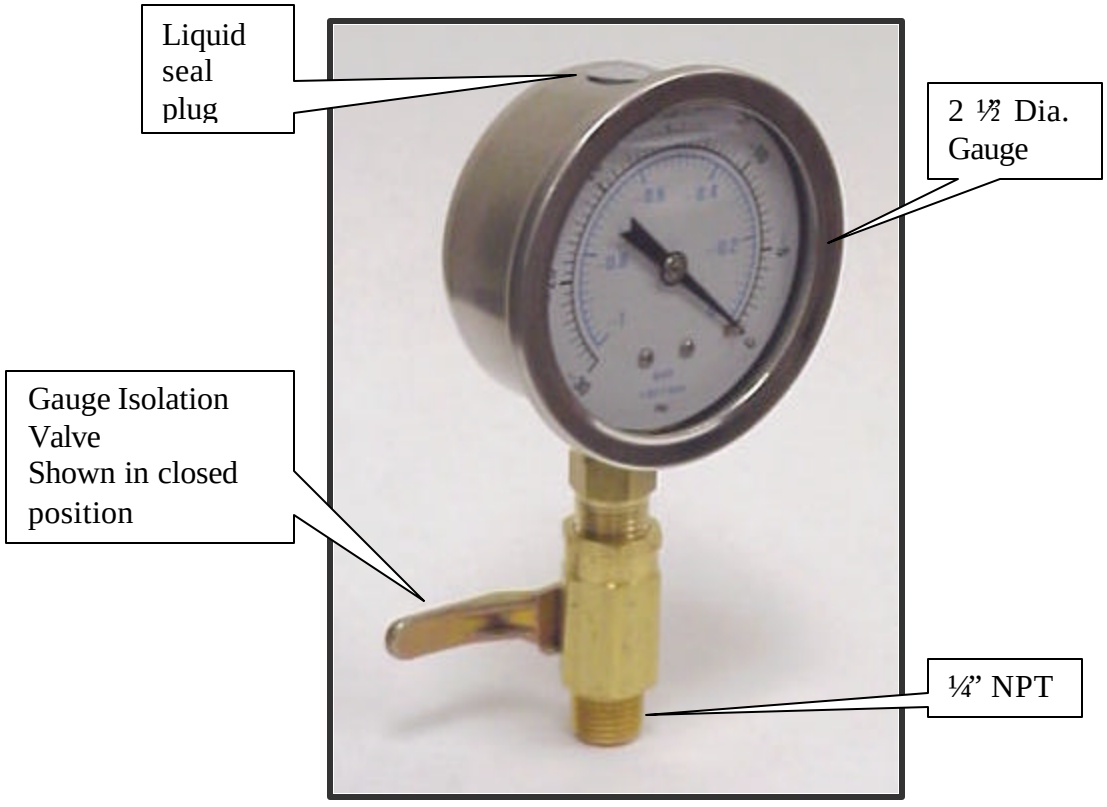
J. E. GASHO & ASSOCIATES, INC.

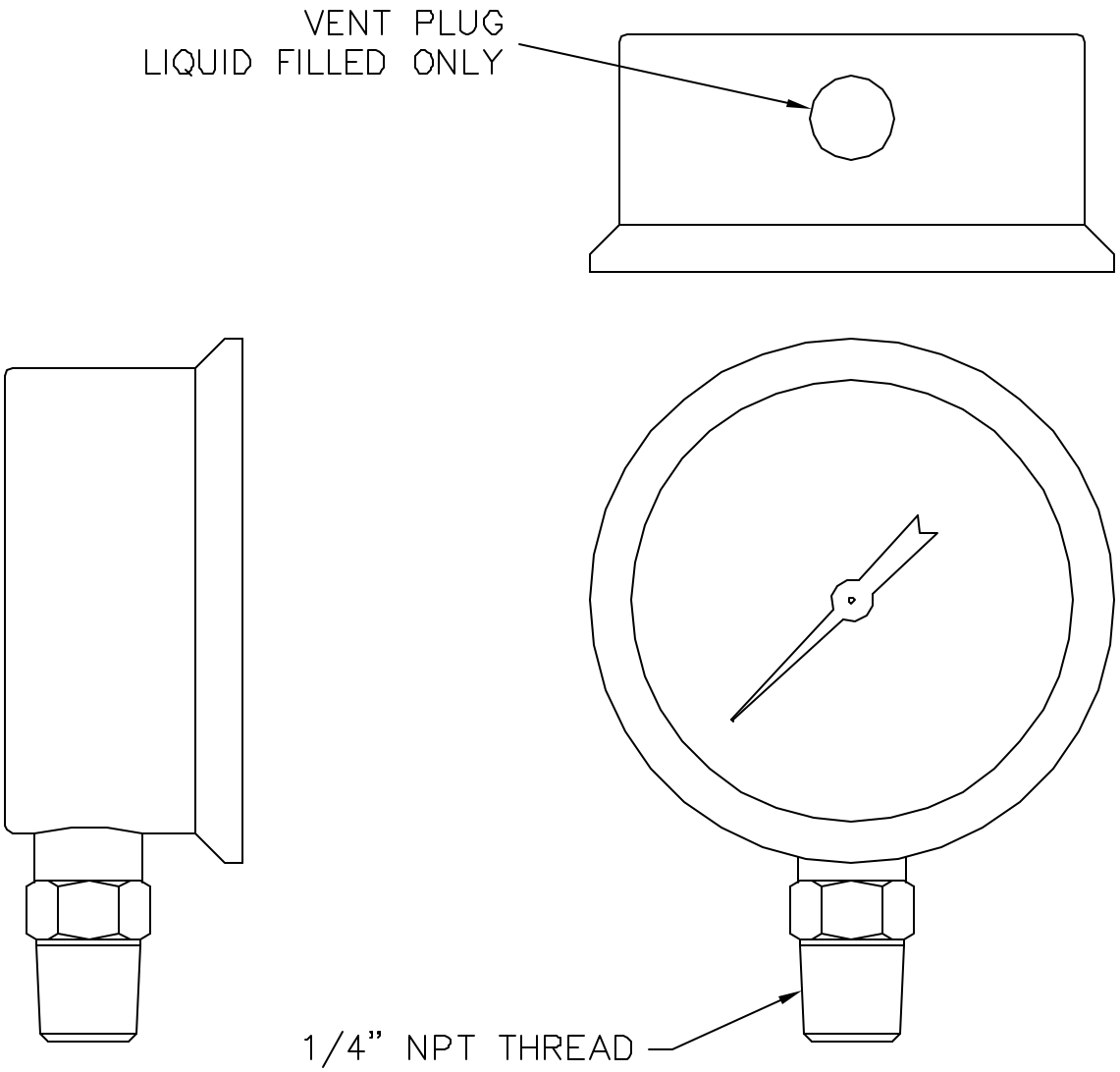
Authorized Manufacturer's Representative
Air / Gas Moving Equipment
460 W. GAY STREET
WEST CHESTER, PA 19380
PHONE: 610-692-5650 FAX: 610-692-5837

Pressure and Vacuum Gauges

We use both standard gauges and liquid filled gauges from a variety of manufacturers. Gauges are installed on our packages with gauge isolation valves (gauge cocks) part number VIS-0.25-FM-B-0000. The gauge isolation valve can be used as a snubber while reading the gauge by opening it slightly. To protect gauges from damage due to shocks or pulsations in the system, gauge isolation valves should be closed except when the gauge is being read.

Liquid filled gauges may display incorrect readings due to variations in atmospheric pressure. To determine if a gauge is subject to this condition, the liquid filled cavity should be temporarily vented to atmosphere. Most liquid filled gauges have a seal plug in the liquid filled cavity. Remove this plug to allow the cavity to be vented to atmosphere. In some instances the case can be lightly squeezed to burp it. Replace the plug.





25.0.015PSI

NOMINAL SIZE
- 25 = 2.5in
- 40 = 4.0 in.

TYPE
- 0 = NON-FILLED
- 1 = LIQUID FILLED

RANGE

NOTES:
1. WE USE BOTH STANDARD GAUGES & LIQUID FILLED GAUGES FROM A VARIETY OF MANUFACTURERS
2. STANDARD RANGES:
   - PRESSURE: 0-6 PSI & 0-160 IWC
     0-15 PSI
     0-30 PSI
   - VACUUM: 0-12 IN. HG. & 0-160 IWC
     0-30 IN., HG.

REV.	DATE	DESCRIPTION

DRAWN BY: M. WITTE	DATE 8-18-00
APPROVED BY:	DATE
DIMENSIONS IN INCHES	
SCALE	
TOLERANCE	ANGULAR TOLERANCE
MATERIAL	WEIGHT
SHEET 1 OF 1	

J. E. GASHO & Assoc., Inc.
460 W. GAY ST.
WEST CHESTER, PENNSYLVANIA 19380

PRESSURE GAUGE NUMBERING SYSTEM

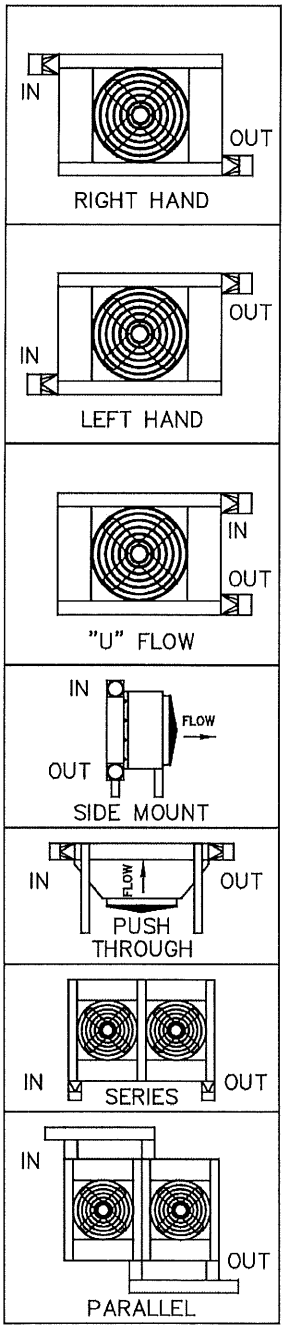
—

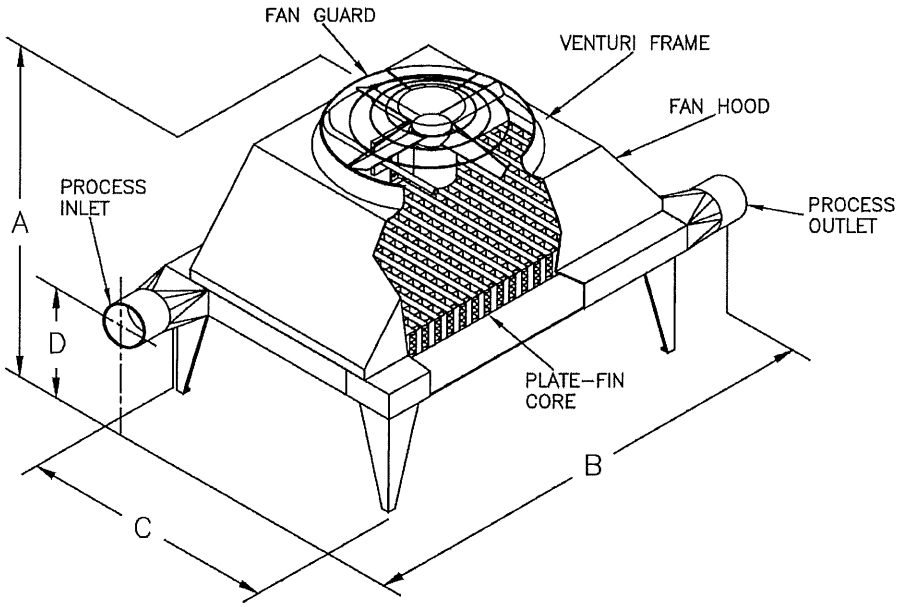
INDUSTRIAL HEAT EXCHANGERS
XCHANGER

1401 7th STREET S.
HOPKINS, MN 55343
952-933-2559
XCHANGER.COM

AA Series Heat Exchanger

AA Series exchangers cool low pressure air streams using fan-drafted ambient air. Air flows to 3,500 CFM from vacuum to 75 PSI can be cooled near ambient, with under 0.2 PSI pressure loss. AA Series exchangers are ideal for installation outdoors where cooling water is unavailable or undesirable due to freezing temperatures. Indoor installations should be well ventilated. The process air should be filtered and pulsating flow, such as that produced by rotary lobe blowers, should be dampened by a chambered silencer prior to entering the heat exchanger.





SEE LINE #54 OF DATA SHEET FOR APPROXIMATE DIMENSIONS

Design Options:

- Connection types: tube, pipe, flange, NPT, ferrule, etc
- Materials of construction:
  Core: aluminum (others available with our LC series)
  Propeller, venturi, and shroud: aluminum, painted, galvanized, or stainless steel
- Motors: any available
- Epoxy phenolic coating for corrosion protection of the core
- Units can be built to required dimensions
- Multiple cores combined together to make a single unit

Accessories:

• Instrument Coupling	$ 60
• Thermometer (Includes Coupling)	$ 90
• Differential Pressure Gauge	$ 280
• Service side filters	Ask
• Others available upon request	

Xchanger, Inc. **Rating for Model AA-250 ref #146996**

Engineer: David Wangensteen June 16, 2020

Prepared for:

J.E. Gasho & Associates, Inc.

PERFORMANCE	**PROCESS MEDIA**	**SERVICE MEDIA**
Fluid Circulated	Air	Ambient Air
Volumetric Flow Rate	230.0 Std. ft^3/min	1,679.1 Std. ft^3/min
Total Fluid Entering	1,035.0 lb/hr	7,556.0 lb/hr
Liquid		
Vapor		
Non-Condensibles	1,035.0 lb/hr	7,556.0 lb/hr
Vaporized or (Cond.)		
Temperature In	150.0 °F	80.0 °F
Temperature Out	89.6 °F	88.3 °F
Inlet Pressure (Absolute)	16.196 lb/in^2	14.696 lb/in^2
Velocity (Standard)	1,956 ft/min	1,821 ft/min
Pressure Loss	0.11 lb/in^2	0.04 lb/in^2
Fouling Factor	0.0001 ft^2-°F-hr/BTU	0.00010 ft^2-°F-hr/BTU

Total Heat Exchanged: 14,987 BTU/hr

AVERAGE MEDIA PROPERTIES		
Thermal Conductivity	0.016 BTU/hr-ft-°F	0.015 BTU/hr-ft-°F
Specific Heat	0.240 BTU/lb-°F	0.240 BTU/lb-°F
Viscosity	0.047 lb/ft-hr	0.045 lb/ft-hr
Density (MW)	(29.0)	(29.0)
Latent Heat of Vapor		

CONSTRUCTION		
Design Temperature	200 °F	Not Applicable
Design Pressure (Gauge)	15 lb/in^2	Not Applicable
Test Pressure (Gauge)	15 lb/in^2	Not Applicable
Flow Direction	Right Hand Horizontal	Vertical Up/Pull Through
Coating	None	None

Plate-Fin Core	: Aluminum	Fan Hood	: Galvanized Steel
Fan Guard	: Galvanized Steel	Venturi Frame	: Galvanized Steel
Service Filter	: None	Weight	: 135 lb
Thermometers	: None	Diff Pres Gauge	: No
Instrument	:		

CONNECTIONS

Process Inlet : 4 inch 150 lb. ANSI pattern FFF, 3/8" thick

Process Outlet : 4 inch 150 lb. ANSI pattern FFF, 3/8" thick

MECHANICAL EQUIPMENT

Fan Diameter	: 12 inch	Motor	: 1.00 HP TEFC
Fan Qty/Speed	: 1 / 3450 RPM	Motor Qty/Speed	: 1 / 3450 RPM
Fan Type	: 4 Blade Mill Galv. St	Motor Electrical	: 208-230/460/3/60

NOTES

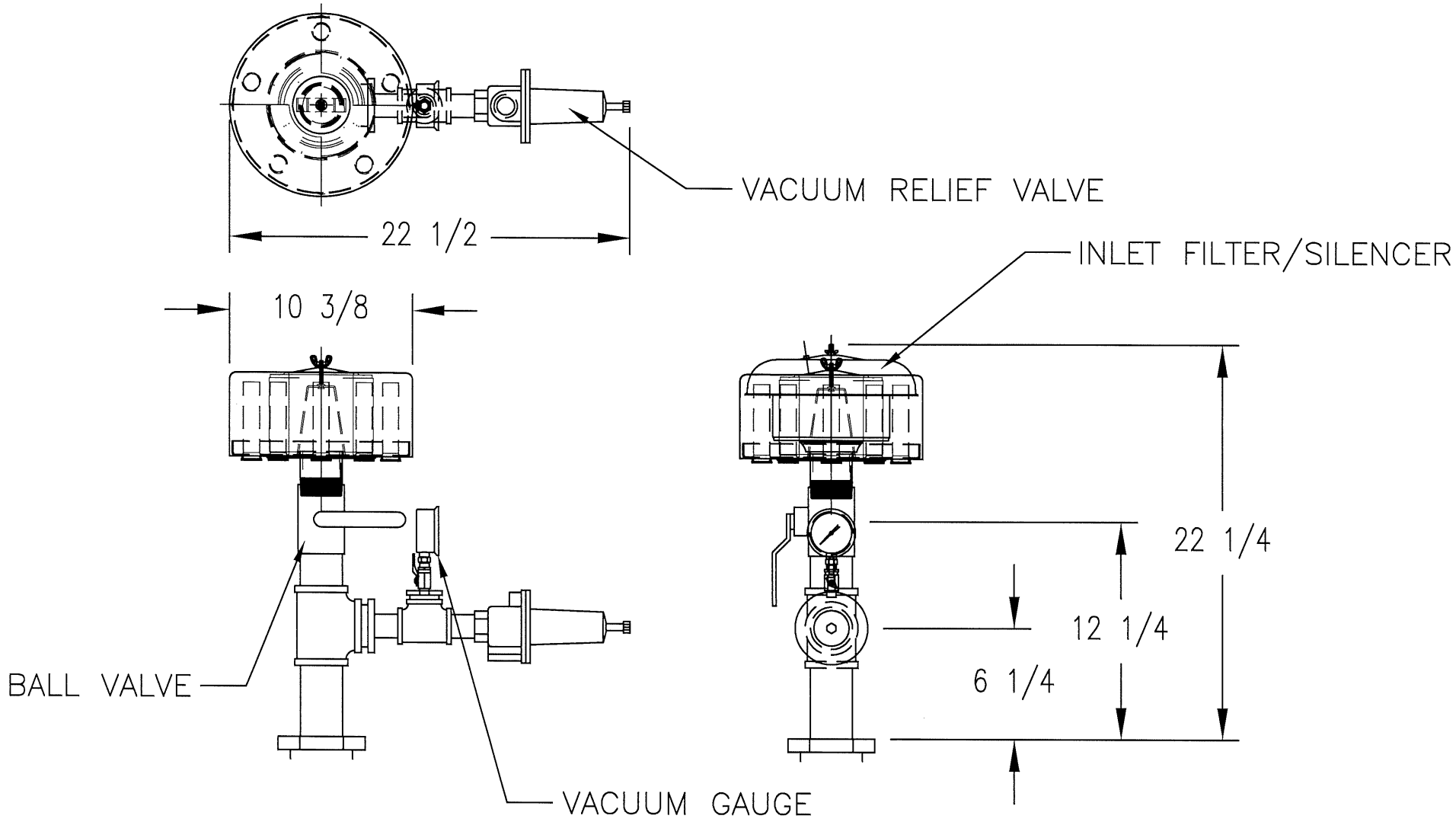
Approximate unit dimensions (inches): A = 33, B = 32, C = 24, D = 14

Construction material suitability must be determined by customer.

The process flow must be uniform, smooth and free of pulsation.

A motor access panel is included in the fan hood.

2" DILUTION VALVE



Compact Inlet Filters
F Series 1/2" - 6" MPT, Flange

Features

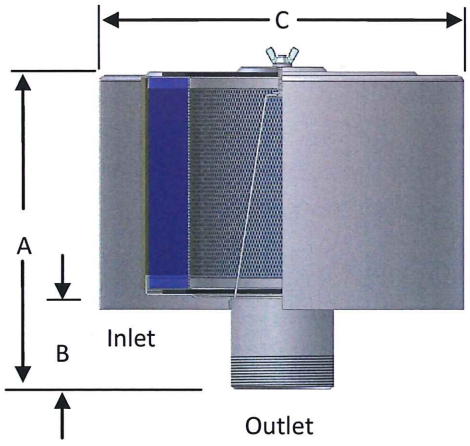
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Low entry velocity air gap between base and cover
- Heavy gauge base with low pressure drop outlet pipe and center bracket design
- Durable carbon steel construction with baked enamel finish & powder coated weatherhood

Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220° (104°C)
- Filter change out differential: 15-20" H_2O over initial Δ P
- Pressure drop graphs available upon request
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

- 1/8" tap holes available for 3" and larger connections
- Pressure drop indicator (See page 3-11)
- Various media for different environments
- Stainless steel construction
- Epoxy coated finish
- Special connections



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Outlet Connections

MPT Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
1/2"	10	F-15-050	F-14-050	4	1 1/2	6	2	15	14	35
3/4"	25	F-15-075	F-14-075	4	1 1/2	6	2	15	14	35
1"	35	F-15-100	F-14-100	4	1 1/2	6	2	15	14	35
1"	55	F-19P-100	F-18P-100	6 5/8	1 5/8	6	3	19P	18P	100
1 1/4"	70	F-19P-125	F-18P-125	6 5/8	1 5/8	6	3	19P	18P	100
1 1/2"	85	F-19P-150	F-18P-150	6 5/8	1 5/8	6	3	19P	18P	100
2"	135	F-31P-200	F-30P-200	7 1/4	2 1/4	7 3/4	5	31P	30P	195
2"	135	F-231P-200	F-230P-200	12 1/4	2 1/4	10	12	231P	230P	300
2 1/2"	195	F-31P-250	F-30P-250	7 1/2	2 1/2	7 3/4	6	31P	30P	195
2 1/2"	195	F-231P-250	F-230P-250	12 1/2	2 1/2	10	13	231P	230P	300
3"	300	F-231P-300	F-230P-300	13	3	10	14	231P	230P	300
3"	300	F-235P-300	F-234P-300	13	3	10	15	235P	234P	570
3"	300	F-275P-300	F-274P-300	13	3	16	24	275P	274P	1100
4"	520	F-235P-400	F-234P-400	14	4	10	15	235P	234P	570
4"	520	F-275P-400	F-274P-400	14	4	16	26	275P	274P	1100
5"	800	F-245P-500	F-244P-500	14	4	16	23	245P	244P	880
5"	800	F-275P-500	F-274P-500	14	4	16	27	275P	274P	1100
6"	1100	F-275P-600	F-274P-600	15	5	16	29	275P	274P	1100

See Filter Assembly Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

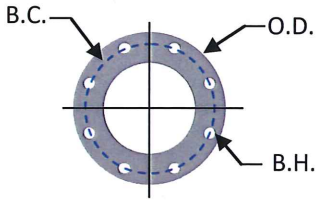
Flange Outlet Connections

Flange Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
4"	520	F-235P-400F	F-234P-400F	14	4	10	20	235P	234P	570
4"	520	F-275P-400F	F-274P-400F	14	4	16	31	275P	274P	1100
5"	800	F-245P-500F	F-244P-500F	14	4	16	27	245P	244P	880
5"	800	F-275P-500F	F-274P-500F	14	4	16	32	275P	274P	1100
6"	1100	F-275P-600F	F-274P-600F	15	5	16	34	275P	274P	1100

See Filter Assembly Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

125/150# Pattern Flg	Dimensions - inches O.D.	B.C.	B.H.	No. of Holes	Flange Thickness
4"	9	7 1/2	0.75	8	0.38
5"	10	8 1/2	0.88	8	0.38
6"	11	9 1/2	0.88	8	0.38



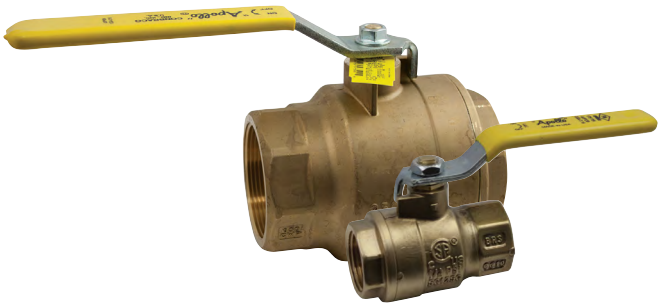
O.D.: Outside Dimension
B.C.: Bolt Circle
B.H.: Bolt Hole

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

"Apollo" Valves SUBMITTAL SHEET

77F-100 Series

Full Port Threaded End Brass Ball Valve



Job Name:	
Job Location:	
Engineer:	
Contractor:	
Tag:	
PO#:	
Rep:	
Wholesale Dist.:	

DESCRIPTION

The Apollo 77F-100 Series is a full port forged brass ball valve suitable for a wide range of flow control applications including HVAC, fuel gas, fire protection, irrigation etc. These NPT threaded, 2-piece valves combine reliable operation with maximum economy. Valves include most pertinent agency approvals. Proudly Made in the USA.

FEATURES

- Heavy Pattern Forged Design
- Corrosion Resistant Materials
- Full-Port Flow
- Premium RPTFE Seats and Packing
- Adjustable Stem Packing
- Blowout-Proof Stem
- 2-1/2" - 4" Sizes Now Feature 316SS Ball and Stem (Standard)
- Silicone Free Assembly
- 100% Factory Tested
- **Made in USA, ARRA Compliant**

PERFORMANCE RATING

- Rating: 600 CWP (1/4" – 2")
- Rating: 400 CWP (2-1/2" – 4")
- Steam Rating: 150 psi SWP
- Temperature Range: 0°F - 400°F
- Vacuum Service to 29 in. Hg

Not intended for potable water in USA

OPTIONS

• (-01) Standard Lever	
• (-04) 2-1/4" Stem Extension	1/4" – 2-1/2"
• (-07) Tee Handle	1/4" – 2"
• (-10) Stainless Steel Lever & Nut	1/4" – 2"
• (-11) Therma-Seal™ Insulating Tee Handle	1/4" – 2"
• (-27) Locking Handle SS	1/4" – 2-1/2"
• (77F140 Series) – SS Ball & Stem	
• (77FLF Series) Lead Free (0.25% Lead Max)	

STANDARD MATERIALS LIST

BODY	Brass, ASTM B283 alloy C37700
SEAT	RPTFE
BALL	Brass, ASTM B16, C36000 or B283, C37700 Chrome Plated 316 SS (2-1/2" - 4")
STEM PACKING	RPTFE
NUT	Corrosion Resistant Plated Steel
STEM	Brass, ASTM B16, C36000 316 SS (2-1/2" - 4")
RETAINER	Brass, ASTM B283 alloy C37700 or ASTM B16, C3600
HANDLE	Plated Steel / Insulated Polyvinyl
GLAND	Brass, ASTM B16, C36000

APPROVALS

- MSS SP-110
- IAPMO/ANSI Z1157

FM LISTED

- FM 1140 (<175 PSI) (1/4" – 2")

CSA LISTED

- CGA 3.16 (125 PSI)
- CGA CR91-002 (5 PSI)
- ANSI Z21.15/CSA 9.1 (1/2 PSI)
- ASME B16.44 (5 PSI)
- ASME B16.33 (125 PSI) (1/2" – 2")

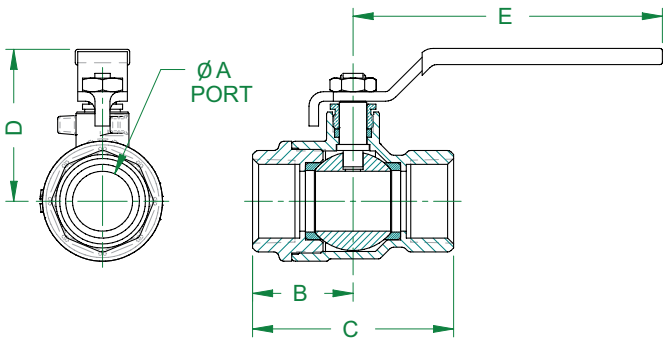
UL LISTED

- UL 125 - Flow Control Valves for LP-Gas, Guide YSDT to 250 psi max
- UL 258 - Fire Protection Trim & Drain, Guide VQGU to 175psi max (1/4" – 2")
- UL 842 - Valves for Flammable Fluids, Guides YRBX, YRPV, and MHKZ to 250 psi max. (1/4" - 4" NPT only)
- UL 1477 - Compressed Gas Shutoff Valves, Guide YQNZ to 250 psi max (1/4" - 4" NPT only)

Gas approvals apply to NPT models only

DIMENSIONS

PART NUMBER	SIZE (IN.)	DIMENSIONS (IN.)					WT. (LB.)
		A	B	C	D	E	
77F-101-01	1/4"	0.38	0.81	1.62	1.61	2.85	0.3
77F-102-01	3/8"	0.38	0.85	1.70	1.61	2.85	0.3
77F-103-01	1/2"	0.50	1.14	2.25	1.66	2.85	0.5
77F-104-01	3/4"	0.75	1.29	2.57	1.91	3.86	0.8
77F-105-01	1"	1.00	1.60	3.20	2.11	3.86	1.3
77F-106-01	1-1/4"	1.25	1.73	3.46	2.44	4.75	2.1
77F-107-01	1-1/2"	1.50	2.00	4.00	2.91	5.42	3.2
77F-108-01	2"	2.00	2.37	4.74	3.69	7.77	5.6
77F-149-01	2-1/2"	2.50	2.99	5.98	4.14	7.77	12.8
77F-140-01	3"	3.00	3.52	7.05	5.03	9.92	19.7
77F-14A-01	4"	4.00	3.83	7.65	5.70	14.78	25.5



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The Leader in Blower & Vacuum Solutions

Moisture Separators

Moisture separators are used to remove water and other liquids from air streams. They are typically used on the inlet of vacuum systems to remove water and other contaminants before they enter the vacuum pump. The air volume of the moisture separator reduces the velocity of the air stream to allow liquids to precipitate. Up to 95% water removal is possible. The models GX-30 & GX-60 are rated for full vacuum. Other moisture separators are rated to 18 in. Hg. Higher vacuum ratings available.

Inside the top of the separators is a basket with stainless steel demister/filter media to trap entrained water droplets. Standard accessories include a sight gauge and drain valve.

Options include: 1 to 3 level switches, hand operated sludge pump, automatic pump down systems, heat tracing, vacuum gauges, and thermometers.

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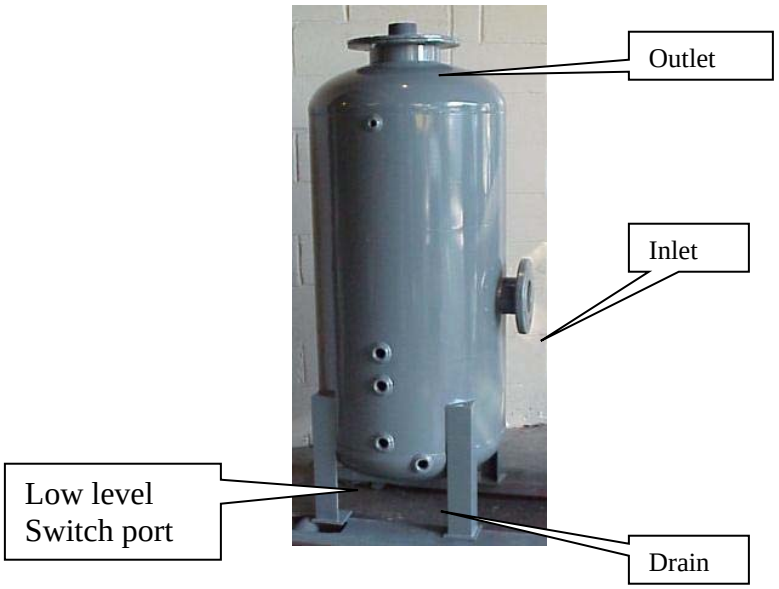
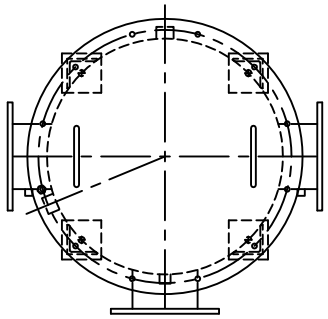
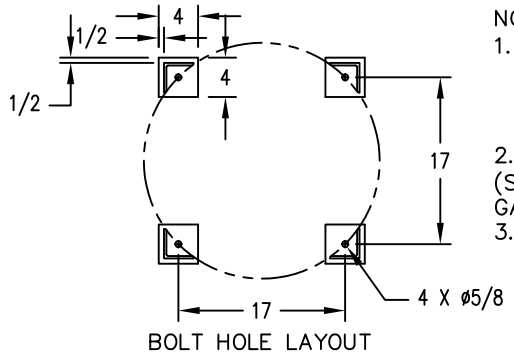


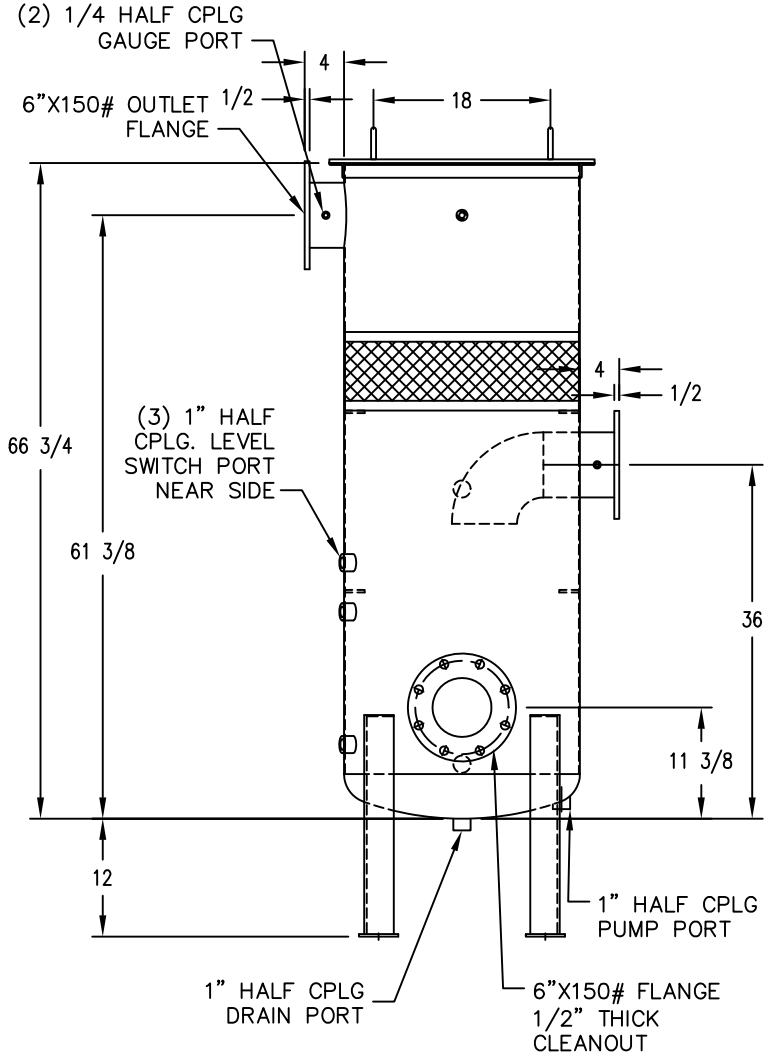


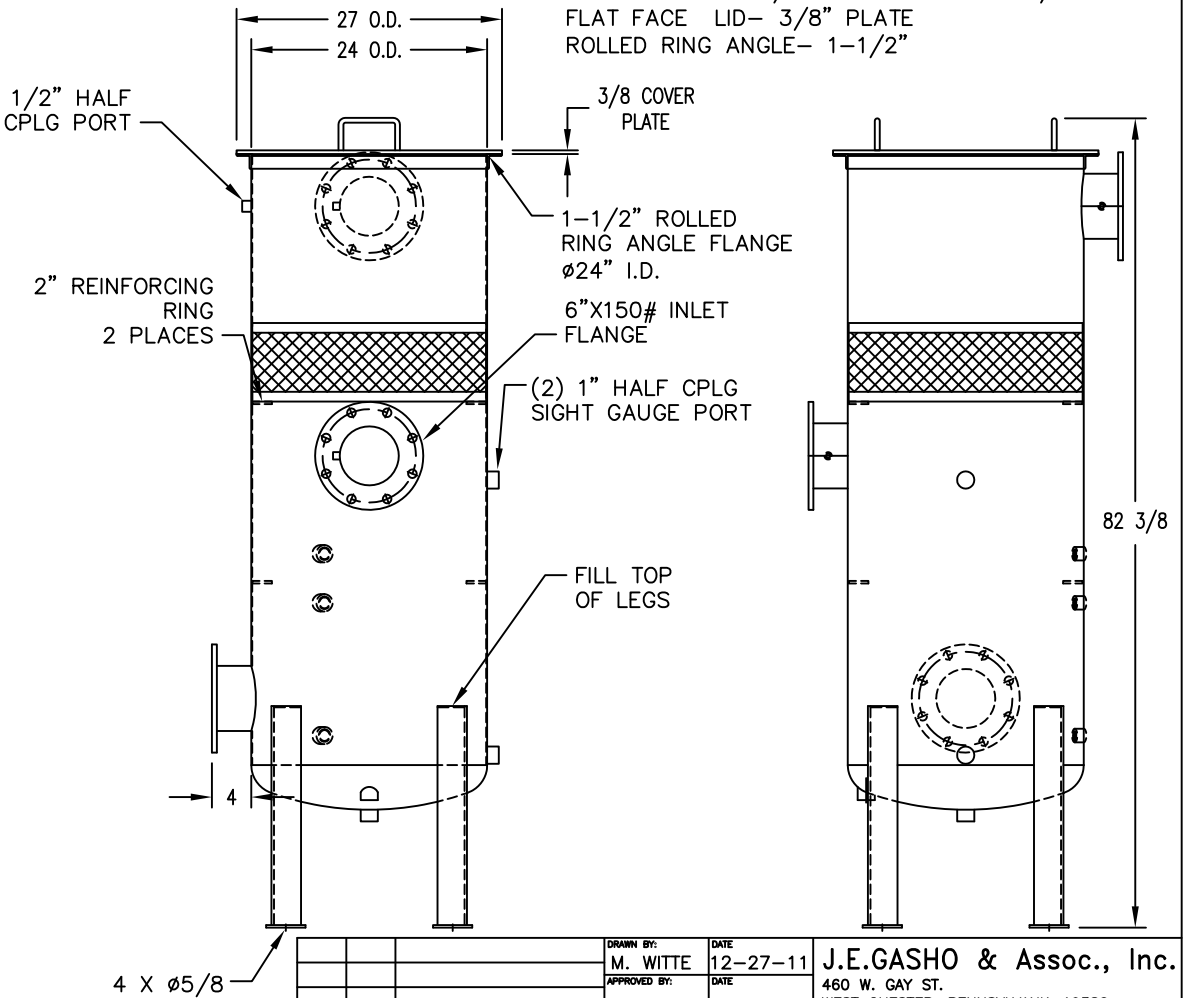


BOLT HOLE LAYOUT

NOTES:
1. VOLUME: 1.925 GAL/INCH HEIGHT
   52" NEEDED FOR 100 GALLONS
   35 GALLONS NOMINAL LIQUID STORAGE = 18.2"
   40 GALLONS NOMINAL LIQUID STORAGE = 21"
2. LEVEL SWITCH LOCATION: LO 7.5" = 14 GAL (STATIC VOLUME), HI 21" = 40 GAL, HI-HI 26" = 50 GAL, PUMP OUT VOLUME = 26 GAL.
3. ALL CONTINUOUS WELDS TESTED LEAK TIGHT.

MATERIAL:
SHELL- #12 GA. HRS
HEADS- #12 GA HRS P & O
REINFORCING RING- 2"X1/4" HRS
FEET- 4X 4 X 1/4 PLATE
LEGS- 3 X 3 X 1/4 ANGLE FLANGE- 1/2" THICK
FLAT FACE LID- 3/8" PLATE
ROLLED RING ANGLE- 1-1/2"





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			DIMENSIONS IN INCHES	
			SCALE	
			TOLERANCE	ANGULAR TOLERANCE
			MATERIAL STEEL	WEIGHT 320 LB
A	4/26 2018	ROTATE L. SWITCH PORTS	SHEET 1 OF 1	
REV.	DATE	DESCRIPTION		

J.E.GASHO & Assoc., Inc.
460 W. GAY ST.
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MOISTURE SEPARATOR
GX125DL HIGH VAC
USE WITH DEMISTER PAD

1500-C-9270 | A

Orifice Plates

Simple, Predictable and Reliable Differential Flow Measurement

Series 500 & 520 Universal Plates and Seals
Series 560 & 590 Ring Type Joint Plates

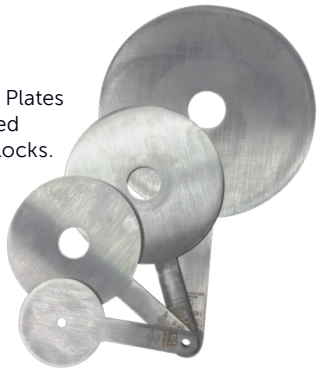
We manufacture all of our flow measurement universal orifice plates, paddle plates, ring type joint (RTJ) plates and restriction orifice unions to meet or exceed standards set by A.G.A., I.S.A., A.N.S.I., A.S.M.E. and A.P.I. recommendations. Stocked plates include 304 & 316 stainless steel in 1/8" and 1/4" thicknesses. Other material and/or thicknesses are available upon request. We bore the plates to the customer's supplied sizing calculation, but we also provide sizing calculation services for an additional fee.

Series 500 Orifice Plates & Seals

Our Universal Orifice Plates are designed to be used with all standard orifice fitting assemblies or RTJ plate holders. Standard industry sizing allows our plates to be used with any of the dual- or single-chambered orifice fittings on the market,

Seal rings for Series 500 Orifice Plates are sold separately.

Series 520 Paddle Orifice Plates



USA Industries' Paddle-Type Orifice Plates are manufactured for use with Raised Face Orifice Flanges and Holding Blocks.

Skilled craftsmen and state-of-the-art machining practices assure that our paddle orifice plates meet or exceed the stringent requirements of AGA, ISA, ANSI, ASME & API Standards.

Series 560 Plates & 590 Plate Holders

Series 560 plates are machined as one piece and available in all ring sizes.

Series 590 plates are manufactured with hold-down screws and use Universal Plates for the Orifice bore.

The RTJ type orifice plate incorporates an integral gasket, either oval or octagonal ring, for mounting between RTJ flanges. It's proven technology has no moving parts and is suitable for high temperature and pressure applications.

Plate thicknesses depend on line size and differential pressure, and may be machined in one piece, or alternatively from two pieces, with an Orifice Plate screwed onto a carrier ring/gasket.

Restriction Orifice Unions

Restriction Orifice Unions consist of orifice plates that are one-piece stainless steel shaped to fit the contour of the union seat (ball to cone), eliminating the need for gaskets. Plates can be configured to work as recessed, pressed, or pressed with tab so you can identify the orifice size without breaking the union.

Orifice unions are stocked in carbon & stainless steel bodies with pressure ratings of 3,000 PSIG. Restriction orifice unions are also available in line sizes from 1/4" through 2" and with female NPT or socket-weld connections. Other non-standard orifice union sizes and materials can be produced rapidly upon request.

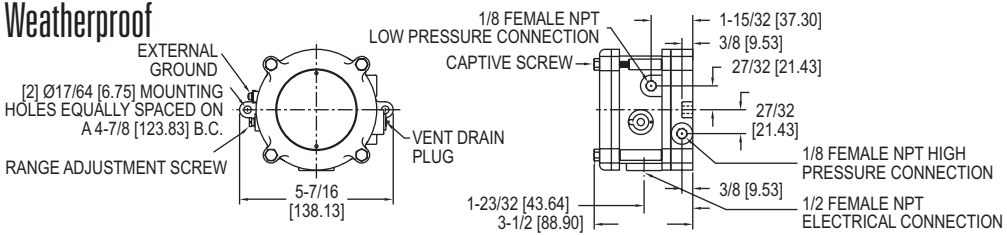
For more information on USA Industries, Inc.'s products, contact us at (713) 941-3797 or go to www.USAIndustries.com

Dwyer

SERIES 1950

EXPLOSION-PROOF DIFFERENTIAL PRESSURE SWITCH

Compact, Low Cost, Explosion-proof and Weatherproof



Series 1950 Explosion-Proof Differential Pressure Switch combines the best features of the popular Dwyer® Series 1900 Pressure Switch with an integral explosion-proof and weatherproof housing, making it an exceptional value for either application. It is CE, UL and CSA listed, FM approved for use in Class I, Div 1, Groups C and D, Class II Groups E, F, and G and Class III hazardous atmospheres NEMA 7 & 9. Rain tight NEMA 3 (IP54), weatherproof features include a drain plug and O-ring seal in cover. Electrical connections are easily made by removing front cover. For convenience the set point adjustment screw is located on the outside of the housing. Twelve models offer set points from .03 to 20 in w.c. (0.0075 to 5 kPa) and from .5 to 60 psi (0.035 to 3.5 bar). The unit is very light and compact - about half the weight and bulk of other explosion-proof or weatherproof switches with separate enclosures. CAUTION: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.

FEATURES/BENEFITS

- Explosion-proof and weatherproof housing provides device protection for outdoor use or harsh environment operation
- External set point screw provides easy access that simplifies making adjustments without opening or disassembling enclosure
- Easily accessible electrical connection simplifies the installation

APPLICATIONS

- HVAC applications
- Process applications
- All-weather applications

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits: Continuous: 1950's - 45 in w.c. (0.11 bar); 1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar). Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: NEMA 3 (IP54), NEMA 7 & 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8″ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, CSA, FM, UL.

MODEL CHART

Model	Range, psid	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point	Model*	Range*	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point	Model	Range, in w.c.	Approximate Deadband Min. Set Point	Approximate Deadband Max. Set Point
1950P-2-2F	0.5 to 2	0.3	0.3	**1950P-50-2F**	15 to 50	1.0	1.5	**1950-1-2F**	.4 to 1.6	.15	.20
1950P-8-2F	1.5 to 8	1.0	1.0	**1950-02-2S**	.03 to .10	.025	.05	**1950-5-2F**	1.4 to 5.5	.30	.40
1950P-15-2F	3 to 15	0.9	0.9	**1950-00-2F**	.07 to .15	.04	.05	**1950-10-2F**	3 to 11	.40	.50
1950P-25-2F	4 to 25	0.7	0.7	**1950-0-2F**	.15 to .50	.10	.15	**1950-20-2F**	4 to 20	.40	.60

*P=PSID range models. Other ranges in w.c.

Caution: For use only with air or compatible gases. Applications with hazardous atmospheres and a single positive pressure may require special venting.

Rotameters for Air Sparge and Vapor Extraction

PRMFiltration

- Designed For Vapor Extraction, Air Sparge and other industrial air flow applications.
- Scaled for standard cubic feet per minute (SCFM) and can be used on pressure and high vacuum applications.
- Meter sizes designed to provide an ample working range and are less prone to failure through impact exposure.
- Larger than comparable meters on the market which provides a fine scale control for a higher degree of accuracy.

Specifications:

- Materials:
  - Body: Acrylic with PVC (gray) or Polypropylene (white) replaceable end tails
  - 304 SS Float and travel rod
  - Viton® O-rings and seals
- Maximum 85 psig pressure rating
- Maximum Temperature rating of 125°F
- Accuracy: +/- 4% of full scale flow

SCFM scale based on 1 atm air @ 68° F
Rotameter readings must be adjusted for pressure and temperature. Discover more about air flow readings: https://www.prmfiltration.com/scfm-acfm-calculator

Options:

PRM can provide meters scaled for custom applications. Typical lead time is 3-5 weeks from time of order. Custom meters require a minimum quantity commitment of 50 meters.

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Rotameters for Air Sparge and Vapor Extraction

PRMFiltration

INSTALLATION & USE:
PRM rotameters are available in a broad choice of flow ranges with direct reading scales for air, gas or water. Installation, operation and maintenance are very simple and only a few common sense precautions must be observed to assure long, trouble-free service.

Before proceeding with the installation of your PRM Rotameter, check to be sure you have the model and flow range you require. PRM Flowmeters are designed for use at pressures up to 85 psi and temperatures up to 125°F. DO NOT EXCEED THESE LIMITS!
The installation should not be exposed to strong chlorine atmospheres or solvents such as benzene, acetone, carbon tetrachloride, etc. The mounting panel should be free of excessive vibration since it may prevent the unit from operating properly.

Inlet Piping Run: It is good practice to approach the flowmeter inlet with as few elbows and restrictions as possible. In every case the inlet piping should be at least as large as the connection to the flowmeter. Discharge Piping: As on the inlet, discharge piping should be at least as large as the flowmeter connection.

POSITION AND MOUNTING All PRM Rotameters must be mounted in a vertical position with the inlet connection at the bottom and outlet at the top .

It is important to understand that a rotameter is affected by variations in temperature and air pressure. This rotameter has been calibrated at the Standard operating conditions of 14.7 psia (0 psi) pressure and 70° F. When using the rotameter at a different temperature and pressure than where it was calibrated, the following formula will provide a correction factor:

$$Q_2 = Q_1 \times \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

Where:

Q1 = Actual or Observed Flowmeter Reading
Q2 = Standard Flow Corrected for Pressure and Temperature
P1 = Actual Pressure (14.7 psia + Gauge Pressure)
P2 = Standard Pressure (14.7 psia, which is 0 psig)
T1 = Actual Temperature (460 R + Temp °F)
T2 = Standard Temperature (530 R, which is 70°F)

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Rotameters for Air Sparge and Vapor Extraction

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FMDFG03: 0.3-3 scfm
1/2" FNPT
8" tall
1.3" OD

FMDFG15: 1-8 scfm
1/2" FNPT
8" tall
1.3" OD

FMDFG25: 1-15 scfm
1" FNPT
10.5" tall
2" OD

FMDFG40: 2-25 scfm
1.5" MNPT
12" tall
2" OD

FMDFG4050:
5-50 scfm
1.5" MNPT
12" tall
2" OD

FMDFG50: 10-100 scfm
2" FNPT
13.5" tall
3" OD

FMDFG51: 20-200 scfm
2" FNPT
13.5" tall
3" OD

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Equipment Specifications may vary. Product Recovery Management, Inc. • 200 20th Street • Butner, NC 27509 P-02 (2)









SCH 80 PVC Sample Port Ball Valve - 1/4 Inch MNPT X Barb

$ 7.75

Quantity 1

ADD TO CART

SKU: 13PVC80SP025

Category: PVC Valves, Sch 80 PVC Sample Port Ball Valves, Sch 80 PVC Valves, Schedule 80 PVC Fittings & Valves

← VIEW ALL PVC VALVES

Description | Warranty | Shipping and Delivery | Exchanges | Customer Review

SCH 80 PVC 1/4" SAMPLE PORT VALVE WITH HOSE BARB AND CHEMICAL RESISTANT VITON O-RING.

SAMPLE PORT VALVE -

HOSE BARB FOR 1/4" ID HOSE X 1/4" BSPP CONNECTION, COMES WITH 1/4" PVC ADAPTER TO CONVERT BSPP CONNECTION TO NPT. CHEMICAL RESISTANT BUNA-N SEALING WASHER INCLUDED.

This Sch 80 PVC Sample Port Valve is a ball valve is made of PVC (polyvinyl chloride) for less weight than metals, and has a lever handle for on/off manual control. This inline valve has 1/4" male BSPP threads and comes with a National Pipe Taper (NPT) adapter to connect to a female threaded pipe and a 1/4" ID hose connection to connect to a hose going in the same direction. This valve has a Viton Rubber seal for increased chemical resistance. This inline ball valve is suitable for chemical processing and water and wastewater applications.

Ball valves use a spherical disc to control the flow between pipes, tubes, or hoses. Flow is allowed when the hole that pierces the ball-shaped disc is in line with the inlet and outlet of the valve and is blocked when the ball is horizontally swiveled 90 degrees, so that the hole of the ball is perpendicular to the opening of the valve. Ball valves can be referred to as full port or reduced port (also known as regular or standard port) depending on the inner diameter or the valve. A ball valve is full port if the hole of the ball is the same size as the inner diameter of the connecting pipeline (resulting in lower friction) and termed reduced port if the hole of the valve is one pipe size smaller than the pipe, resulting in less flow through the valve than through the shaft of the pipe. Ball valves may have a handle or lever that aligns with the ball's position (open or closed) for manual operation. They are primarily used in air, gas, liquid, and steam applications.

CUSTOMERS HAVE ALSO PURCHASED

ERA Sch 80 PVC 12 Inch Butterfly Valve, Gear Operated

$ 738.39 Lead Time

ADD TO CART

ERA Sch 80 PVC 2 Inch Butterfly Valve Kit, With Flanges and Hardware

$ 59.27

ADD TO CART

ERA Sch 80 PVC 2 Inch Butterfly Valve, Lever Handle

$ 27.86

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ERA Sch 80 PVC 2-1/2 Inch Bu Lever Handle

$ 29.63

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Luke Kemp | Project Manager & Field Services
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Sonic Fiber Sound Absorber

Sonic Fiber Sound Absorber is a semi-flexible non-asbestos mineral wool that provides much greater sound attenuation and absorption than fiberglass bats or urethane foam Sonic Fiber is naturally hydrophobic (repels water), fire resistant, does not promote mold growth, and is vermin-proof. It is available in sheets that are either un-faced or faced on one side with an encapsulant which protects the fibers yet remains breathable. Sonic Fiber comes in standard size sheets of 4' x 6' with a 2" thickness, and a density of 8 lbs/ cu. ft. Different thicknesses, sheet sizes and facings are available upon request. Mechanical and acoustic properties are provided below.

Un-Faced

Faced in Black

The Noise Reduction Coefficient (NRC) of a material is obtained through testing by a certified laboratory to ASTM standards. The NRC is an indication of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection (such as a smooth concrete surface) and an NRC of 1 indicates perfect absorption. Sonic Fiber is used inside rooms, enclosures and walls to significantly reduce acoustical reflections and overall sound energy, and may be used together with sound barrier materials, such as Sonic-Shield™ Noise Barrier.

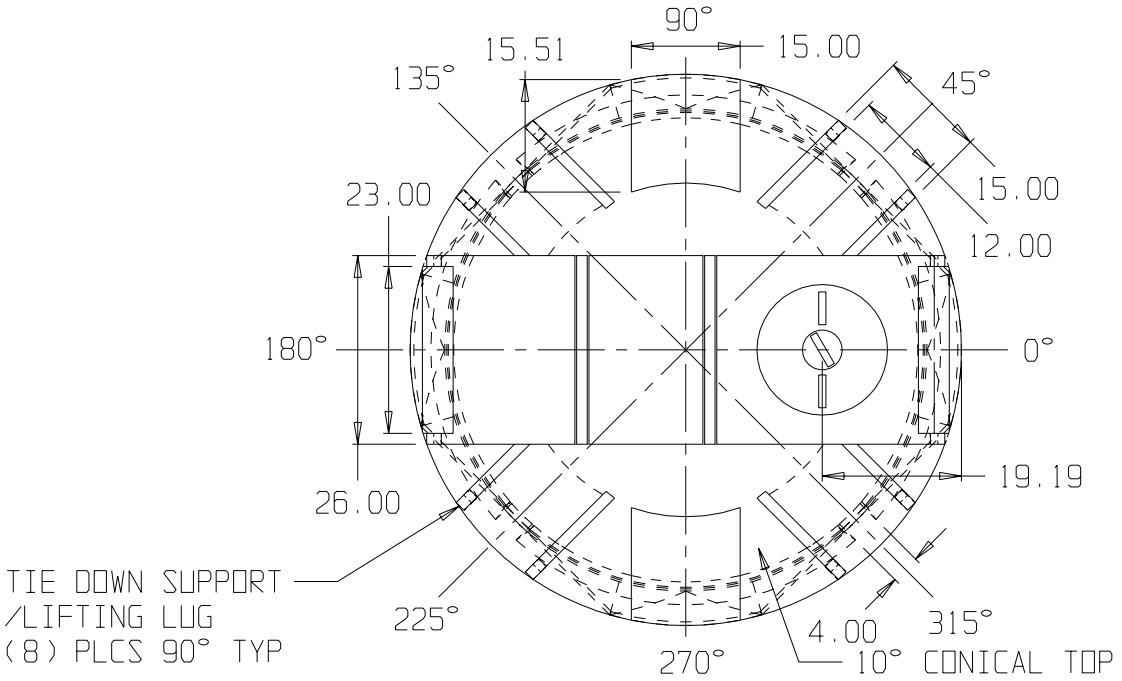
Typical Mechanical Properties	
Weight Density	8 lb./cu.ft.
Thickness	2.00Ó
Adsorption[1]	<1% by volume
Combustibility[2]	Non-combustible
Corrosivity[3]	Non-corrosive
Thermal R-Value	8.3
Maximum Temperature[4]	1200°F

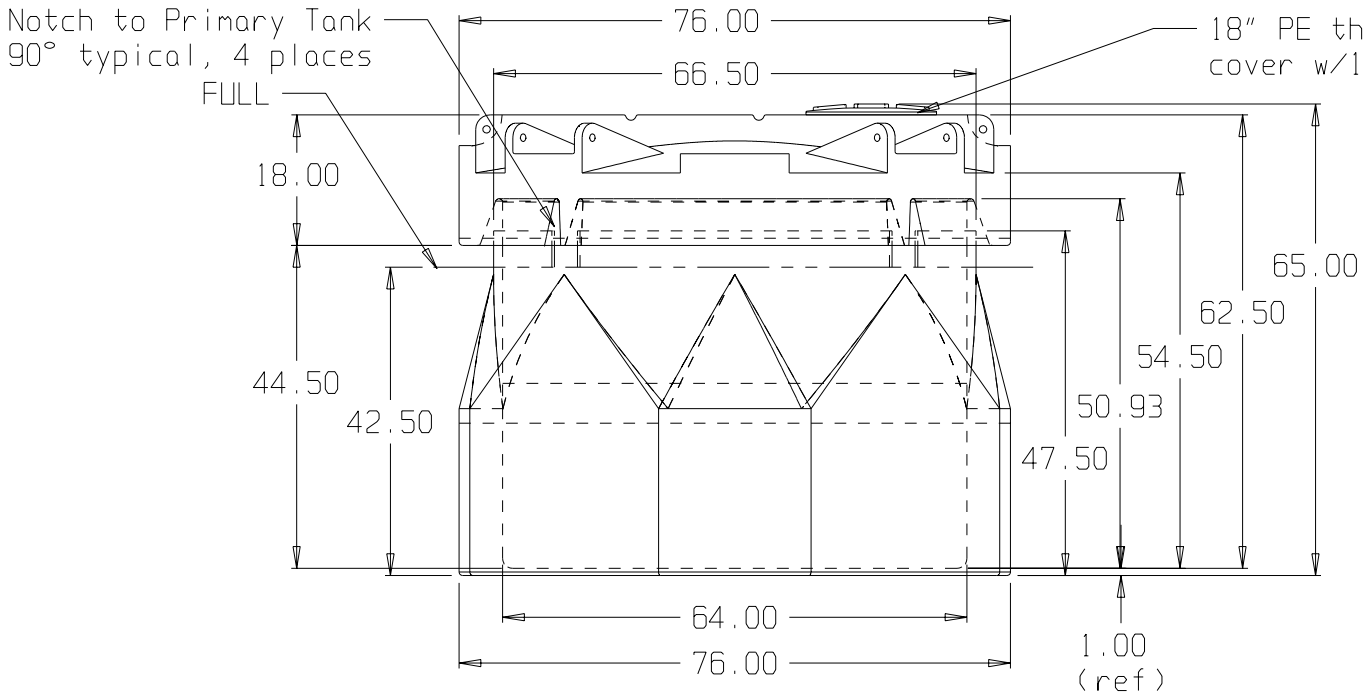
1. *ASTM C 1104*
2. *NFPA Standard 220 tested IAC ASTM E 136*
3. *ASTM C 665, MIL-I-24244*
4. *ASTM C 411*
5. *ASTM C 423*

Typical Acoustical Properties (NRC)[5]		
Frequency (Hz)	2" thick	4" thick*
125	0.35	1.15
250	0.84	1.17
500	1.08	1.18
1000	1.04	1.03
2000	0.96	1.06
4000	0.93	1.08
NRC	1.00	1.10

*estimated

For other product information, technical assistance or ordering, please call Sonic-Shield at 888-769-0766 or on-line at www.sonic-shield.com





(all dimensions in inches)

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE

550 GALLON CAPTOR CONTAINMENT SYSTEM

PART # PRIMARY: 504--

CONTAINMENT: 503--

REF#: 0000 01/23/03

SNYDER INDUSTRIES INC.

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Contact Dial Thermometer

Special features

- Class 1.5
- Display range -40° C to +600° C
- Temperature controller with actual value display as built-in or add-on device in the stainless steel case with a bayonet connection
- Case size ∅: 100 mm
- Protection type IP 65

Brief description

Contact dial thermometers are devices with an actual value display for temperature measurement, control, and monitoring and can be used universally.

The temperature-dependent volume change in a measuring system filled with liquid or the temperature-dependent pressure change in a measuring system filled with gas is converted to a rotational movement of the actual value indicator by a bourdon tube; no transmission gear is required. The microswitch is actuated by the rotational movement of the indicator shaft via a tap system.

Technical data

Basic type extension	0210, 1010, 2010, 2210, 2310
Case	Stainless steel case with bayonet connection (1.4301)
Protection type	IP 65 according to DIN EN 60529
Front pane	Polycarbonate
Scale	White, with black lettering
Display	Class 1.5 similar to DIN EN 13190
Strain relief spring	For capillary devices on the case and the temperature probe
Setpoint value adjustment	By setpoint adjuster in the front pane; with screwdriver, protected by the bolted cover.
Display correction	On the rear, no display correction with design type 20
Limit value temperatures	For transport and storage -20°C to +70°C (for display range 0 to +60°C up to max. 65°C; -40 to +40°C up to max. 50°C; -30 to +50°C up to max. 60°C)
Rated position (NL)	Any

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
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JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
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Technical data

Display range (AB)	Display range in °C	Measuring range in °C	Tolerance in °C (+/-)
469	-40 to +40	-30 to +30	1.5
566	-30 to +50	-20 to +40	1.5
643	-20 to +120	0 to +100	3.0
807	0 to +60	+10 to +50	1.5
810	0 to +80	+10 to +70	1.5
814	0 to +100	+10 to +90	1.5
818	0 to +120	+20 to +100	3.0
826	0 to +160	+20 to +140	3.0
832	0 to +200	+20 to +180	3.0
834	0 to +250	+30 to +220	4.0
926	+50 to +250	+70 to +230	3.0
840	0 to +300	+30 to +270	6.0
927	+50 to +300	+80 to +270	4.0
843	0 to +350	+50 to +300	6.0
932	+50 to +350	+80 to +320	6.0
848	0 to +400	+50 to +350	6.0
851	0 to +450	+50 to +400	6.0
854	0 to +500	+50 to +450	8.0
858	0 to +600	+100 to +500	10.0

	Liquid filling	**Gas filling**
Measuring system	Display range (AB) ≤ 350°C	Display range (AB) ≥ 400°C
Time constant $t_{0.632}$	Approx. 12 s, measured in water, with a probe Ø of 6 mm made of Cu.	Approx. 4 s, measured in oil, with a probe Ø of 10 mm made of stainless steel.
Ambient temperature influence effect	In % of the display range (referring to the deviation from the reference value +23°C)	
On case	0.15% of the display range per K ambient temperature change	0.05% of the display range per K ambient temperature change
On capillary (per m)	0.03% of the display range per K ambient temperature change	No influence
	At higher ambient temperature – higher temperature display – lower switching point	

	Standard	**Extra code (TZ) 650**
Electrical contact		
Contact type	Single-pole microswitch with mechanically actuated changeover contact	
Switching capacity	AC 230V, +10/-15%, 48 to 63Hz, cos φ = 1 (0.6)	
	5 (1.5) A	10 (3) A
Switching differential	Approx. 1.5% of the display range	1.5 to 3% of the display range
Switching point accuracy	± 0.5% of the display range referring to the switch-off point with rising temperature	
Switching reliability	To ensure a high switching reliability, we recommend a minimum voltage of 24 V and a minimum current of 100 mA	

Electrical connection	Junction box: conductor cross-section up to 2.5 mm^2, suitable for cable Ø from 6.5 to 13 mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
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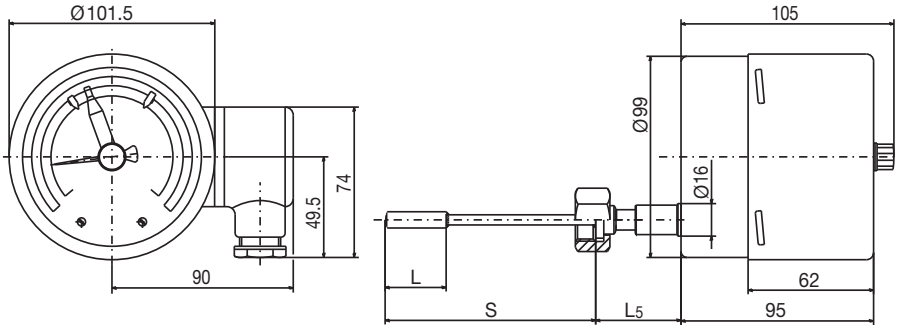
Dimensions

Type:
608523/0210



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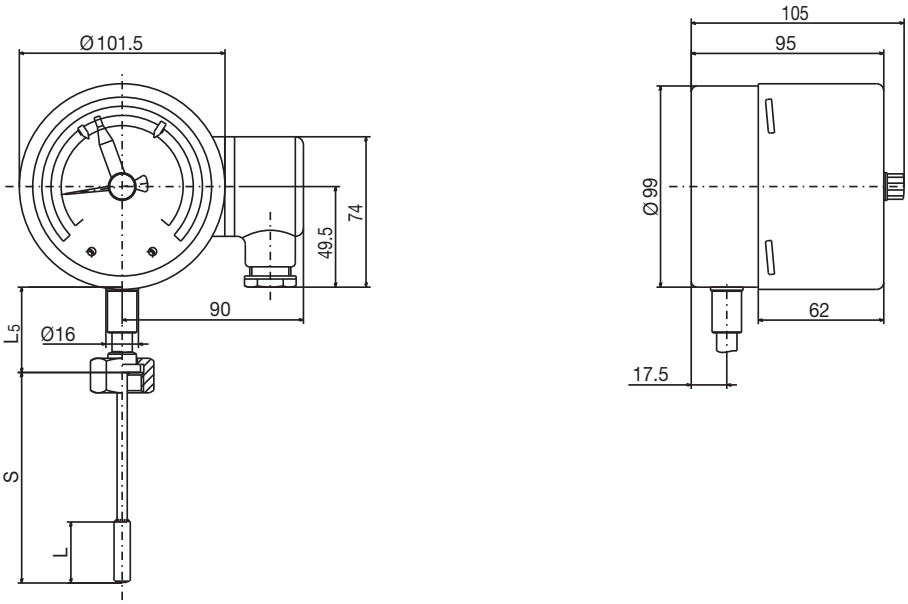

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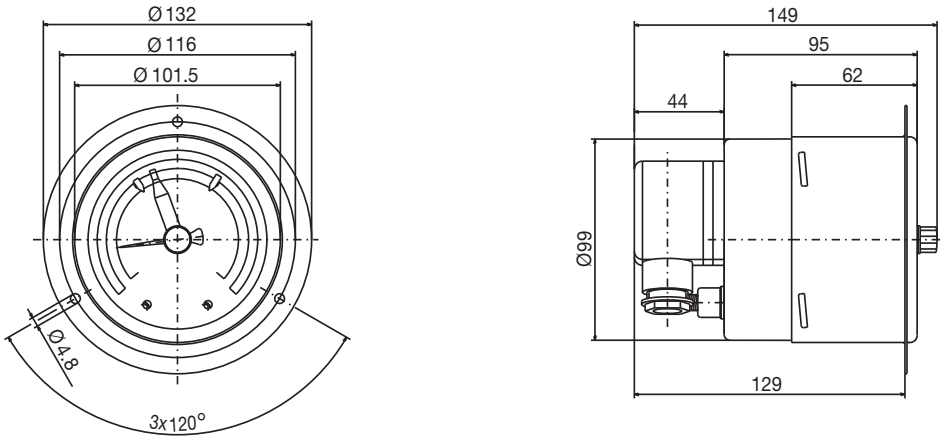

Panel cut-out Ø 105 $^{+0,5}$ mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
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JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
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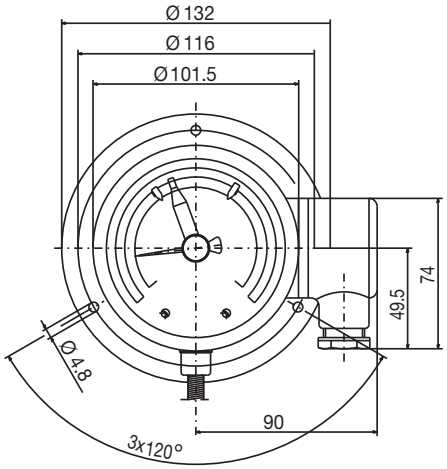
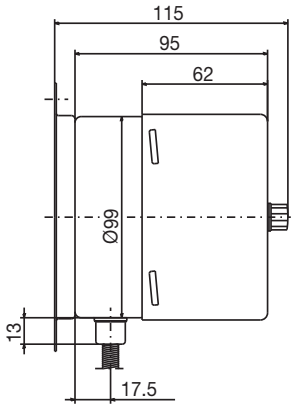
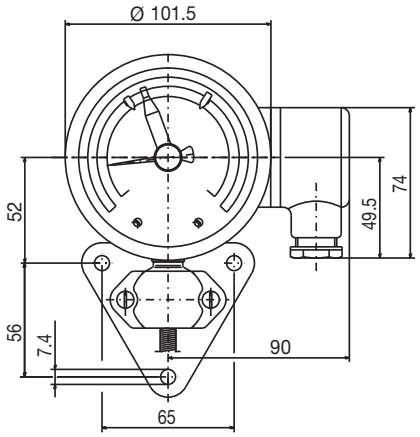


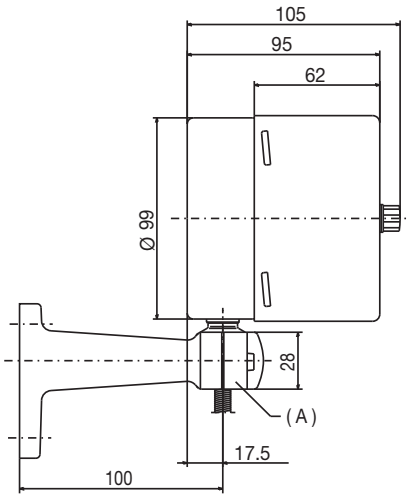


Panel cut-out Ø 105 $^{+0,5}_{0}$ mm

Type:
608523/2310



Bracket for measuring device according to DIN 16281



(A) Spigot Ø 26 mm

L_5	Protection tube connection type
40 mm	TA 03, TA 30
≤ 69 mm	TA 02
42.5 mm	TA 21
51.5 mm	TA 22, TA 31

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
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Fax: +49 661 6003-607
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Internet: www.jumo.net

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JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
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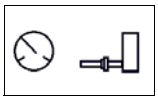
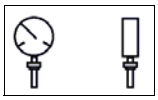
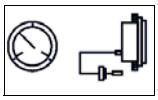
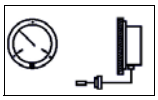
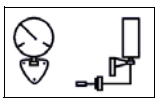
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Order details

Order code	(1)	Basic type	
608523		Mechanical contact dial thermometer class 1.5	
	(2)	**Basic type extension**	Case size Ø
0210		Design type 02 	100 mm
1010		Design type 10 	100 mm
2010		Design type 20 	100 mm
2210		Design type 22 	100 mm
2310		Design type 23 	100 mm

	(3)	Display range in °C
469		-40 to +40
566		-30 to +50
643		-20 to +120
807		0 to +60
810		0 to +80
814		0 to +100
818		0 to +120
826		0 to +160
832		0 to +200
834		0 to +250
926		+50 to +250
840		0 to +300
927		+50 to +300
843		0 to +350
932		+50 to +350
848		0 to +400
851		0 to +450
854		0 to +500
858		0 to +600

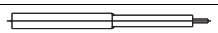
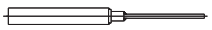
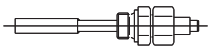
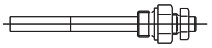
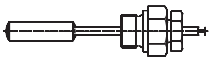
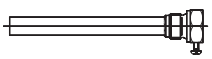
JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Order code	(4)	Capillary type (FL) [a]
00		Without (with rigid connection)
02		FL 02 Cu capillary with Cu textile braiding, approx. Ø 2.5 mm (up to AB end value +300°C)
11		FL 11 Cu capillary with PE coating, approx. ø 3.5 mm (up to AB end value +120°C)
17		FL 17 Stainless steel capillary, approx. Ø 1.5 mm
21		FL 21 Cu capillary, approx. Ø 1.0 mm (up to AB end value +300°C)

	(5)	Capillary length [b]
0		Without (with rigid connection)
1000		1000 mm
2000		2000 mm
3000		3000 mm
4000		4000 mm
5000		5000 mm
. . . .		Special length (specification in plain text: 1,000 mm increments, maximum length 10,000 mm), additional lengths upon request

	(6)	Process connection (PC)[a]		
750	TF 01	Temperature probe with stepped support tube		
752	TF 11	Temperature probe without support tube		
843	TA 02	Protection tube with union nut and loose screw connection [b]		
161	TA 03	Protection tube with loose screw connection		
847	TA 06	Protection tube with displaceable threaded fitting on support tube [b]		
311	TA 20	Protection tube with loose screw connection and connection collar [b]		
872	TA 21	Protection tube with loose pressure screw and conical seal (only G 3/8 possible)		
873	TA 22	Protection tube with loose pressure screw, conical seal, and loose screw connection [b]		
401	TA 23	Protection tube with pressure screw and contact pressure spring (only M 10x1 possible)		
913	SH 07	Screw-in protection tube, multi-sectional, with clamping piece and fixing screw (suitable for TF 01 and TF 11)		
820	SH 09	Weld-in protection tube, multi-sectional, with clamping piece and fixing screw[b] (not for FL 21 – welding collar with steel 1.4515)		
876	SH 10	Screw-in protection tube, multi-sectional[b] (suitable for TA 21)		
871	SH 11	Screw-in protection tube, multi-sectional[b] (suitable for TA 21)		

[a] For the description and special features refer to data sheet 608730.
[b] Screw-in spigot according to DIN 3852, form A.

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
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Order code	(7)	Ø Process connection (PC) [a]
6		6 mm
8		8 mm
10		10 mm
11		11 mm
12		12 mm

	(8)	Thread type of process connection (PC)[a]
000		Without thread (for TA 01 and TF 11)
103		Screw connection G 3/8
104		Screw connection G 1/2
105		Screw connection G 3/4
114		Screw connection M 10 x 1 (only with TA 23 and SH 11)

	(9)	Material, probe / support tube [a]
26		Stainless steel (CrNi, 1.4571)
96		Copper (Cu) / Brass (CuZn) (up to 200°C)
95		Stainless steel (CrNi, 1.4571) - probe / Brass (CuZn) - support tube from 250°C)

	(10)	Material of process connection (PC)[a]
00		Without (only TF 01 and TF 11)
26		Stainless steel (CrNi, 1.4571)
46		Brass (CuZn)

	(11)	Insertion length, process connection (PC) [a] (dimension "EL" or "S")
0		Minimum insertion length TF 11 (active probe dimension)
50		50 mm
100		100 mm
150		150 mm
200		200 mm
. . .		Special length (specifications in plain text – 50 mm increments)

[a] For the description and special features refer to data sheet 608730.

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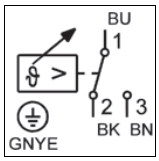
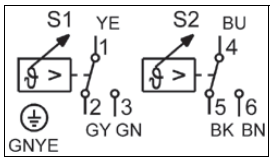
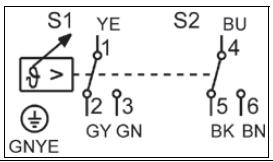
Order code	(12)	Switching output	
28		1 switch	
27		2 switches	
19		2 switches in fixed sequence	

	(13)	Extra codes (TZ)
000		Without extra code
434		Drag indicator can be adjusted with a screwdriver, protected by a cover
650		Microswitch 10 (3) A (AC/DC 230 V, +10/-15%, 48 to 63 Hz, cos φ = 1 (0.6))
518		Stop for Min. — or Max. — setpoint value limitation, default setting
522		Customized scale

Special versions upon request!

Order code

(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)		(13)	
608523	/	....	-	...	-	..	-	....	-	...	-	..	-	...	-	..	-	..	-	...	-	..	/	...	, ...

Order example

608523 / 2010 - 818 - 21 - 2000 - 750 - 10 - 000 - 26 - 00 - 100 - 28 / 000[a] , ...

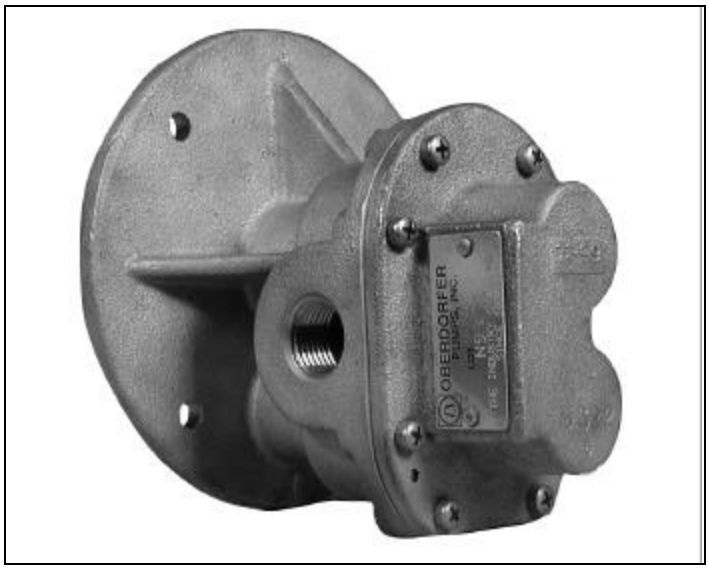
[a] List extra codes in sequence, separated by commas.

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

OBERDORFER PUMPS
A Subsidiary of Thomas Industries Inc.

MODEL N994 SERIES

MODEL N994 - 1/2" NPT PORTS



FEATURES

- **n** Bronze Construction with Stainless Steel Shafts
- **n** Helical gears for quiet operation
- **n** Easy Field Assembly to Motors
- **n** Self-Lubricating Carbon Bearings
- **n** O-ring seal for maximum leak protection

GENERAL DESCRIPTION

Pump housings and gears are made of top quality bronze, shafts are stainless steel 303. Bearings are made of high performance carbon-graphite material selected for wear resistance and long service life.

Gear pumps are positive displacement pumps. Each shaft revolution displaces a definite amount of liquid relatively unaffected by the back pressure in the discharge line. Shaft speed and flow are directly proportional.

DRIVE ARRANGEMENT

Close coupled pumps are mounted directly to the electric motor by means of a suitable adapter bracket. The pump drive shaft is connected to the motor shaft by a flexible coupling.

LIQUIDS AND TEMPERATURE

These pumps are suitable for all liquids that are compatible with bronze. Most common liquids are water, oil, and mild chemicals in the pH-range of 4 to 11. Viscous liquids require reduced shaft speeds of 1150 RPM or lower. Consult factory.

Liquids containing solids, abrasives, powders or paint pigments are definitely not recommended for gear pumps. If abrasives are unavoidable, use a very low shaft speed. The recommended liquid temperature range is 32^{0}F to 140^{0}F for longest pump life. If more extreme temperature conditions exist, our factory should be consulted. Freezing of water-filled pumps can cause damage and must be avoided. Oils at low temperatures are very viscous requiring a lower speed or extra power.

PERFORMANCE

Water 70^0 F

1725 R.P.M.					Pump & Motor No.	
PSI	GPM	HP Req.	HP Motor	Motor Frame	Single Phase	Three Phase
0	10.5	0.50	1/2	56C	N994HJ45	N994HJ95
20	10.3	0.75	3/4	56C	N994HM26	N994HM95
40	10.1	0.9	1	56C	N994HN26	N994HN95
60	9.9	1.2	1 1/2	145TC	N994JT45	N994JT95
80	9.6	1.5	1 1/2	145TC	N994JT45	N994JT95
100	9.4	1.75	2	145TC	N994JW45	N994JW95
125*	9.2	2	2	145TC	N994JW45	N994JW95
150*	9	2.32	3	182TC	N994KY45	N994KY95

1150 R.P.M.					Pump & Motor No.	
PSI	GPM	HP Req.	HP Motor	Motor Frame	Single Phase	Three Phase
0	6.9	0.24	1/2	56C	N994HJ46	N994HJ96
20	6.6	0.29	1/2	56C	N994HJ46	N994HJ96
40	6.4	0.43	1/2	56C	N994HJ46	N994HJ96
60	6.1	0.58	3/4	56C	N994HM46	N994HM96
80	5.9	0.72	3/4	56C	N994HM46	N994HM96
100	5.6	0.93	1	145TC	N994JN46	N994JN96
125*	5.4	1.25	1 1/2	145TC	N994JT46	N994JT96
150*	5.2	1.63	2	184TC	N994KW46	N994KW96

*For pressures over 100 psi, the above selections are suitable for pumping fluids with lubricity (e.g. oils, polymers). Service life will decrease for fluids without lubricity (e.g. water, solvents).

SUCTION LIFT

As a general rule, the suction lift should be kept at an absolute minimum by placing the pump as close to the liquid source as possible. A gear pump in new condition can lift 20 feet of water in the suction line. A foot valve (preferably with built-in strainer) is recommended at the beginning of the suction line. For a first start-up, the pump should be primed to avoid dry running. Minimum size of the suction pipe is the size of the pump inlet port. For longer suction lines (over 3 feet), or for viscous liquids, the pipe size should be at least one size or two sizes larger than the pump inlet port.

ROTATION AND RELIEF VALVE

The relief valve is not intended to be a metering or flow control device. Its main purpose is to function as a discharge pressure relief when the spring tension is exceeded by the discharge pressure. Overheating can occur within 5-10 minutes if the discharge line is completely shut off for extended periods.

Unless otherwise specified, the pump motor unit is supplied by the factory for shaft rotation clockwise from shaft end. Reversing the motor rotation will reverse the "in" and "out" ports and also requires changing the relief valve location. The relief valve is always on the discharge side in this pump series. The factory pressure setting is 50 PSIG. To increase pressure, turn the relief valve adjusting screw in a clockwise direction.

To reverse single phase motors, find instructions on the inside of the junction box cover or on the name plate of the motor.

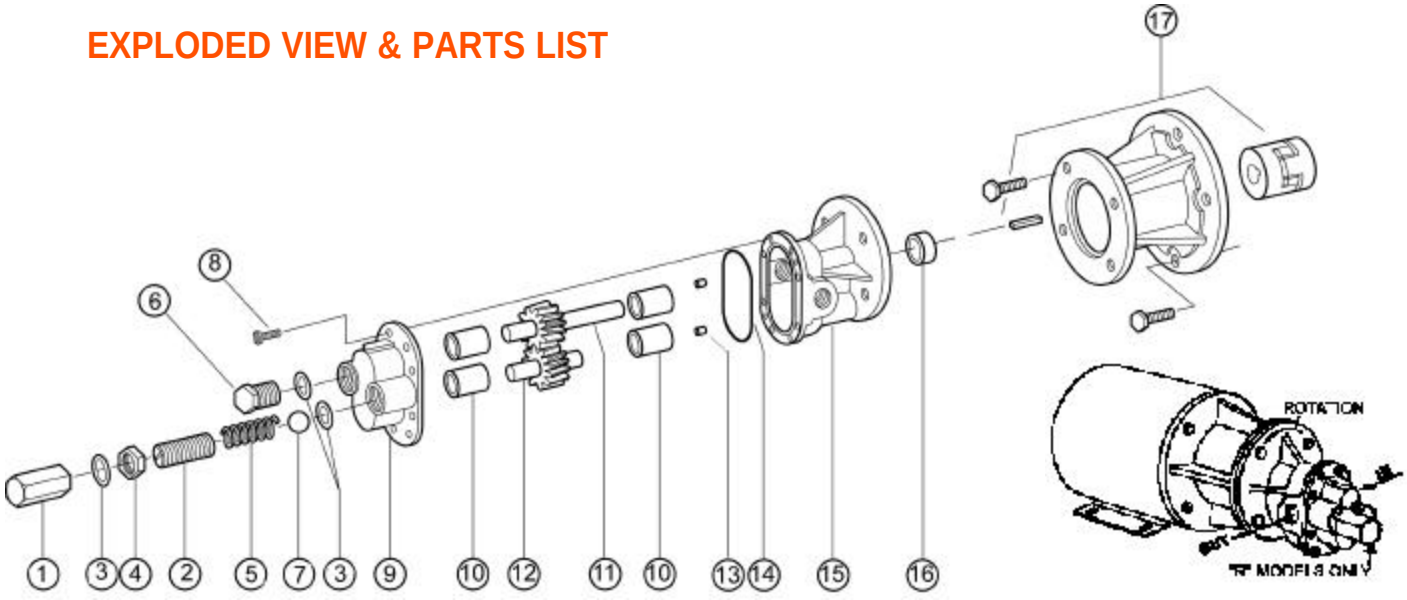
Three phase motors are not wired for any particular rotation. They can be reversed by interchanging any two (2) wires of the three (3) wire leads.

MODEL
N994
SERIES

BRONZE CLOSE COUPLED ROTARY GEAR PUMPS

OBERDORFER PUMPS
A Subsidiary of Thomas Industries Inc.

EXPLODED VIEW & PARTS LIST



Pump No.	1	2	3	4	5	6	7	8	9	10[1]	11[1]	12[1]	13	14[1]	15	16[1,2]	17
	Bypass Nut	Adj. Screw	Fiber Washer	Locknut	Spring	Plugnut	Ball	Screw	Cover	Bearing	Drive Gear Assy.	Idle Gear Assy.	Dowel Pin	O-Ring	Body	Lipseal	Adapter Kits
	1 Req'd	1 Req'd	3 Req'd	1 Req'd	1 Req'd	1 Req'd	1 Req'd	8 Req'd	1 Req'd	4 Req'd	1 Req'd	1 Req'd	2 Req'd	1 Req'd	1Req'd	1 Req'd	
N994	---	---	---	---	---	---	---	5385	9322NN5N	5091	33011	33008	8885	9797-041	9320ND2N	5463	See Below
N994R	5204	5200	6964	5209	5207	5205	5206	5385	9323NN5B	5091	33011	33008	8885	9797-041	9320ND2N	5463	

[1] Repair kits contain items 10, 11, 12, 14 & 16. Repair kit for N994(R) is 11333.

[2] Part # 5463 is standard Buna N, part #9997 is Viton(R)*-Teflon(R)*.

Adapter Kits

Adapter Kit	Part Number	Description
H	11299	56C Frame
J	11300	143TC/145TC
K	11301	182TC/184TC
L	11302	213TC/215TC

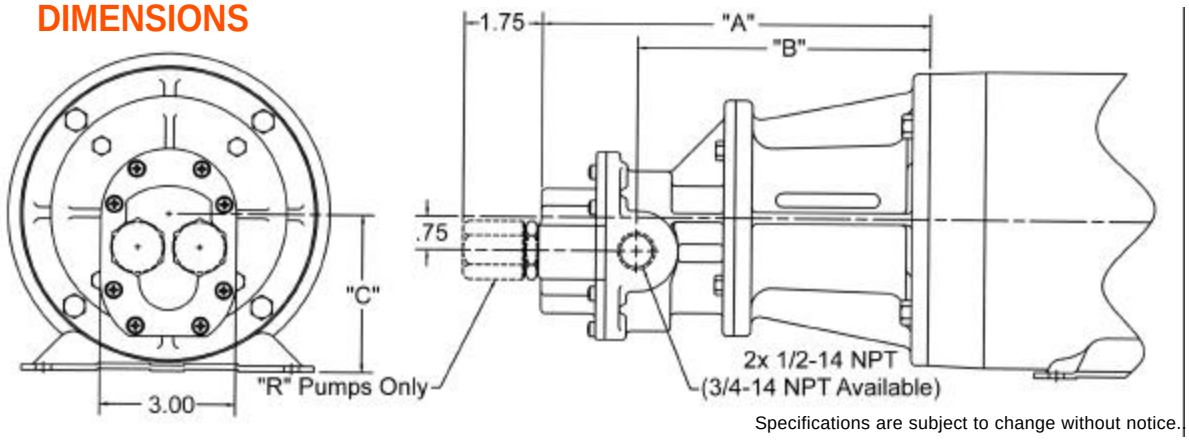
Variations

Pump Model	16[1,2] Lipseal	Description	Repair Kit
N994S15	9997	Viton(R)*-Teflon(R)*	12100
N994RS15	9997	Viton(R)*-Teflon(R)*	12100

Motor/Adapter Kit Dimensions (see below)

Model	Motor Frame	"A"	"B"	"C"
N994(R)H	56C	8.63	6.50	3.50
N994(R)J	143TC/145TC	8.63	6.50	3.50
N994(R)K	182TC/184TC	9.45	7.31	4.50
N994(R)L	213TC/215TC	9.45	7.31	5.25

DIMENSIONS



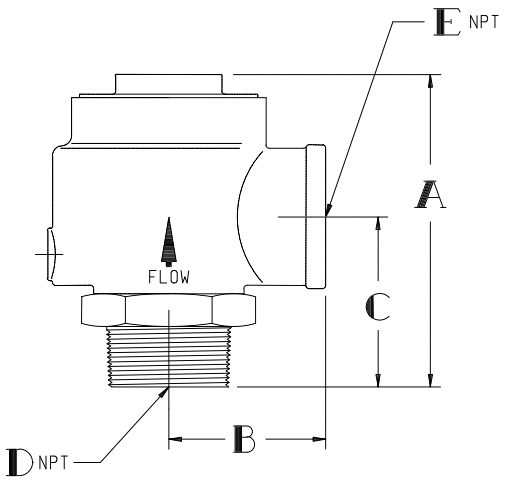
Specifications are subject to change without notice.

*Viton(R) or equivalent FKM will be used. Viton(R) is a trademark of DuPont Dow Elastomers.
Teflon(R) or equivalent PTFE will be used. Teflon(R) is a registered trademark of DuPont.

6/00

LTR	REVISION	DATE	DR	CH
A	REDRAWN WITH REVISIONS (ECN 2665)	8-22-97	SM	NF

M-D PART NUMBER	SEAT DIAMETER	VALVE SIZE	A ± 1/4	B ± 3/32	C ± 3/32	D NPT	E NPT	WEIGHT LBS
1362-6	2	2	7 1/4	3 1/4	3 1/4	2" MALE	2" FEMALE	8
1362-7	2 1/2	2 1/2	8	3 3/4	3 3/4	2 1/2" MALE	2 1/2" FEMALE	12
1362-8	3	3	9 1/2	4 1/4	4 1/4	3" MALE	3" FEMALE	19



NOTE:
SERVICE RECOMMENDATONS: AIR OR GAS. 22" HG AT 300°F

MATERIALS OF CONSTRUCTION:
BRONZE NOZZLE. DISC. GUIDE & SEAT.
SST SPRING.

INSTRUCTIONS:
1. AVOID OVERTIGHTENING OF VALVE DURING INSTALLATION.
2. VACUUM SETTING MAY BE VARIED APPROXIMATELY ± 10% OF ORIGINAL SETTING BY REMOVING AND LOOSENING THE FILLISTER HEAD MACHINE SCREW AND THEN RUNNING SCREW IN OR OUT AS DESIRED.
3. VALVE MAY BE CLEANED BY REMOVING DISC AND CLEANING SEAT SURFACE WITH A SOFT CLOTH. SEATING SURFACE MAY BE LAPPED IN CASE OF LEAKAGE BY USING A FINE GRIT COMPOUND.
4. REFER TO M-D SPRING DRAWING 1352S SERIES FOR VACUUMS FROM 1" HG TO 30" HG.
5. VALVE PRE-SET TO RECOMMENDED SPECIFICATIONS OF PURCHASE ORDER AT M-D PRIOR TO SHIPMENT.

VACUUM SET AT 130 H2O

TOLERANCES
.XX ± .
.XXX ± .
.XXXX ± .
ANGULAR ±
FRACTIONAL ±
CHAMFERS ± 2°

BREAK ALL SHARP EDGES AND CORNERS

DR SM 8-21-97
CH NF 9-12-97

FIRST USED ON

MATL P/N:
MATL:

TUTHILL Pneumatics Group Springfield, Missouri USA

VACUUM RELIEF VALVE

SIZE: B | 1362

SCALE: NONE | WT LBS | SHEET OF

Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

Dayton® Automatic Power Attic Roof Ventilator

Description

Dayton Automatic Power Attic Roof Ventilator are used to provide a high volume of air circulation for general cooling applications and remove high humidity air in attic area. Low sound levels for domestic or commercial applications. The metal dome is a weather proof powder coated galvanized steel that comply with UL standard UL507 wind test requirement. Stamped aluminum 6-blade propeller, 115V, 60 Hz motor has automatic reset thermal protection. The thermostat and humidistat allow setting the attic roof ventilator to operate at the desired temperature/humidity to remove high temperature/humidity attic air and keep the attic cool and dry. Motors are permanently lubricated.

All ventilators are UL and cUL listed and comply with UL507.

Figure 1 – Attic Roof Ventilator

Figure 2 – Control box

Unpacking

1. Inspect carefully for any signs of damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.

General Safety Information

⚠ WARNING ***To reduce the risk of fire, electric shock, or injury to persons, observe the following:***

1. All wiring must be in accordance with the National Electrical Code (ANSI/NFPA 70-1999) and local electrical code. Electrical installation should be performed by a qualified listed electrician.
2. Ensure that the power source conforms to the electrical requirements of the ventilator.

⚠ WARNING ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the ventilator. Failure to do so may result in fatal electrical shock.***

⚠ WARNING ***Do not insert fingers or foreign objects into the fan. Do not block or tamper with the fan in any manner while it is in operation.***

⚠ WARNING ***Do not touch motor. May be hot enough to cause injury.***

3. Fan is intended for general air venting ONLY. It must NOT be used in potentially dangerous locations such as flammable, explosive, chemical-laden, or wet atmospheres.

⚠ WARNING ***Unplug prior to servicing unit.***

4. Fan motor is equipped with an automatically resetting thermal protector that will disconnect power if the motor overheats. Always disconnect ventilator before removing guard, as motor may restart unexpectedly.
5. In cases in which property damage may result from malfunction of the ventilator, a suitable alarm (air switch, temperature sensor, etc.) should be used.
6. Do not operate any fan with a damaged electric connection. Discard ventilator or return to an authorized service facility for examination and/or repair.
7. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
8. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent excessive low air pressure and back drafting.Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), and the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and the local code authorities.
9. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.
10. Ducted fans must always be vented to the outdoors.
11. If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application and be connected to a GFCI (Ground Fault Circuit Interrupter) – protected branch circuit.

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Installation

LOCATION

1. Place the Attic Ventilator to the center of the rear slope of the roof will get the best effect to remove the hot and humidity air in the roof. It will also be invisible from the street. Make sure the location is free of obstacles like TV atenna, Electric lines...etc before installation.

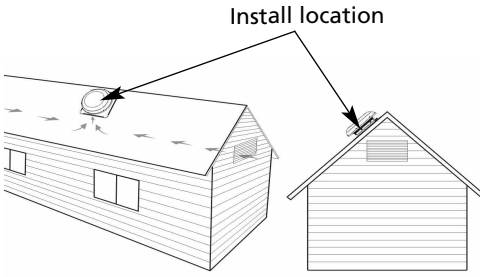


Figure 3 – Location & Air intake opening

2. Go to attic and find the central location in the attic. Put a nail on the roof that go through the other side of the roof board by a hammer. It will use as a center location of the Attic fan.

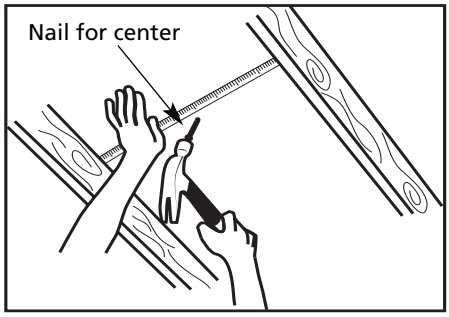


Figure 4 – Put a nail go throught the roof board as a center point

3. Go to the roof, use template to mark and cut the shingles and remove them all.

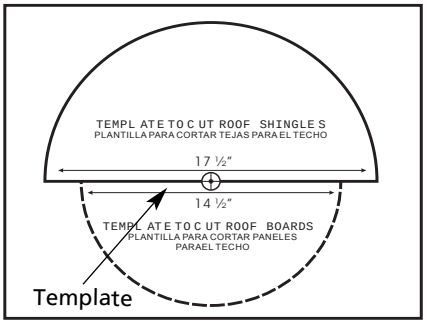
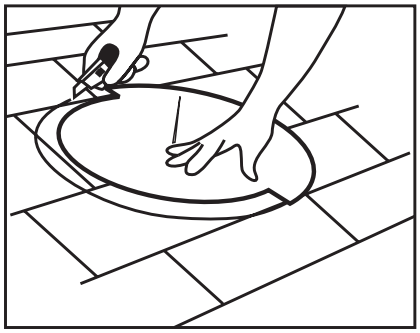
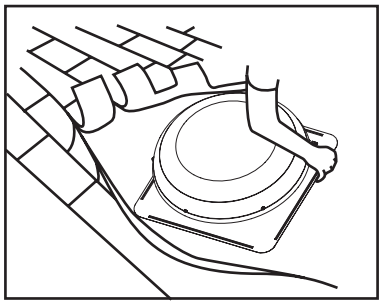


Figure 5 – Template for shingle & roof board marking and cutting





4. Trail the line and use a Reciprocating saw to cut a hole for air intake of the attic fan

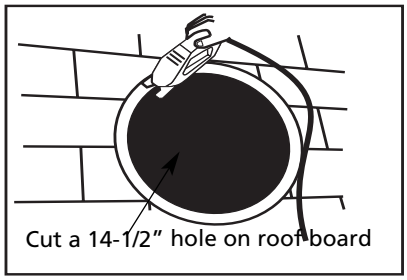
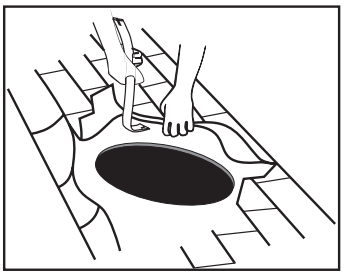
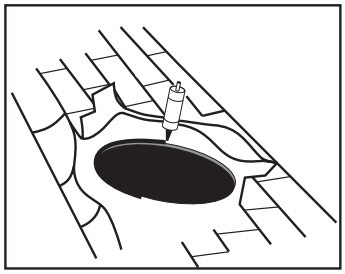


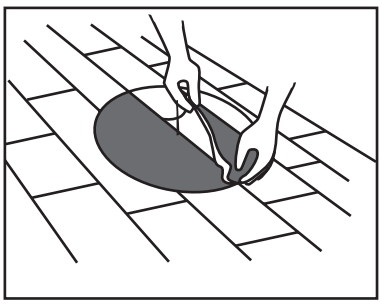
Figure 6 – Cut the air intake hole

5. Use the prying bar to move the shingles around the holes for lay down the attic fan. Try to preserve the shingle becasue you need to put back the shingle after lay down the attic fan.

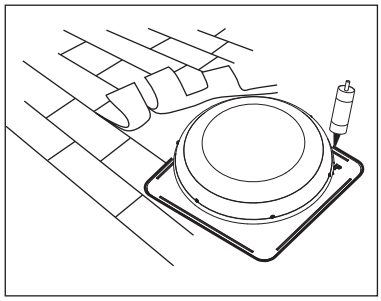


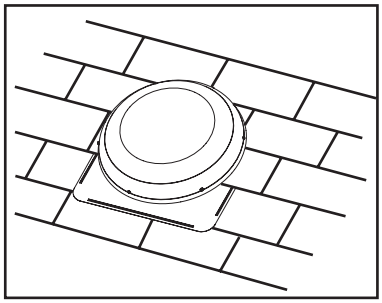


6. Place attic Fan - Apply caulk on the roof board around the holes and lay down the attic fan on the hole. Secure the attic fan by nailing the roof nails around the flange of the attic fan. Then apply caulk again around the base of the attic fan to seal, put back the shingles.Seal the flange and shringle by non-hardening sealant.



Models 10N201, 10N202 and 10N203





7. After secure the roof ventilator unit. Go inside to the attic. Secure the control box of 10N202 onto the rafter adjacent to the unit before wire connection.

Remark: The control box of 10N201 with thermostat only was mounted on the unit directly.

⚠ WARNING ***Consult a licensed electrician for wiring.***

Figure 7 – Control box of 10N201 was mounted on the base.

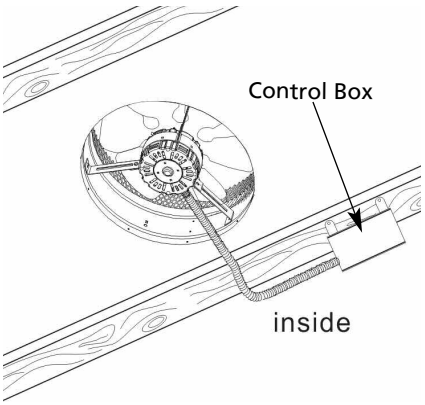


Figure 8 – Mount the control box of 10N202 on the adjacent rifter

8. Connect the Black and White wire line out from the control box to the electric lines controlled by a master On/Off switch as shown in the wiring diagram in Fig 9 for 10N201 and Fig.10 for 10N202.

⚠ WARNING ***Turn off the master switch prior to servicing unit.***

To avoid personal injury, wall switch must be turn off before servicing since the built-in theraml protection may turn on the circulator automatically.

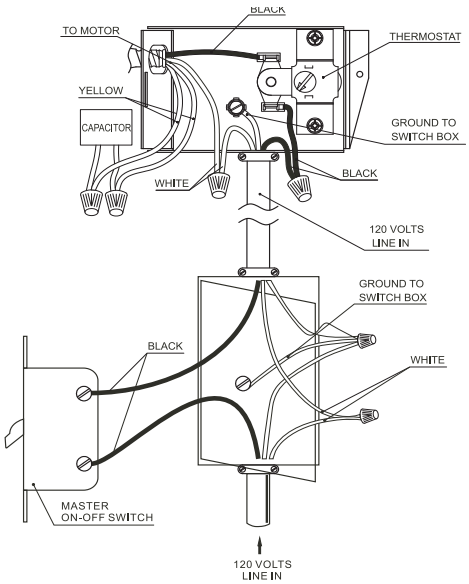


Figure 9 – Wiring Diagram for wire connection of 10N201

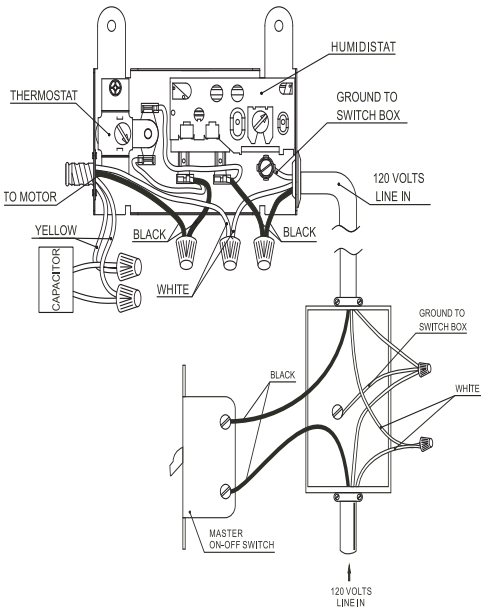


Figure 10 – Wiring Diagram for wire connection of 10N202

Operation

Please set the Thermostat and/or Humidistat to desired condition before operated, using screw driver to turn the arrow of the knob to the desire temperature/humidity mark on the panel of the control box.

Maintenance

⚠ WARNING ***Parts replacement and troubleshooting to be performed only by qualified personnel.***

⚠ WARNING ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the vetilator. Failure to do so may result in fatal electrical shock.***

⚠ CAUTION ***Do not use gasoline, benzene, thinner, harsh cleaners, etc., which are dangerous and will damage the air circulator.***

⚠ WARNING ***Turn off the master switch before servicing or cleaning.***

⚠ WARNING ***The thermostat + humidistat 10N203 control box is to be used only with Dayton attic ventilators.***

CLEANING

The propeller and motor should be cleaned periodically to prevent overheating, and/or operating in an imbalanced condition.

If cleaning requires the removal of the dome, remove only the top dome and re-install when finished in its originally installed position.

Do not repair propeller if it becomes damaged. The propeller is accurately balanced at the factory and should be replaced if damaged. Motor is permanently lubricated.

Notes

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

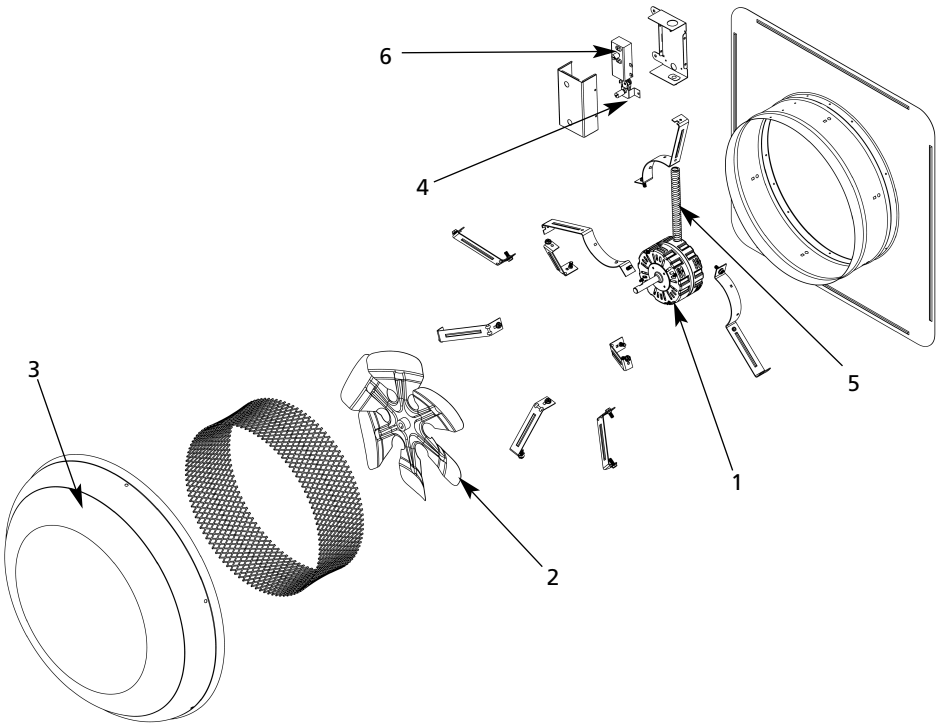


Figure 13 – Repair Parts Illustration for Automatic Power Attic Roof Ventilator

Repair Parts List for Automatic Power Attic Roof Ventilator

Reference Number	Description	Part Number for Models: 10N201	10N202	Quantity
1	Motor	VESP127416DG	VESP127416DG	1
2	Blade	VEVRM150300G	VEVRM150300G	1
3	Dome	VEVRM150001G	VEVRM150001G	1
4	Thermostat	VEVRM150420G	VEVRM150420G	1
5	Flexible Conduit	VEVRM150009G	VEVRM150009G	1
6	Humidistat		VEVRM150009G	1

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Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Unit fails to operate	1. Blown fuse or open circuit breaker 2. No power 3. Defective motor	1. Replace fuse or reset circuit breaker 2. Contact power company 3. Replace unit; motor is not field serviceable
Excessive vibration	1.Propeller imbalance due to accumulation of dirt, etc.	1. Clean propeller

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® AUTOMATIC POWER ATTIC ROOF VENTILATOR, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

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Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

Manufactured for Dayton Electric Mfg. Co.
Niles, Illinois 60714 U.S.A.

Por favor lea y guarde estas instrucciones. *Léalas cuidadosamente antes de tratar de montar, instalar, operar o dar mantenimiento al producto aquí descrito. Protéjase usted mismo y a los demás observando toda la información de seguridad. ¡El no cumplir con las instrucciones puede ocasionar daños, tanto personales como a la propiedad! Guarde estas instrucciones para referencia en el futuro.*

Ventilador automático de techo del ático de Dayton®

Descripción

El ventilador automático de techo del ático de Dayton se utiliza para proporcionar un alto volumen de circulación de aire para las aplicaciones de refrigeración y eliminar el aire de alta humedad en el área del ático. Los bajos niveles de ruido son ideales para aplicaciones domésticas o comerciales. La cúpula de metal es resistente a mal tiempo con recubrimiento de polvo de acero galvanizado que cumplen con el requisito de la prueba de viento de las normas UL UL507. La hélice de 6 palas es de aluminio estampado, y motor automático de 115 V, 60 Hz tiene la protección térmica de reposición. El termostato y el higrostato permiten que el ventilador de techo del ático funcione a la humedad/la temperatura deseada para quitar la alta temperatura / humedad del aire del ático y mantener elático fresco y seco. Los motores están permanentemente lubricados.

Todos los ventiladores son UL y cUL listados y cumplen con UL507.

Figura 1 – Ventilador de techo del ático

Figura 2 – Caja de control

Desempaque

1. Inspeccione el producto cuidadosamente para verificar si se han producido daños durante el transporte.
2. Si han ocurrido daños durante el envío, se deberá presentar un reclamo a la compañía de transporte.

Información de Seguridad General

⚠ ADVERTENCIA ***Para reducir el riesgo de incendio, una sacudida eléctrica o lesiones a personas, observe lo siguiente:***

1. Todos los cableados deben estar de acuerdo con el Código Eléctrico Nacional (ANSI / NFPA 70-1999) y el código eléctrico local.La instalación eléctrica debe ser realizada por un electricista calificado.
2. Asegúrese que la fuente de alimentación satisfaga los requisitos eléctricos del ventilador.

⚠ ADVERTENCIA ***No dependa de un interruptor como único medio de desconectar la alimentación eléctrica cuando instale o le dé servicio al ventilador. Si no lo hace, podría sufrir un choque eléctrico fatal.***

⚠ ADVERTENCIA ***No inserte sus dedos ni objetos extraños en el ventilador. No bloquee ni altere el ventilador en forma alguna mientras está funcionando.***

3. El ventilador está diseñado UNICAMENTE para la circulación general del aire. NO debe utilizarse en lugares posiblemente peligrosos, tales como áreas donde haya productos inflamables, explosivos o químicos o en ambientes húmedos. No use el ventilador en o cerca de una ventana, ya que la lluvia podría crear un peligro eléctrico. No conecte conductos en el ventilador.

⚠ ADVERTENCIA ***Desenchúfelo antes de darle servicio a la unidad.***

4. El motor del ventilador está equipado con un protector térmico de restablecimiento automático que desconectará la alimentación eléctrica si el motor se sobrecalienta. Siempre desenchufe el ventilador antes de quitarle la rejilla ya que el motor podría arrancar inesperadamente.
5. En los casos donde podrían ocurrir daños a la propiedad debido a un mal funcionamiento del ventilador, se debe utilizar una alarma adecuada (interruptor de aire, sensor de temperatura, etc.).
6. No opere ningún aparato con un cable o enchufe dañado. Deseche el ventilador o el retorno a un centro de servicio autorizado para su revisión y / o reparación.
7. El trabajo de instalación y el cableado eléctrico debe ser realizado por personal cualificado (s) de acuerdo con todos los códigos y normas aplicables, incluyendo la construcción resistente al fuego.
8. Suficiente aire es necesario para la combustión y escape adecuados de los gases de combustión a través de la chimenea del equipo de la quema de combustible para prevenir la presión del aire baja y la redacción de nuevo. Siga el equipo de calefacción fabricante de referencia y normas de seguridad tales como los

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Ventilador automático de techo del ático de Dayton®

publicados por la Asociación Nacional de la Protección de Fuego (NFPA), y la Sociedad Americana de Calefacción, Refrigeración y Aire Acondicionado Ingenieros Acondicionado (ASHRAE), y las autoridades del código local.

9. Cuando corte o perfore una pared o el techo, no dañe el cableado eléctrico y otros equipamientos ocultos.
10. Ventiladores con conductos deben siempre tener ventilación hacia el exterior.
11. Si esta unidad se va a instalar sobre más de una bañera o ducha, debe estar marcado adecuado para la aplicación y conectarse a un GFCI (Ground Fault Circuit Interruptor) - rama protegida de circuito.

Información localización

1. Colocar el Ventilador del Ático en el centro de la ladera posterior del techo conseguirá el mejor efecto para quitar el aire caliente y la humedad en el techo. También será visible desde la calle. Asegúrese de que el lugar está libre de obstáculos como la antena de televisión, líneas eléctricas ... etc antes de la instalación.

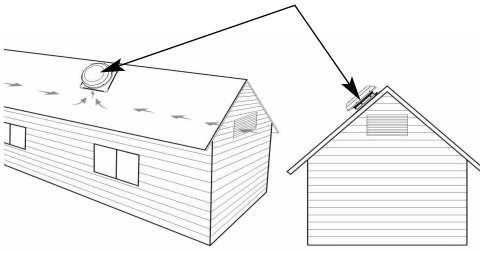


Figura 3 – Localización y apertura de entrada de aire

2. Vaya al ático y busque la ubicación central en el ático. Ponga un clavo en el techo que pasa por el otro lado de la placa del techo con un martillo. Se utilizará como la ubicación central del ventilador de ático.

Figure 4 – Ponga un clavo que pasa por la placa del techo como un punto central

3. Vaya a la azotea, use la plantilla para marcar y cortar las tejas y elimine todos.

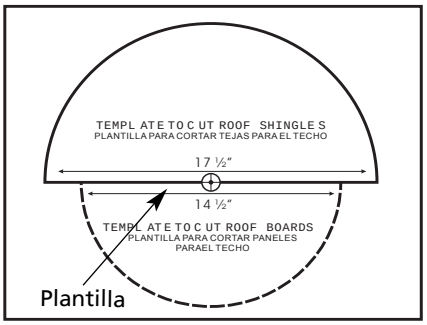
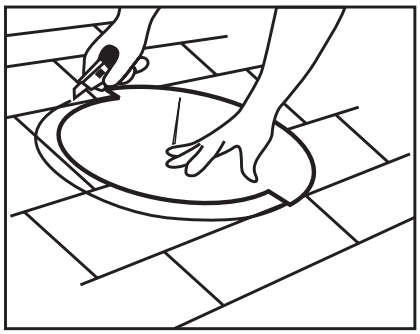
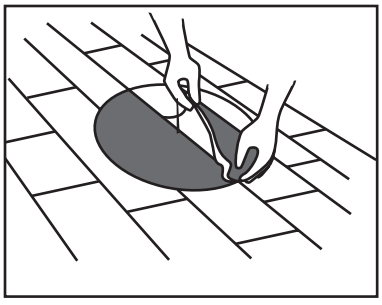


Figure 5 – Plantilla para el marcado y corte de la teja y placa de techo

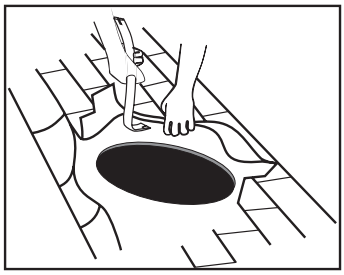


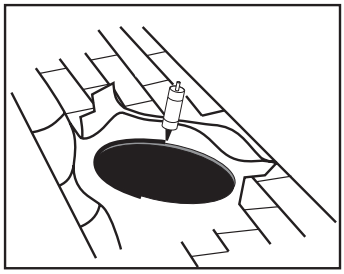


4. Siga la línea y use una sierra de sable para cortar un agujero para la entrada de aire del ventilador de ático.

Figure 6 – Corte el orificio de entrada de aire

5. Utilice la barra de palanca para mover las tejas alrededor de los agujeros para fijar el ventilador de ático. Trate de preservar la teja porque es necesario volver a poner la teja después de fijar el ventilador de ático.





6. Colocar el Ventilador del ático - Aplique masilla en la placa del techo alrededor de los agujeros y fije el ventilador de ático en el agujero. Asegure el ventilador del ático clavando los clavos del techo alrededor de la brida del ventilador del ático. A continuación, aplique

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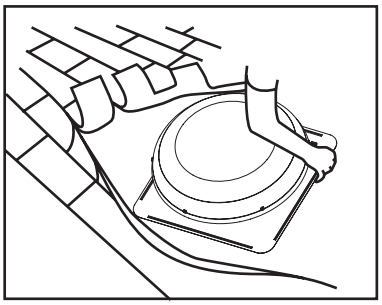
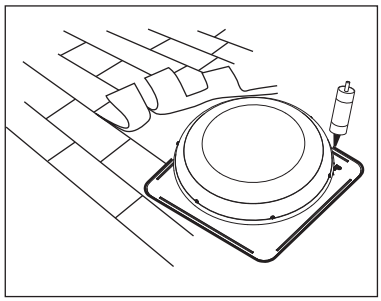
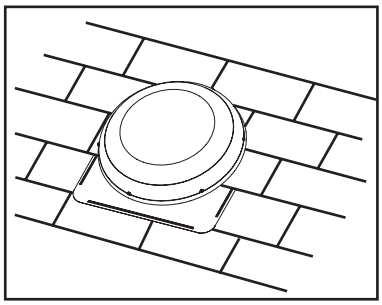
Modelos 10N201, 10N202 and 10N203

masilla de nuevo alrededor de la base del ventilador del ático para sellar, ponga de nuevo las tejas. Selle la brida y teja por sellador no endurecido.







7. Después de asegurar la unidad de ventilador de techo, vaya al interior del ático. Asegure la caja de control de 10N202 en la viga adyacente a la unidad antes de la conexión de cable.

Nota: La caja de control de 10N201 con termostato sólo fue montado en la unidad directamente.

⚠ ADVERTENCIA ***Consulte a un electricista con licencia para el cableado.***

Figure 7 – La caja de control de 10N201 fue montada en la base.

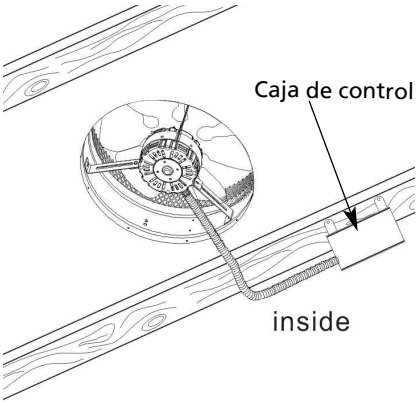


Figure 8 – Monte la caja de control de 10N202 en la viga adyacente

8. Conecte el cable Blanco y Negro desde la caja de control a las líneas eléctricas controladas por un interruptor principal de Encendido / Apagado como se muestra en el diagrama de cableado en la Figura 9 para 10N201 y Figura 10 para 10N202.

⚠ ADVERTENCIA ***Apague el interruptor principal antes de hacer el mantenimiento a la unidad. Para evitar lesiones personales, el interruptor de pared debe desactivarse antes de hacer el mantenimiento,porque la protección térmica incorporada puede activar el circulador de forma automática.***

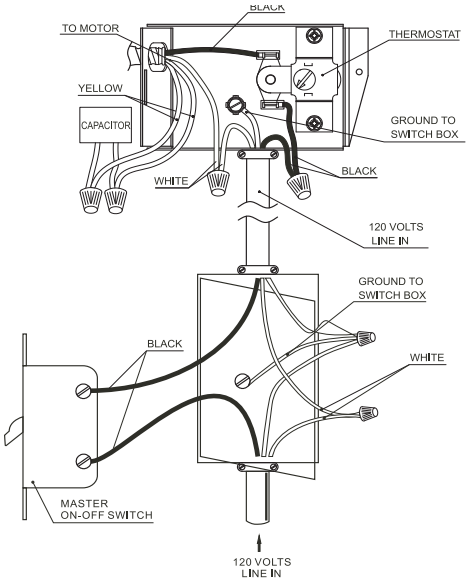


Figure 9 – Diagrama de cableado para la conexión del cable de 10N201

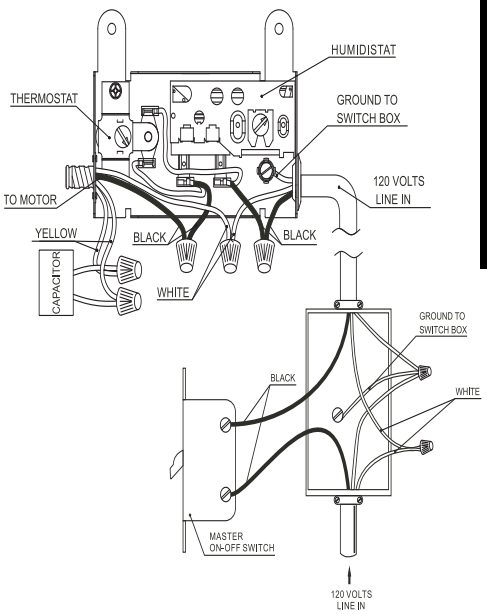


Figure 10 – Diagrama de cableado para la conexión del cable de 10N202

Operación

Por favor ajuste el Termostato y/o Humidistato a condición deseada antes de operar, utilizando un destornillador para girar la flecha de la perilla a la marca de temperatura / humedad deseada en el panel de la caja de control.

ESPAÑOL

Mantenimiento

⚠ ADVERTENCIA ***Todo reemplazo de partes y toda identificación y solución de problemas deberán ser realizados únicamente por personal calificado.***

⚠ ADVERTENCIA ***No dependa de un interruptor como único medio de desconectar la alimentación eléctrica cuando instale o le dé servicio al ventilador. Si no lo hace, podría sufrir un choque eléctrico fatal.***

⚠ PRECAUCION ***No utilice gasolina, benceno, diluyente, limpiadores duros, etc., ya que son peligrosos y le ocasionarán daños al circulador de aire.***

⚠ ADVERTENCIA ***Apague el interruptor principal antes de mantenimiento o limpieza.***

El termostato + higrostato 10N203 caja de control se va a utilizar sólo con ventiladores Dayton ático.

LIMPIEZA

La hélice, la rejilla y el motor se deben limpiar periódicamente para evitar el sobrecalentamiento, y/o el funcionamiento en condición desequilibrada.

Si la limpieza requiere la remoción de una rejilla, remueva sólo la protección frontal y vuelva a instalarla en la posición original cuando termine de limpiar. No repare la hélice si se daña. La hélice se equilibra en forma precisa en la fábrica y se debe reemplazar si se daña.

El motor está permanentemente lubricado.

Notas

ESPAÑOL

Para Obtener Partes de Reparación en México Llame al 001-800-527-2331 en EE.UU. Llame al 1-800-323-0620

Servicio permanente – 24 horas al día al año

Por favor proporciónenos la siguiente información:
-Número de modelo
-Número de serie (si lo tiene)
-Descripción de la parte y número que le corresponde en la lista de partes

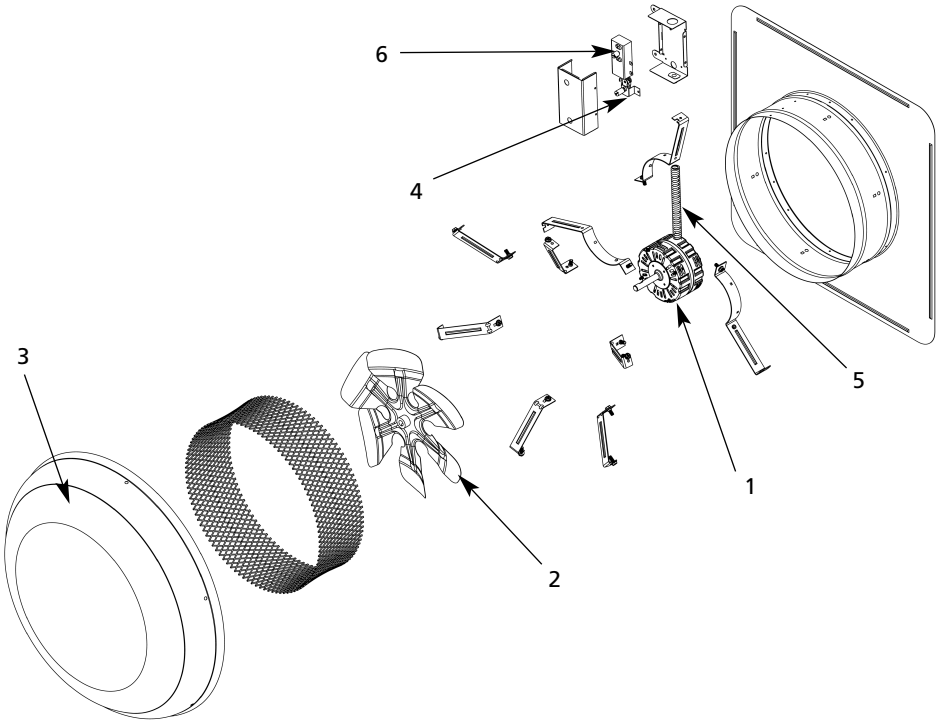


Figura 13 – Ilustración de las Partes de Reparación para los Ventilador automático de techo del ático

Lista de Partes de Reparación para los Ventilador automático de techo del ático

Número de Referencia	Descripción	Número de Parte para Modelos: 10N201	10N202	Cantidad
1	Motor	VESP127416DG	VESP127416DG	1
2	Hoja	VEVRM150300G	VEVRM150300G	1
3	Cúpula	VEVRM150001G	VEVRM150001G	1
4	Termostato	VEVRM150420G	VEVRM150420G	1
5	Conductos / flexibles	VEVRM150009G	VEVRM150009G	1
6	Humidistato		VEVRM150009G	1

ESPAÑOL

Ventilador automático de techo del ático de Dayton®

Tabla de Identificación de Problemas

Síntoma	Causa(s) Posible(s)	Medida Correctiva
La unidad no funciona	1. Fusible o cortacircuitos abierto o quemado	1. Reemplace el fusible o reinicie el cortacircuitos
	2. No hay alimentación	2. Comuníquese con la empresa de energía eléctrica
	3. Motor defectuoso	3. Reemplace la unidad; al motor no se le puede hacer servicio en campo
Vibración excesiva	1. Hélice desequilibrada debido a acumulaciones de suciedad, etc.	1. Limpie la hélice

ESPAÑOL

GARANTIA LIMITADA

GARANTIA LIMITADA DE DAYTON POR UN AÑO. *DAYTON ELECTRIC MFG. CO. (DAYTON) LE GARANTIZA AL USUARIO ORIGINAL QUE LOS MODELOS TRATADOS EN ESTE MANUAL DE LOS VENTILADOR AUTOMÁTICO DE TECHO DEL ÁTICO DAYTON® ESTAN LIBRES DE DEFECTOS EN LA MANO DE OBRA O EL MATERIAL, CUANDO SE LES SOMETE A USO NORMAL, POR UN AÑO A PARTIR DE LA FECHA DE COMPRA. CUALQUIER PARTE QUE SE HALLE DEFECTUOSA, YA SEA EN EL MATERIAL O EN LA MANO DE OBRA, Y SEA DEVUELTA (CON LOS COSTOS DE ENVIO PAGADOS POR ADELANTADO) A UN CENTRO DE SERVICIO AUTORIZADO DESIGNADO POR DAYTON, SERA REPARADA O REEMPLAZADA (NO EXISTE OTRA POSIBILIDAD) SEGUN LO DETERMINE DAYTON. PARA OBTENER INFORMACION SOBRE LOS PROCEDIMIENTOS DE RECLAMO CUBIERTOS EN LA GARANTIA LIMITADA, VEA LA SECCION "ATENCION OPORTUNA" QUE APARECE MAS ADELANTE. ESTA GARANTIA LIMITADA CONFIERE AL COMPRADOR DERECHOS LEGALES ESPECIFICOS QUE VARIAN DE JURISDICCION A JURISDICCION.*

LIMITES DE RESPONSABILIDAD. *EN LA MEDIDA EN QUE LAS LEYES APLICABLES LO PERMITAN, LA RESPONSABILIDAD DE DAYTON POR LOS DAÑOS EMERGENTES O INCIDENTALES ESTA EXPRESAMENTE EXCLUIDA. LA RESPONSABILIDAD DE DAYTON EXPRESAMENTE ESTA LIMITADA Y NO PUEDE EXCEDER EL PRECIO DE COMPRA PAGADO POR EL ARTICULO.*

EXCLUSION DE RESPONSABILIDAD DE LA GARANTIA. *SE HAN HECHO ESFUERZOS DILIGENTES PARA PROPORCIONAR INFORMACION E ILUSTRACIONES APROPIADAS SOBRE EL PRODUCTO EN ESTE MANUAL; SIN EMBARGO, ESTA INFORMACION Y LAS ILUSTRACIONES TIENEN COMO UNICO PROPOSITO LA IDENTIFICACION DEL PRODUCTO Y NO EXPRESAN NI IMPLICAN GARANTIA DE QUE LOS PRODUCTOS SEAN VENDIBLES O ADECUADOS PARA UN PROPOSITO EN PARTICULAR NI QUE SE AJUSTAN NECESARIAMENTE A LAS ILUSTRACIONES O DESCRIPCIONES. CON EXCEPCION DE LO QUE SE ESTABLECE A CONTINUACION, DAYTON NO HACE NI AUTORIZA NINGUNA GARANTIA O AFIRMACION DE HECHO, EXPRESA O IMPLICITA, QUE NO SEA ESTIPULADA EN LA "GARANTIA LIMITADA" ANTERIOR.*

Consejo Técnico y Recomendaciones, Exclusiones de Responsabilidad. *A pesar de las prácticas, negociaciones o usos comerciales realizados previamente, las ventas no deberán incluir el suministro de consejo técnico o asistencia o diseño del sistema. Dayton no asume ninguna obligación o responsabilidad por recomendaciones, opiniones o consejos no autorizados sobre la elección, instalación o uso de los productos.*

Adaptación del Producto. *Muchas jurisdicciones tienen códigos o regulaciones que rigen la venta, la construcción, la instalación y/o el uso de productos para ciertos propósitos que pueden variar con respecto a los aplicables a las zonas vecinas. Si bien se trata de que los productos Dayton cumplan con dichos códigos, no se puede garantizar su conformidad y no se puede hacer responsable por la forma en que se instale o use su producto. Antes de comprar y usar el producto, revise su aplicación y todos los códigos y regulaciones nacionales y locales aplicables y asegúrese de que el producto, la instalación y el uso los cumplan.*

Ciertos aspectos de limitación de responsabilidad no se aplican a productos al consumidor; es decir (a) algunas jurisdicciones no permiten la exclusión ni limitación de daños incidentales o consecuentes, de modo que las limitaciones o exclusiones anteriores quizás no apliquen en su caso; (b) asimismo, algunas jurisdicciones no permiten limitar el plazo de una garantía implícita, por lo tanto, la limitación anterior quizás no aplique en su caso; y (c) por ley, mientras la Garantía Limitada esté vigente no podrán excluirse ni limitarse en modo alguno ninguna garantía implícita de comercialización o de idoneidad para un propósito en particular aplicables a los productos al consumidor adquiridos por éste.

Atención Oportuna. *Se hará un esfuerzo de buena fe para corregir puntualmente, o hacer otros ajustes, con respecto a cualquier producto que resulte defectuoso dentro de los términos de esta garantía limitada. En el caso de que encuentre un producto defectuoso y que esté cubierto dentro de los límites de esta garantía haga el favor de escribir primero, o llame, al distribuidor a quien le compró el producto. El distribuidor le dará las instrucciones adicionales. Si no puede resolver el problema en forma satisfactoria, escriba a Dayton a la dirección a continuación, dando el nombre del distribuidor, su dirección, la fecha y el número de la factura del distribuidor y describa la naturaleza del defecto. La propiedad del artículo y el riesgo de pérdida pasan al comprador en el momento de la entrega del artículo a la compañía de transporte. Si el producto se daña durante el transporte, debe presentar su reclamo a la compañía transportista.*

Fabricado para Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 EE.UU.

Fabricado para Dayton Electric Mfg. Co.
Niles, Illinois 60714 EE.UU.

Veuillez lire et conserver ces instructions. *Lire attentivement avant de commencer à assembler, installer, faire fonctionner ou entretenir l'appareil décrit. Protégez-vous et les autres en observant toutes les informations sur la sécurité. Négliger d'appliquer ces instructions peut résulter en des blessures corporelles et/ou en des dommages matériels ! Conserver ces instructions pour références ultérieures.*

Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

Description

Le Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton est utilisé pour fournir un grand volume de circulation de l'air pour des applications de refroidissement générales et pour enlever l'air de humidité élevé dans le secteur de grenier. Niveaux sonores bas pour des applications commerciales ou domestiques. Le dôme en métal est un acier galvanisé enduit par poudre imperméable qui sont conforme à la condition d'essai du vent UL507. Estampé en aluminium 6-pale d'hélice, le moteur de 60 hertz, 115V, a la protection thermique de remise automatique. Le thermostat et l'hygrostat permet de régler le ventilateur de grenier pour fonctionner à la température/humidité désirées pour enlever l'air de grenier de température/humidité et pour maintenir le grenier frais et le grenier sec. Des moteurs sont lubrifiés en permanence.

Tous les ventilateurs sont UL et cUL énumérés et sont conformes à UL507.

Figure 1 – Ventilateur de grenier sur le toit

Figure 2 – Boîtier de contrôle

Déballage

1. Vérifier soigneusement qu'aucun dommage n'est survenu durant le transport.
2. Toute réclamation pour des dommages pendant le transport doit être soumise au transporteur.

Informations générales sur la sécurité

⚠ AVERTISSEMENT ***Pour reduire le risque du feu, la décharge électrique, ou blessures corporelles, observer ce qui suit***

1. Tout le câblage doit être conforme au Code Electrique National (ANSI/NFPA 70-1999) et au code électrique local. L'installation électrique devrait être effectuée par un électricien qualifié listé.
2. S'assurer que la source d'alimentation est conforme aux exigences électriques du ventilateur.

⚠ AVERTISSEMENT ***Ne pas dépendre d'un quelconque interrupteur comme moyen unique de coupure de l'alimentation lors de l'installation ou de l'entretien du ventilateur. Le fait de négliger cette consigne peut entraîner une décharge électrique fatale.***

⚠ AVERTISSEMENT ***Ne pas insérer les doigts ou des corps étrangers dans le ventilateur. Ne pas bloquer ou manipuler le ventilateur d'une quelconque manière pendant son fonctionnement.***

3. Le ventilateur est conçu pour la circulation générale de l'air SEULEMENT. Il ne doit PAS être utilisé dans des endroits potentiellement dangereux comme des atmosphères inflammables, explosives, chargées de produits chimiques ou humides. Ne pas utiliser le ventilateur dans ou à proximité d'une fenêtre, car la pluie peut créer un risque de choc électrique. Ne pas raccorder de conduit au ventilateur.

⚠ AVERTISSEMENT ***Débrancher avant de réparer l'appareil.***

4. Le moteur du ventilateur est équipé d'une protection thermique à réenclenchement automatique qui coupe l'alimentation au moteur en cas de surchauffe. Toujours débrancher le ventilateur avant d'enlever la protection, car le moteur peut redémarrer subitement.
5. Dans les cas où des dommages à la propriété peuvent survenir suite à une anomalie de fonctionnement du ventilateur, utiliser une alarme qui convient (disjoncteur à l'air libre, capteur de température, etc.).
6. Ne pas utiliser un ventilateur avec un cordon ou une fiche endommagé. fan Jeter ou retourner à un centre de service autorisé pour examen et / ou réparation.
7. Les travaux d'installation et le câblage électrique doivent être faits par les personnes qualifiées selon tous les codes et normes applicables, y compris la construction coupe-feu.
8. Suffisamment d'air est nécessaire pour la combustion et l'épuisement appropriés des gaz par la conduite (cheminée) de l'équipement brûlant de carburant pour éviter trop faible pression d'air et le dos rédaction. Suivre les directives du fabricant d'équipement de chauffage et les

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Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

normes de sécurité comme ceux édités par l'Association Nationale de Protection du Feu (NFPA),et Société Americaine pour Chauffage, Réfrigération et Air conditionnement (ASHRAE),et les normes stipulées par l'autorite locale.

9. Quand la coupure ou le forage dans le mur ou le plafond, n'endommage pas le câblage électrique et tous autres utilités cachées.
10. Des ventilateurs canalisés doivent toujours être exhalés à l'extérieur.
11. Si cette unité doit être installée au-dessus d'un bac ou d'une douche, elle doit être marquée appropriée pour l'application et reliée à un circuit de branchement protégé GFCI (interrupteur de circuit de défaut de la terre).

Installation

LOCALISATION

1. Placez le ventilateur de grenier au centre de la pente arrière du toit obtiendra le meilleur effet pour enlever l'air chaud et d'humidité dans le toit. Il sera également invisible de la rue. Assurez-vous que l'endroit est libre d'obstacles comme l'antenne de télé, des lignes électriques… etc. avant l'installation.

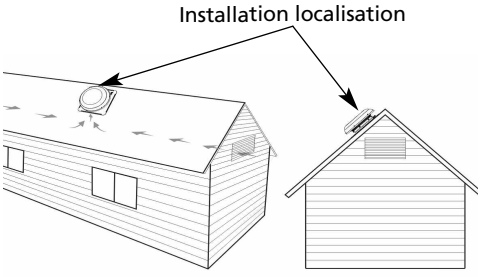


Figure 3 – Localisation & trou d'entrée d'air

2. Allez au grenier et trouvez l'endroit central dans le grenier. Mettez un clou sur le toit qui passent par l'autre côté du panneau de toit par un marteau. Il sera utilize comme un endroit central du ventilateur de grenier.

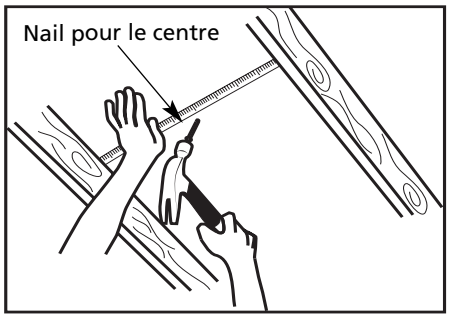


Figure 4 – Mettez un clou de passer par le panneau de toiture comme un point central

3. Allez sur le toit, utilisez le modèle pour marquer et couper les bardeaux et les supprimer tous.

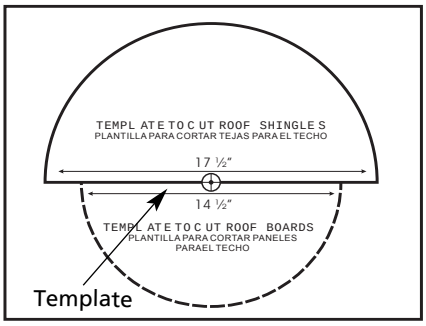
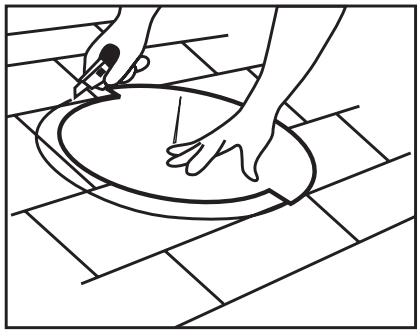
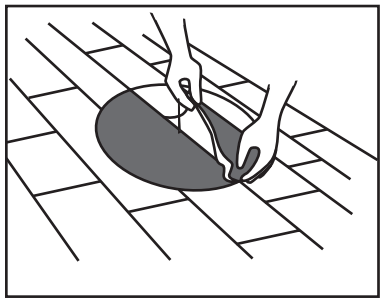


Figure 5 – Modèle pour le bardeau & marquage et découpage de panneau de toit





4. Suivez la ligne et utilisez une scie alternative pour couper un trou pour l'entrée d'air du ventilateur de grenier.

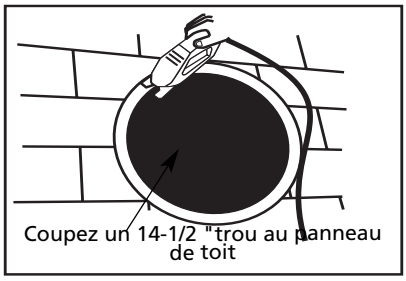
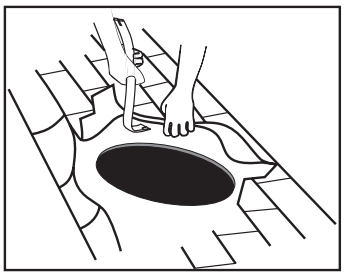
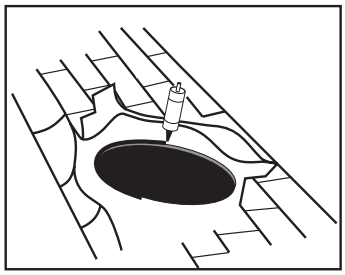


Figure 6 – Couper le trou d' entrée d'air

5. Utilisez le levier pour déplacer les bardeaux autour des trous pour fixer le ventilateur de grenier. Essayez de préserver le bardeau car vous avez besoin de remettre le bardeau après fixant le ventilateur de grenier.





6. Placez le ventilateur de grenier - Appliquez le mastic sur le bord du toit autour des trous et fixez le ventilateur de grenier sur le trou. Fixez le ventilateur de grenier en clouant les clous de toit autour de la bride du ventilateur de grenier. Appliquez alors le mastic encore autour de la base du ventilateur de grenier, remettez les bardeaux. Scellez de bride et du bardeau par le mastic non durcissant.

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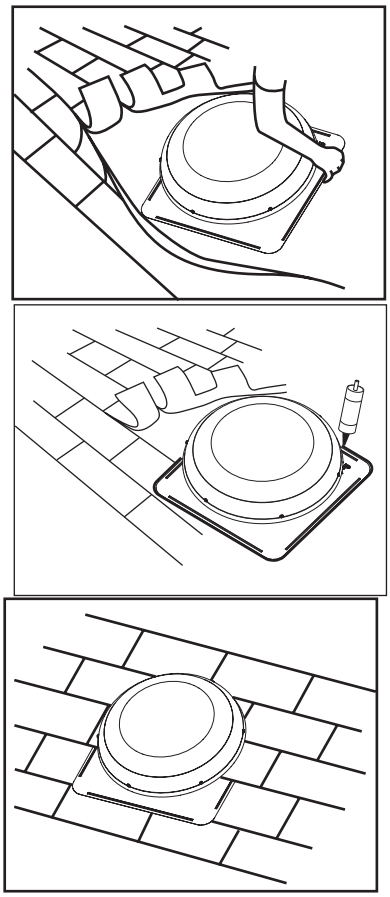
Modèles 10N201, 10N202 et 10N203



7. Après bloqué l'unité de ventilateur de toit, allez à l'intérieur au grenier. Fixez la boîte de commande de 10N202 sur le comble à côté de l'appareil avant que la connexion du fil.

Remarque: La boîte de commande de 10N201 avec le thermostat seulement a été montée sur l'appareil directement.

⚠ AVERTISSEMENT ***Consultez un électricien agréé pour le câblage.***

Figure 7 – La boîte de commande 10N201 a été montée sur la base.

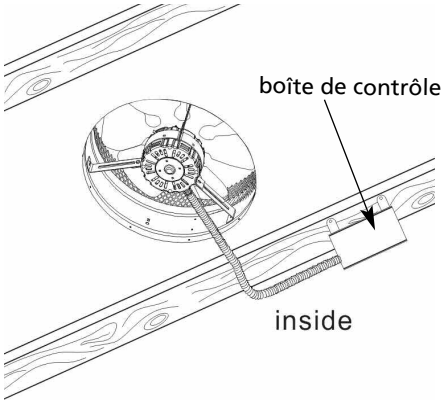


Figure 8 – Montez la boîte de commande 10N202 sur le comble adjacent

8. Reliez la ligne de fil noire et blancheà partir de la boîte de contrôle sur les lignes électriques commandées par un commutateur "Marche/Arrêt", comme indiqué dans le schéma de câblage de la figure 9 pour 10N201 et 10N202 pour Fig.10.

⚠ AVERTISSEMENT ***Arrêtez le commutateur principal avant l'opération de l'unité. Pour éviter les blessures, le commutateur mural doit êtreéteindre avant l'entretien puisque la protection thermique intégrée peut allumer le circulateur automatiquement.***

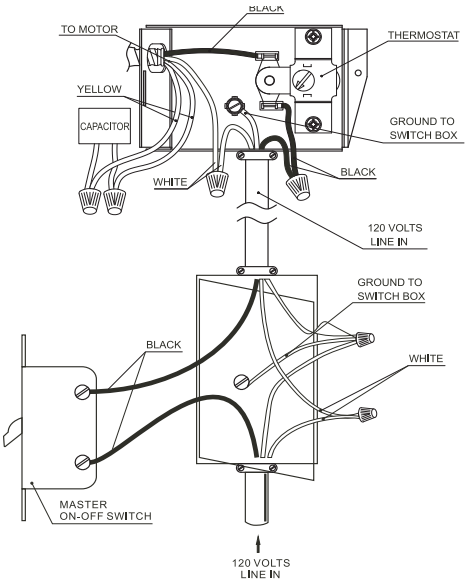


Figure 9 – Montez la boîte de commande 10N202 sur le comble adjacent

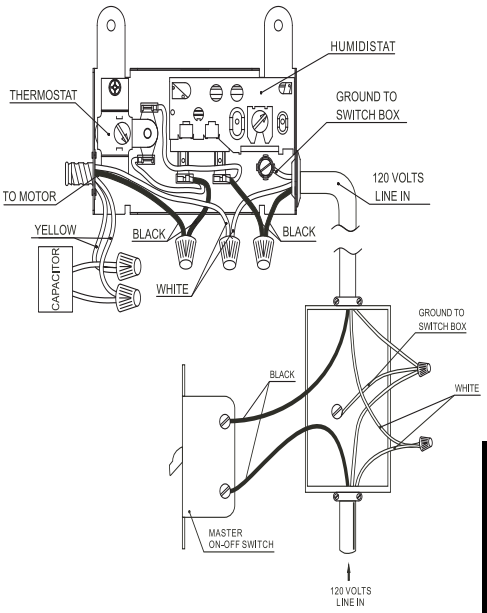


Figure 10 – Schéma de câblage pour le raccordement de fil 10N202

Fonctionnement

Veuillez régler le thermostat et/ou l'hygrostat à l'état désiré avant fonctionné, utilisant le tournevis pour tourner la flèche du bouton à la marquee de température/d'humiditéde désirée sur le panneau de boîte de commande.

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Entretien

⚠ AVERTISSEMENT ***Le remplacement des pièces et le dépannage doivent être effectués pardu personnel qualifié.***

⚠ AVERTISSEMENT ***Ne pas dépendre d'un quelconque interrupteur comme moyen unique de coupure de l'alimentation lors de l'installation ou de l'entretien du ventilateur. Le fait de négliger cette consigne peut entraîner une décharge électrique fatale.***

⚠ ATTENTION ***Ne pas utiliser d'essence, de benzène, de diluant, de nettoyants forts, etc. qui présentent un danger et endommageront le ventilateur.***

⚠ AVERTISSEMENT ***Arrêtez le commutateur principal avant entretien ou nettoyage.***

Le thermostat + hygrostat boîte de contrôle 10N203 doit être utilisé uniquement avec les ventilateurs de Dayton grenier.

NETTOYAGE

Nettoyer l'hélice, la protection et le moteur régulièrement pour éviter une surchauffe et/ou des conditions de fonctionnement déséquilibré.

Si le nettoyage exige le démontage d'une protection, enlever seulement la protection avant et la réinstaller dans sa position d'origine lorsque terminé. Ne par réparer une hélice qui a subi des dommages. L'hélice est équilibrée avec précision en usine et doit être remplacée si elle subit des dommages.

Le moteur est lubrifié en permanence.

Notes

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Commandez les pièces détachées en appelant gratuitement 1 800 323-0620

24 heures par jour – 365 jours par an

S'il vous plaît fournir l'information suivante :
-Numéro de modèle
-Numéro de série (s'il y en a un)
-Description de la pièce et son numéro comme montré sur la liste de pièces

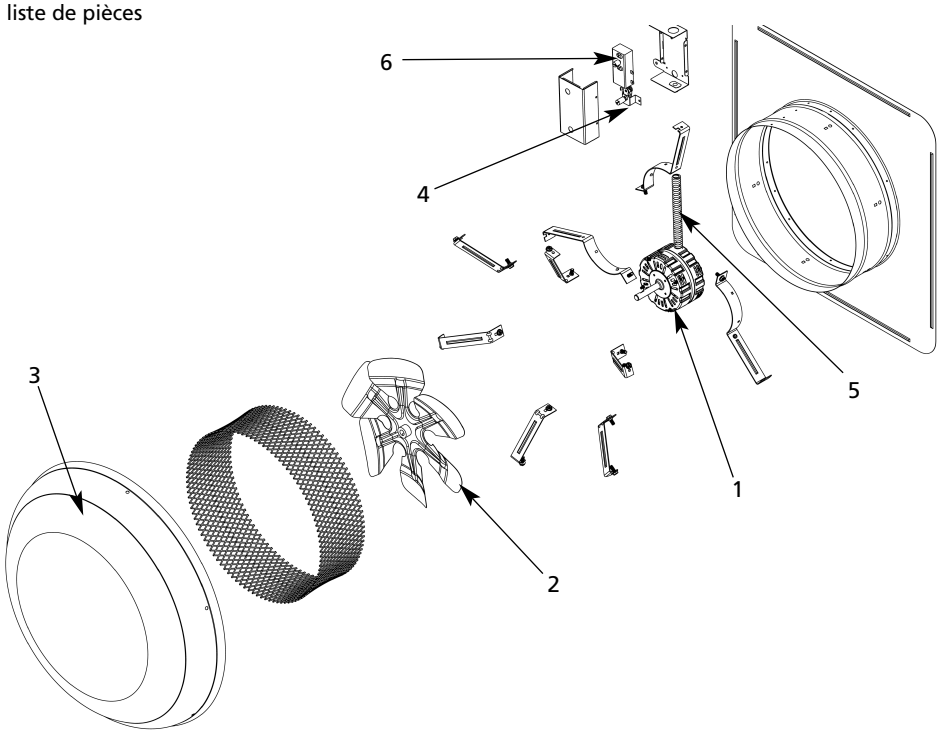

Figure 13 – Illustrations des pièces détachées pour Ventilateur de Grenier sur le Toit de Puissance Automatique

Liste des pièces détachées pour Ventilateur de Grenier sur le Toit de Puissance Automatique

Numéro de référence	Description	Numéro de pièce pour modèles : 10N201	10N202	Quantité
1	Moteur	VESP127416DG	VESP127416DG	1
2	Lame	VEVRM150300G	VEVRM150300G	1
3	Dôme	VEVRM150001G	VEVRM150001G	1
4	Thermostat	VEVRM150420G	VEVRM150420G	1
5	Conduit / flexible	VEVRM150009G	VEVRM150009G	1
6	Hygrostat		VEVRM150009G	1

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Ventilateur de Grenier sur le Toit de Puissance Automatique Dayton®

Tableau de dépannage

Symptôme	Cause(s) possible(s)	Action corrective
L'appareil ne fonctionne pas	1. Fusible grillé ou disjoncteur déclenché 2. Pas d'alimentation électrique 3. Moteur défectueux	1. Remplacer le fusible ou réenclencher le disjoncteur 2. Contacter le pourvoyeur d'électricité 3. Remplacer l'appareil; le moteur ne peut être réparé sur place
Vibration excessive	1. Fusible grillé ou disjoncteur déclenché	1. Nettoyer l'hélice

GARANTIE LIMITÉE

GARANTIE LIMITÉE DE UN AN DE DAYTON. *LES MODÈLES DE VENTILATEUR DE GRENIER SUR LE TOIT DE PUISSANCE AUTOMATIQUE DAYTON® COUVERTS DANS CE MANUEL SONT GARANTIS À L'UTILISATEUR D'ORIGINE PAR DAYTON ELECTRIC MFG. CO. (DAYTON), CONTRE TOUT DÉFAUT DE FABRICATION OU DE MATÉRIAUX, LORS D'UNE UTILISATION NORMALE, ET CELA PENDANT UN AN APRÈS LA DATE D'ACHAT. TOUTE PIÈCE, DONT LES MATÉRIAUX OU LA MAIN D'OUVRE SERONT JUGÉS DÉFECTUEUX, ET QUI SERA RENVOYÉE PORT PAYÉ, À UN CENTRE DE RÉPARATION AUTORISÉ PAR DAYTON, SERA, À TITRE DE SOLUTION EXCLUSIVE, SOIT RÉPARÉE, SOIT REMPLACÉE PAR DAYTON. POUR LE PROCÉDÉ DE RÉCLAMATION SOUS GARANTIE LIMITÉ, REPORTEZ-VOUS À LA CLAUSE DE « DISPOSITION PROMPTE » CI-DESSOUS. CETTE GARANTIE LIMITÉE DONNE AUX ACHETEURS DES DROITS LÉGAUX SPÉCIFIQUES QUI VARIENT DE JURIDICTION À JURIDICTION.*

LIMITES DE RESPONSABILITÉ. *LA RESPONSABILITÉ DE DAYTON, DANS LES LIMITES PERMISES PAR LA LOI, POUR LES DOMMAGES INDIRECTS OU FORTUITS EST EXPRESSEMENT DÉNIÉE. DANS TOUS LES CAS LA RESPONSABILITÉ DE DAYTON EST LIMITÉE ET NE DÉPASSERA PAS LA VALEUR DU PRIX D'ACHAT PAYÉ.*

DÉSISTEMENT DE GARANTIE. *DE DILIGENTS EFFORTS SONT FAITS POUR FOURNIR AVEC PRÉCISION LES INFORMATIONS ET ILLUSTRATIONS DES PRODUITS DÉCRITS DANS CETTE BROCHURE; CEPENDANT, DE TELLES INFORMATIONS ET ILLUSTRATIONS SONT POUR LA SEULE RAISON D'IDENTIFICATION, ET N'EXPRIMENT NI N'IMPLIQUENT QUE LES PRODUITS SONT COMMERCIALISABLES, OU ADAPTABLES À UN BESOIN PARTICULIER, NI QUE CES PRODUITS SONT NÉCESSAIREMENT CONFORMES AUX ILLUSTRATIONS OU DESCRIPTIONS. SAUF POUR CE QUI SUIT, AUCUNE GARANTIE OU AFFIRMATION DE FAIT, ÉNONCÉE OU IMPLICITE, AUTRE QUE CE QUI EST ÉNONCÉ DANS LA « GARANTIE LIMITÉE » CI-DESSUS N'EST FAITE OU AUTORISÉE PAR DAYTON.*

Désistement sur les conseils techniques et les recommandations. *Peu importe les pratiques ou négociations antérieures ou les usages commerciaux, les ventes n'incluent pas l'offre de conseils techniques ou d'assistance ou encore de conception de système. Dayton n'a aucune obligation ou responsabilité quant aux recommandations non autorisées, aux opinions et aux suggestions relatives au choix, à l'installation ou à l'utilisation des produits.*

Conformité du produit. *De nombreuses juridictions ont des codes et règlements qui gouvernent les ventes, constructions, installations et/ou utilisations de produits pour certains usages qui peuvent varier par rapport à ceux d'une zone voisine. Bien que Dayton essaie de s'assurer que ses produits s'accordent avec ces codes, Dayton ne peut garantir cet accord, et ne peut être jugée responsable pour la façon dont le produit est installé ou utilisé. Avant l'achat et l'usage d'un produit, revoir les applications de ce produit, ainsi que tous les codes et règlements nationaux et locaux applicables, et s'assurer que le produit, son installation et son usage sont en accord avec eux.*

Certains aspects de désistement ne sont pas applicables aux produits pour consommateur; ex : (a) certaines juridictions ne permettent pas l'exclusion ou la limitation des dommages indirects ou fortuits et donc la limitation ou exclusion ci-dessus peut ne pas s'appliquer dans le cas présent; (b) également, certaines juridictions n'autorisent pas de limitations de durée de la garantie implicite, en conséquence, la limitation ci-dessus peut ne pas s'appliquer dans le cas présent; et (c) par force de loi, pendant la période de cette Garantie Limitée, toutes garanties impliquées de commerciabilité ou d'adaptabilité à un besoin particulier applicables aux produits de consommateurs achetés par des consommateurs, peuvent ne pas être exclues ni autrement désistées.

Disposition prompte. *Un effort de bonne foi sera fait pour corriger ou ajuster rapidement tout produit prouvé défectueux pendant la période de la garantie limitée. Pour tout produit considéré défectueux pendant la période de garantie limitée, contacter tout d'abord le concessionnaire où l'appareil a été acheté. Le concessionnaire doit donner des instructions supplémentaires. S'il est impossible de résoudre le problème de façon satisfaisante, écrire à Dayton à l'adresse ci-dessous, en indiquant le nom et l'adresse du concessionnaire, la date et le numéro de la facture du concessionnaire, et en décrivant la nature du défaut. Le titre et le risque de perte passent à l'acheteur au moment de la livraison par le transporteur. Si le produit a été endommagé pendant le transport, une réclamation doit être faite auprès du transporteur.*

Fabriqué pour Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 États-Unis

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